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Digital Transformation, Institutional Quality, and Tax Revenue in West Africa

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Abstract

Purpose: The paper examined the individual and combined effects of digitalization and institutional quality on the mobilization of tax revenue in West Africa. It aims to understand the interplay of these factors in shaping tax outcomes in developing economies, with particular attention to distributional impacts and causal mechanisms.

Design/Methodology/Approach: The mixed-methods quantitative approach applies to panel data from 14 ECOWAS member countries for 2000-2023. The analysis employs the fixed effects models, Method of Moments Quantile Regression (MMQR), and the panel Structural Vector Autoregression (PSVAR) in measuring the average treatment effects, the heterogeneous effects across the revenue distribution, and dynamic causal effects between digitalization and institutional quality on the one hand and tax revenues on the other hand.

Findings: The results indicate that internet penetration, as measured by tax revenue, has a positive impact, with a stronger effect in high-revenue countries. The role of institutional quality is consistently positive and significant for tax mobilization across settings, underscoring the complementarity of technological diffusion and institutional factors. Although there are increasing returns to internet distribution, a variance decomposition analysis shows that tax revenues are more strongly affected by the quality of the institutional environment than by internet penetration per se, suggesting that the digitalization of the tax system works optimally only in an environment with strong institutional structures.

Practical Implications: The study advises West African governments to focus on institutional quality and investments in digital infrastructure. Policymakers should aim to strengthen governance structures, enhance regulatory uniformity, and build institutional capacity to ensure that the benefits of digitalization for tax revenue are fully realized. Different countries with varying levels of revenue must adopt different approaches, and low-revenue countries must have their institutional structures in place before digital tax systems will yield high rates.

Originality/Value: The work is relevant as it entails a systematic analysis of the nexus between digitalization and institutional quality in tax mobilization in the West African region. In contrast to earlier literature that examined these factors separately, the current study highlights their interactions and distributional heterogeneity, yielding subtle policy implications for policymakers in developing economies seeking to increase fiscal capacity through technological and institutional change.

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INTRODUCTION

One of the most serious structural issues in the economies of West African countries, where sustainable development, fiscal independence, and a reduced reliance on external funding are aimed to be achieved, is domestic resource mobilization (DRM). Although reforms have been made, revenue collection has been low, indicating structural and administrative inefficiencies. The tax-to-GDP ratio in Africa was estimated at about 16% in 2022, whereas ECOWAS countries recorded 13.8-13.9% in 2023, which is not enough to fund public services, social protection, and infrastructure (OECD 2025a). This ongoing fiscal imbalance limits policy flexibility as well as increasing susceptibility to external disruptions. Traditional policy adjustments have not been sufficient without more ground breaking reforms and technical assistance, underscoring the urgent need to introduce transformative changes in revenue systems (OECD/ATAF/AUC 2024).

Digitization can be a good way to improve taxation systems and increase fiscal space. Digital instruments (e-tax portals, mobile payments, and digital identification) can help lower compliance costs, increase transparency, and expand the tax base, as internet penetration in Africa reached 35.7% as of 2025 (ITU 2025). Nevertheless, the extent of these advantages depends on the quality of institutions, especially regulatory effectiveness, the rule of law, accountability, and the control of corruption. Research has shown that successful e-government applications can be achieved only with strong legal systems, effective administration, and proper data management (Kochanova et al. 2020; Junquera-Varela et al. 2022). The same can be applied to the relationship between GovTech in the public sector and digitalization in the private sector, which can enhance fiscal benefits (Nose et al. 2025), whereas weak institutions, corruption, and bureaucratic inefficiency may undermine such benefits (Appiah et al. 2025).

Despite new developments, serious gaps remain in research in West Africa. The available literature pays little attention to the interaction between digitalization and institutional quality in determining tax performance and to whether their impacts are complementary or substitutive. Most of them use methodologically mean-based panel estimators that do not account for regional differences in digital preparedness, governance, and fiscal performance, in favour of homogeneity across countries. These strategies do not capture the dynamics of time, lag effects, and possible nonlinearities in the impact of digitalization. Given the high heterogeneity of West African countries, ranging from those advancing their digital reforms to those lagging due to institutional bottlenecks, there is a risk that standard empirical models will conceal significant country-specific variation. To overcome these shortcomings, the present study takes a localized West Africa approach based on dynamic, distribution-aware approaches. The study examines the heterogeneous and dynamic impacts of digitalization and institutional quality on tax mobilization using panel quantile techniques and structural vector autoregression (SVAR). This subtle method provides context-driven evidence to craft differentiated and effective fiscal digitalization strategies across West Africa.

Against this backdrop, this study examines the individual and combined effects of digitalization and institutional quality on tax revenue mobilization across 14 ECOWAS member countries for the period 2000-2023, with particular attention to distributional heterogeneity and dynamic causal mechanisms. Three principal research hypotheses are tested:

H_1: Internet penetration (as a proxy for digitalization) has a positive and significant effect on tax revenue mobilization in West Africa.

H_2: Institutional quality (measured by regulatory quality) has a positive and significant effect on tax revenue mobilization.

H_3: Digitalization and institutional quality are complementary, as the fiscal benefits of digitalization are significantly larger in countries with stronger governance structures.

These hypotheses align with the institutional economics tradition (North 1990) and the technology-efficiency hypothesis (Oti-Akenteng et al. 2025), suggesting that digital tools improve revenue collection most effectively when embedded within robust governance systems.

LITERATURE REVIEW

Digitalization, Institutional Quality and Tax Revenue Mobilization Challenges in West Africa

The relationship between digitalization and revenue mobilization operates through channels that enhance administrative capacity, expand the tax base, and shape stakeholders' behaviour within the tax system. Digital tools reorganize fundamental tax core functions: identification of taxpayers, monitoring compliance by checking transactions, and enforcement by detection mechanisms, which redefine relationships in administrations (Okunogbe and Santoro 2023) in both developing contexts. The compliance cost reduction channel describes the increase in revenue resulting from reducing the filing, payment, and record-keeping costs borne by taxpayers and authorities. Mobile payments and electronic filing improve transparency, reduce discretion and promote compliance. It has been demonstrated that declarations and

payments increased revenue in 2022 by widening the tax base (OECD/ATAF/AUC 2024; Kochanova et al. 2020). The channel for reducing information asymmetry focuses on digitalization's ability to create verifiable transaction records, thereby limiting opportunities to evade taxes. Cross-verification is provided by the electronic sales registration system, digital invoicing, and real-time reporting. Empirical data on tax collection show that management systems and digital billing enhance collection efficiency in West Africa (El-Manaseer et al. 2023). This is because the tax base expansion channel recognizes the ability of digitalization to highlight and bring informal economic activities that were hitherto unrecorded into the formal tax system. Digital identification, geospatial property databases, and mobile money transaction tracking enable revenue authorities to reach taxpayers who previously existed outside administrative control. Nevertheless, according to the IMF/ATAF (2025) Africa is estimated to lose about $60 billion each year due to poor digital tax collection frameworks and illegal financial leakages, and that digitalization is therefore not the solution but needs to be supplemented by institutional change.

According to the institutional quality philosophy, the efficiency of tax systems is fundamentally rooted in the governance environment in which they operate. Effective institutions of the rule of law, high-quality regulation, corruption control, and government effectiveness create a conducive environment for voluntary compliance, and empirical results across Africa indicate that institutional quality is positively correlated with tax revenue. As an example, Bah (2024) uses system GMM estimation of 42 sub-Saharan Africa with 1996-2019 period, which concludes that all six World Governance Indicators (voice and accountability, political stability, regulatory quality, rule of law, control of corruption, and government effectiveness) have a positive and significant influence on aggregate tax revenues, direct taxes, income taxes, and goods and services taxes. The findings are consistent with previous research by Benitez et al. (2023), who showed that institutional capacity building can raise the tax-to-GDP ratio by strengthening administrative systems. The institutional quality revenue relationship works in several ways, ensuring that a well-organized bureaucracy enhances the technical capacity to implement complex tax policies and handle advanced tax vehicles. Also, the preservation of the rule of law and the protection of property rights promote formalization and voluntary compliance, as taxpayers are assured that their payments will not be arbitrarily seized, placing top priority on corruption control to minimize leakage and ensure that the revenues collected by the government reach their coffers rather than their pockets. Contemporary studies in literature offer astute facts about such relationships. Nikiema and Zore (2025) studied the concept of tax revenue instability in sub-Saharan Africa and found that institutional quality influences both revenue levels and revenue stability as a factor in fiscal planning. Moreover, the moderating effect of democracy has been shown to be important, as the quality of bureaucracy and democracy are complementary sources of tax revenue, whereas corruption and the quality of bureaucracy are substitutes that decrease revenue (Nature Communications 2025).

The tax mobilization problems in West African countries, most of which are also members of the Economic Community of West African States (ECOWAS), are unique due to structural economic factors, institutional legacies, and integration forces. The economies of the region are also characterized by a large informal sector (85-90% of the labour force), a high reliance on trade taxes, and high cross-border economic activity, which makes the countries' revenue bases more complex (Hammond 2023; OECD 2023). Empirical research on West Africa suggests that tax collection efficiency is highly diverse, as the most common external tariff regimes and treaty arrangements among WAEMU members create both opportunities and barriers to revenue mobilization (Quiros-Romero et al. 2021). The West African Tax Administration Forum (WATAF) was formed in 2011 to promote transparency in tax administration, align regional tax policies, and share knowledge on improving revenue collection.

In West Africa, efforts to transform digitally indicate good but asymmetrical development. Other countries have expanded the scope of VAT to cover services delivered via electronic media and improved tax collection through digital withholding systems, resulting in quantifiable revenue benefits (IMF 2024). Still, there are issues in the implementation process, especially in terms of coordination with the regional economic community and the smooth flow of information between government agencies. The level of institutional quality in West Africa has been identified as highly heterogeneous, and this is relevant to digital adoption and revenue performance. Investigations that employ System GMM models have shown that governance systems, openness to trade, and international financial flows interact in intricate ways with the capacity to produce and the region's economic performance (Ogbuabor et al. 2024). The idea that institutional quality moderates the relationship between trade and growth, as recent studies in West Africa have established, can suggest that institutional conditionalities may influence digitalization-revenue relationships.

Theoretical Framework

The work is supported by a comprehensive theoretical framework grounded in the concept of mobilizing tax revenue in developing economies and presents the idea of digital governance of taxation as a

combination of public finance theory, institutional economics, and the digital domain. The classical theory of public finance has highlighted that generating domestic revenue sustainably can be achieved only by expanding the tax base, improving administrative efficiency, and enhancing taxpayer compliance (Mishi and Tshabalala 2023). These circumstances are continually undermined by pervasive informality, diminished administrative capacity, and indefinable governance failures in most West African and other Sub-Saharan African settings, leading to low tax buoyancy and an endemic fiscal deficit (Moore 2023). This means that the preferred framework conceptualizes tax revenue performance not as an outcome of a technical nature, but as the result of structural economic features interacting with institutional and technological facilitators (Queku et al 2024).

The concept of digitalization is introduced as an ancillary process that can loosen traditional restrictions on revenue collection. Digital tools such as electronic filing, digital payments, interoperable databases, and digital identification systems reduce information asymmetries, lower transaction and compliance costs, and enhance administrative monitoring, consistent with the technology-efficiency hypothesis (Oti-Akenteng et al. 2025). These avenues align with the best tax theory, which argues that all forms of distortion should be minimized while voluntary compliance is maximized. The enforcement aspect of the Allingham-Sandmo model is also reinforced by digital transformation, which enhances the perceived likelihood of detection and the effectiveness of sanctions through real-time data access and automated cross-checking (Krieger 2021). The digital systems would increase the predictability and transparency of how the tax is imposed, which reduces the chance of rent-seeking and discretionary power, thus transforming the behaviour of taxpayers.

The framework, however, clearly acknowledges that fiscal digitalization returns require institutional performance. Using institutional economics, formal rules, the capacity to enforce, and the quality of regulations and the governance structure, as developed by North (1990), are critical to how technological reform translates into successful outcomes (Arwani and Priyadi 2024). In a setting typified by the rule of law, accountability, and corruption control, digital tax systems are more likely to work as intended because institutions ensure data integrity, limit malfeasance, and provide consistent legal and regulatory services. On the other hand, the possible benefits of digitalization can be eradicated or even destroyed by weak institutions. The theoretical framework, as such, assumes a complementary and, possibly, nonlinear interaction between institutions and digitalization, in which technology improves revenue collection most effectively when embedded in robust governance systems.

Empirical Review

Empirical studies are increasingly emphasizing the importance of institutional quality in determining tax revenue mobilization in Sub-Saharan Africa (SSA). There are various ways in which governance increases fiscal capacity. Bah (2024) estimates that accountability, political stability, regulatory quality, rule of law, corruption control, and government effectiveness have a positive impact on aggregate and disaggregate tax revenues across 42 SSA countries, using System GMM. On the same note, Nikiema and Zore (2025) also find that stronger institutions aim not only to increase revenue levels but also to stabilize collections, especially direct taxes in countries that meet the minimum governance standards. Furthermore, Katuka and Mudzingiri (2023) identify the governance thresholds beyond which fiscal space grows at an essential rate, while Nichelatti and Hiilamo (2024) show that institutional trust is an important variable associated with voluntary compliance. On the other hand, Bati (2025) finds that political stability and corruption control have statistically insignificant effects due to weak enforcement and high informality, reflecting the contextuality of fiscal outcomes.

Like the field of governance, the topic of the fiscality of digitalization is slowly being researched. Iddrisu (2023) posits that digitalization enhances tax revenues, contending that the impact depends on the strength of the institution. This interdependence is confirmed in subsequent literature by Ackom et al. (2025), who conclude that digital benefits depend on culture, infrastructure, and literacy, while Tolossa and Melese (2024) suggest that the development of e-government significantly increases tax effort when combined across government. Okunogbe and Santoro (2023) provide qualitative evidence that digital tools are useful in identifying the tax base and monitoring compliance, even when the implementation is problematic. At the firm level, Nose et al. (2025) and Mpofu (2022) show that compliance is enhanced by digitalization and state technological capacity, especially in informal firms. There is an additional complication brought by the ICT infrastructure. Research indicates that ICT adoption and mobile money fiscal benefits are realized only after specific penetration levels are reached. However, the fiscal impacts of mobile money are still debated- some believe that it creates efficiency, whereas others believe that mobile money endangers inclusivity. Although approaches to this matter have improved, two stylized facts remain: institutional quality and digitalization co-optimize tax mobilization; the effects of both are nonlinear, threshold-driven, and mediated by the level of trust in the tax authority. The remaining gaps relate to moderating processes, subnational processes, and cultural backgrounds needed to comprehend the governance-digitalization synergies towards fiscal capacity

in SSA.

METHODOLOGY

Research Design

This study adopts a quantitative, post-positivist approach to examine the roles of digitalization and institutional quality in tax revenue mobilization in West Africa. Adopting panel econometric techniques, the study addresses issues of heterogeneity, endogeneity, and dynamics that characterize the modern fiscal literature, which prefers a more subtle, contextual approach to empirical investigation, moving beyond mere average estimators.

Sample Selection and Data Structure

The data cover 14 West African countries that are members of ECOWAS and WAEMU from 2000 to 2023, yielding 322 balanced country-years. The regional nature of the sample is informed by theoretical characteristics shared by member nations, such as colonial histories, the CFA franc exchange rate regime, and harmonized customs rules. The chosen sample consists of economies with high employment informality rates (85-90%), limited regional administrative capacity, and developing information technologies. The countries examined in this study are Benin, Burkina Faso, Cabo Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo. They account for 95% of the regional population.

Data Sources and Variable Definition

Table 1. Variable Definitions, Measurement, and Data Sources

Variable	Abbreviation	Definition and Measurement	Unit	Source	Theoretical Justification
Tax Revenue Mobilization	TAXREV	Total tax revenue as a percentage of GDP	% of GDP	IMF GFS; OECD Revenue Statistics	Captures fiscal capacity; a standard measure in comparative public finance (Besley and Persson 2014)
Internet Penetration	INTERNETPEN	Percentage of population with internet access	% of population	World Bank WDI	Proxy for digital infrastructure (Okunogbe and Santoro 2023)
Regulatory Quality	REGQ	WGI regulatory quality index measuring government's ability to formulate and implement sound policies	Index (−2.5 to +2.5)	World Bank WGI	Account for governance effectiveness for effective digital tax administration (Bah 2024)
Financial Development	CPS	Domestic credit to the private sector as a percentage of GDP	% of GDP	World Bank WDI	Indicates economic formalization and banking penetration that expand taxable base (Benitez et al. 2023)
Foreign Direct Investment	FDI	Net FDI inflows	% of GDP	World Bank WDI	Controls for external capital flows affecting fiscal capacity and institutional development
Economic Development	GDPPC	Natural logarithm of real GDP per capita	Log of constant 2015 US$	World Bank WDI	Captures structural transformation and taxable capacity (Besley and Persson 2014)

Source: Authors' Summarization 2026

Model Specification

The empirical strategy is multi-method and sequential, aiming to provide full evidence on average effects, distributional heterogeneity, and dynamic causal relationships. Such triangulation is beneficial for strengthening robustness and policy relevance, as it addresses various aspects of the nexus between digitalization, institutional quality, and tax revenue.

Fixed Effects Interaction Term Regression

The baseline specification employs a two-way fixed effects estimator that controls for time-invariant country-specific characteristics (α_i) and common time shocks (λ_t):

$$TAXREV_{it} = \beta_0 + \beta_1 INTERNETPEN_{it} + \beta_2 REGQ_{it} + \beta_3 (INTERNETPEN \times REGQ)_{it} + \\ + \beta_4 log(GDPPC)_{it} + \beta_5 CPS_{it} + \beta_6 FDI_{it} + \alpha_i + \lambda_t + \varepsilon_{it} \quad (1)$$

The model examines the relationship between digitalization and institutional quality, as both jointly affect tax revenue. A positive β3 favours complementarity, indicating that digital reforms attract higher tax revenue in a strong institutional environment, whereas a negative β3 suggests that digitalization compensates for weak governance. The heterogeneity and endogeneity issues are alleviated by country and year-specific effects and clustered robust errors.

Panel Quantile Regression

The study explores whether the effects of digitalization and institutional quality vary across countries with different levels of tax mobilization capabilities using Quantile Regression. This methodology captures the distributional heterogeneity of tax revenue levels and quantile-specific information while controlling for unobservable country effects using short panel data (Koenker and Bassett 1978). The conditional quantile is defined as:

$$Q_\tau(TAXREV_{it} \mid X_{it}) = \alpha_i(\tau) + X_{it}\,\beta(\tau) \quad (2)$$

$$Q_{(\tau)}TAXREV_{it(\tau)} = \beta 0_{(\tau)} + \beta_1(\tau)INTERNETPEN_{it} + \beta_2(\tau)REGQ_{it} + \beta_{3(\tau)}(INTERNETPEN \times \\ \times REGQ)_{it} + \beta_{4(\tau)}log(GDPPC)_{it} + \beta_{5(\tau)}CPS_{it} + \beta_6(\tau)FDI_{it} + \alpha_{i(\tau)} + \lambda_{t(\tau)} + \varepsilon_{it(\tau)} \quad (3)$$

Pooled Mean Group (PMG) ARDL Model

The Pooled Mean Group (PMG) ARDL approach is used to explore how the variables interact both in the short run and over time. It allows each country to adjust differently in the short run, while assuming that, in the long run, the relationships between the variables are broadly similar across countries.

$$\text{Long-run form: } TAXREV_{it} = \theta_0 + \theta_1 INTERNETPEN_{it} + \theta_2 REGQ_{it} + \\ + \theta_3(INTERNETPEN \times REGQ)_{it} + \theta 4 log(GDPPC)_{it} + \theta 5 CPS_{it} + \theta 6 FDI_{it} + \mu_i + \lambda_t + u_{it} \quad (4)$$

$$\text{Short-run (Error Correction Form): } \Delta TAXREV_{it} = \varphi_i(TAXREV_{it-1} - \theta_1 INTERNETPEN_{it} - \\ - \theta_2 REGQ_{it} - \theta_3(INTERNETPEN \times REGQ)_{it} - \theta_4 log(GDPPC)_{it} - \theta_5 CPS_{it} - \theta_6 FDI_{it}) + \\ + \Sigma\gamma\Delta X_{it} + \alpha_i + \lambda_t + \varepsilon_{it} \quad (5)$$

Formal tests of coefficient heterogeneity across quantiles, Wald tests of equality, H0: $\beta(\tau 1) = \beta(\tau 2)$ for $\tau 1$ and $\tau 2$. The null hypothesis is rejected, which therefore provides evidence that the effect of the variable in the distribution of tax revenue varies significantly, thus policy interventions of the countries are to be distinguished in terms of their baseline fiscal capacity. Standard errors (500 replications) are bootstrapped, which is a robust inference in finite samples.

ROBUSTNESS VERIFICATION AND DIAGNOSTIC TESTS

Robust diagnostic tests are used to assess economic validity, including stationarity tests (Pesaranet al. 2001; Maddala and Wu 1999), cointegration tests (Pedroni 1999), and causality tests (Dumitrescu and Hurlin 2012) to verify the data's dynamic and equilibrium characteristics. Biases associated with endogeneity and simultaneity are avoided using the internal instruments proposed by Lewbel (2012) and dynamic panel models that incorporate lagged effects. Other tests are concerned with cross-sectional dependence,

heteroskedasticity and serial correlation (Besley and Persson 2014).

Table 2 presents the descriptive statistics for the variables used in the study, including their means, variances, and distributions. This provides a clear picture of the data's nature and how the variables behave before proceeding with further analysis.

Table 2. Descriptive Statistics

Variable	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
TAXREV	10.694	10.590	26.620	2.990	3.894	0.621	4.374
INTERNETPEN	12.880	5.610	72.760	0.020	16.218	1.655	5.302
REGQ	-0.666	-0.590	1.570	-1.860	0.463	-0.128	3.935
CPS	14.818	12.610	68.460	0.640	12.171	2.176	8.302
FDI	138.265	10.400	19293.27	-12089.89	1371.765	6.527	140.304
GDPPC	7.942	7.800	10.480	6.790	0.781	1.260	4.600

Source: Authors' Computation.
Note: All Jarque-Bera tests reject normality at $p<0.01$.

The internet penetration rate varies significantly in this respect, with a coefficient of variation of 126%; rates are barely above zero in some African nations, like Niger, and above 70% in Cape Verde and Ghana. The mean rate of 12.88% masks this disparity due to low internet connectivity indices in most states, with a couple making rather impressive progress in this area, in line with disparities in the digital transformation process within Africa (ITU 2025). On this point too, the mean regulatory quality index of -0.67 points to deficiencies within regional governments, with a range of -1.86 to 1.57, indicating disparities in regional governance (Bah 2024). Regression analysis indicates significant positive associations between tax revenue, financial development, and institutional quality, with a moderate association with internet penetration, suggesting conditional improvements in fiscal performance through digitalization processes.

Table 3 presents the correlation matrix, offering a preliminary view of the relationships among tax revenue and the explanatory variables. The results highlight the strength and direction of pairwise associations, providing useful initial insights before proceeding to more robust econometric analysis.

Table 3. Correlation Matrix

	TAXREV	INTERNETPEN	REGQ	CPS	FDI	GDPPC
TAXREV	1.000					
INTERNETPEN	0.282***	1.000				
REGQ	0.495***	0.170**	1.000			
CPS	0.723***	0.535***	0.528***	1.000		
FDI	-0.116*	0.038	-0.016	-0.015	1.000	
GDPPC	0.068	0.393***	-0.077	0.287***	0.086	1.000

Source: Authors' Computation 2026
Note: ***, **, * denote significance at 1%, 5%, and 10% levels respectively.

Notably, the relationship between internet penetration and regulatory quality is positive but weak ($r = 0.170$, $p < .01$). This indicates that a fair amount of variation exists independently, allowing for the exploration of the interaction between these variables. The variance inflation factors of all the variables are below 3.5 and therefore not threatened by multicollinearity.

Panel Unit Root and Cointegration Test

The specification of models is rooted in the time-series characteristics of the data, which is fundamental to doing inference. Table 4 presents the results of various panel-data unit-root tests: the LLC test, IPS test, ADF-Fisher test, and PP-Fisher test.

Table 4. Panel Unit Root Test Result

Variable	LLC	IPS	ADF-Fisher	PP-Fisher	Stationarity
TAXREV	-4.306***	-4.807***	75.719***	208.850***	I(0)
INTERNETPEN	1.854	6.195	10.757	8.863	I(1)
D(INTERNETPEN)	-2.633***	-5.299***	76.380***	132.504***	I(0)
REGQ	-2.123**	-2.414***	49.213***	53.221***	I(0)
CPS	0.498	1.740	22.244	18.473	I(1)
D(CPS)	-12.521***	-12.540***	180.481***	202.946***	I(0)
FDI	-9.682***	-10.815***	157.969***	225.984***	I(0)
GDPPC	-0.856	2.047	34.498	35.309	I(1)
D(GDPPC)	-9.298***	-11.291***	163.152***	179.973***	I(0)

Source: Authors' Computation *Note: ***, ** indicate rejection of unit root null at 1%, 5%, significance.

The unit root results indicate mixed integration orders across the variables, with important implications for the empirical strategy. Tax revenue (TAXREV) is stationary at a level, indicating a mean-reverting process likely anchored in stable institutional structures (Nikiema and Zore 2025). Similarly, regulatory quality (REGQ) is also stationary, suggesting persistence in governance frameworks over time. In contrast, internet penetration (INTERNETPEN), credit to the private sector (CPS), and GDP per capita (GDPPC) are integrated of order one, reflecting their evolving and trend-driven nature. This combination of I(0) and I(1) variables necessitates a careful approach to modelling long-run relationships. To address this, the study applies panel cointegration techniques. While the Kao test confirms the existence of cointegration, its assumption that all variables are I(1) introduces some limitations in this mixed-integration context. For this reason, the analysis is complemented with the Pedroni cointegration tests, which are more flexible in heterogeneous panels (Pedroni 2004). More importantly, the long-run estimates are obtained using the Pooled Mean Group (PMG) estimator within an ARDL framework, which is well-suited to variables with mixed integration orders (Pesaran et al. 2001). The consistency of results from FMOLS further strengthens confidence in the robustness of the findings.

Cointegration Test

Table 5 presents the results of the panel cointegration tests, employing the Kao residual approach alongside the within- and between-dimension statistics of the Pedroni framework, to examine the existence of a long-run equilibrium relationship among the variables under study.

Table 5. Cointegration Test Results

Test	Statistic	p-value	Inference
Kao Residual Cointegration			
ADF	-3.397	0.0003***	Cointegration
Pedroni Within-Dimension			
Panel PP-Statistic (weighted)	-2.613	0.0045***	Cointegration
Panel ADF-Statistic (weighted)	-3.837	0.0001***	Cointegration
Pedroni Between-Dimension			
Group PP-Statistic	-6.032	0.0000***	Cointegration
Group ADF-Statistic	-3.905	0.0000***	Cointegration

Source: Authors' Computation 2026.
Note: *** denotes significance at 1% level.

The cointegration test results shown in Table 4 above confirm the existence of equilibrium relationships among tax revenues, digitalization, institutional quality, and control variables. This provides justification for using level models and even for using the PMG method to model short- and long-run relationships. While the Kao test assumes all variables are I(1), it was included mainly for transparency despite this limitation. To address this, more robust methods were applied, including the Pedroni test, which performs better with mixed data. Most importantly, the analysis relies on the PMG-ARDL approach, specifically designed for variables with mixed integration orders, making it more appropriate and reliable. The FMOLS results further support the findings, providing additional confidence in the long-run

relationships identified in the study.

Panel Causality Analysis

Table 6 presents the results of the Dumitrescu–Hurlin panel causality tests, clearly showing how key variables such as internet penetration, tax revenue, regulatory quality, credit to the private sector, and GDP per capita influence one another across the sampled economies.

Table 6. Dumitrescu-Hurlin Panel Causality Tests

Null Hypothesis	W-Statistic	Z-bar Statistic	p-value	Direction
INTERNETPEN TAXREV	2.335	2.628	0.009***	INTERNETPEN→ TAXREV
TAXREV INTERNETPEN	1.662	1.174	0.240	No causality
REGQ ↛ TAXREV	2.744	3.502	0.001***	REGQ → TAXREV
TAXREV ↛ REGQ	1.715	1.285	0.199	No causality
CPS ↛ TAXREV	2.310	2.573	0.010**	CPS → TAXREV
TAXREV ↛ CPS	2.039	1.987	0.047**	TAXREV → CPS
GDPPC ↛ TAXREV	3.331	4.777	0.000***	GDPPC → TAXREV
TAXREV ↛ GDPPC	1.412	0.635	0.525	No causality
REGQ INTERNETPEN	2.456/2.662	2.885/3.330	0.004***/0.001***	Bidirectional
GDPPC INTERNETPEN	3.775/3.555	5.742/5.267	0.000***/0.000***	Bidirectional

Source: Authors Computation 2026 Note: ***, ** denote significance at 1%, 5% levels indicate "does not Granger-cause"; indicates "Granger-causes"; indicate bidirectional causality

The Dumitrescu-Hurlin panel causality results presented in Table 5 provide clear insight into the directional relationships among the study variables, offering both empirical depth and practical relevance. The findings show an unidirectional causal flow from internet penetration to tax revenue (W-Stat = 2.335, Z-bar = 2.628, p = 0.009), highlighting how digitalization actively supports fiscal performance through improved tax administration and compliance, consistent with evidence from Sub-Saharan Africa (Okunogbe and Santoro 2023). More striking is the stronger causal influence of regulatory quality on tax revenue (W-Stat = 2.744, Z-bar = 3.502, p = 0.001), reinforcing the idea that effective institutions remain central to fiscal capacity, as emphasized in institutional theory (North 1990; Bah 2024; Nikiema and Zore 2025).

At the same time, the results reveal important feedback mechanisms. Bidirectional causality between regulatory quality and internet penetration (p = 0.004; p = 0.001) suggests a mutually reinforcing relationship, where better governance supports digital expansion, while digitalization strengthens transparency and accountability (Nose et al. 2025). A similar two-way relationship exists between GDP per capita and internet penetration, reflecting the close connection between economic development and digital progress (Beck et al. 2000). Additionally, the bidirectional link between credit to the private sector and tax revenue points to the role of financial deepening in expanding the tax base.

Fixed Effects Regression Result

Results from the baseline fixed-effects panel regression model are presented in Table 7 and serve as the basic model before exploring heterogeneity and dynamics. The regression model controls for countries and time fixed effects. The country's fixed effects help account for unobserved country-specific characteristics.

Table 7. Fixed Effects Panel Regression Results

Variable	Coefficient	Std. Error	t-Statistic	p-value
INTERNETPEN	0.0428**	0.0182	2.352	0.019
REGQ	2.3156***	0.4721	4.904	0.000
INTERNETPEN × REGQ	0.0516**	0.0234	2.205	0.028
LogGDPPC	1.8743***	0.4328	4.331	0.000
CPS	0.1647***	0.0241	6.835	0.000
FDI	-0.00031*	0.00017	-1.824	0.069
Constant	-5.2134**	2.1847	-2.387	0.018
Diagnostics				
R-squared (within)	0.6847			
F-statistic	58.342***			
Countries	14			
Observations	319			
Country FE	Yes			
Time FE	Yes			

Source: Authors' Computation 2026.
*Note: ***, **, * denote significance at 1%, 5%, 10% levels.

The empirical results provide clear evidence that digitalization, institutional quality, and their interaction are central to shaping fiscal performance. Internet penetration has a positive, statistically significant effect on tax revenue ($\beta = 0.043$, $p = 0.019$), implying that a 1 percentage point increase in internet usage raises the tax-to-GDP ratio by 0.043 percentage points. While modest in isolation, this effect becomes economically meaningful at scale; a 10-50 percentage point increase in penetration, typical of digital transitions in African economies, translates into approximately 1.7 percentage points increase in tax revenue, representing about a 16% improvement over the regional average. This finding aligns with emerging African evidence linking digitalization to enhanced fiscal outcomes (Iddrisu 2023; Tolossa and Melese 2024).

Institutional quality, particularly regulatory quality, emerges as an even stronger determinant of revenue mobilization ($\beta = 2.316$, $p < 0.001$). A one-standard-deviation improvement increases tax revenue by about 1.07 percentage points of GDP, reinforcing the argument that effective governance strengthens compliance, reduces leakages, and improves administrative efficiency (Bah 2024; Nikiema and Zore 2025). Importantly, the interaction between internet penetration and regulatory quality is positive and significant ($\beta = 0.052$, $p = 0.028$), indicating that the fiscal gains from digitalization are conditional on institutional strength. Marginal effects reveal that in weak governance environments, digitalization yields limited or even negative returns, whereas in stronger institutional settings, it generates substantial fiscal benefits. This supports the view that technology and institutions are complementary rather than substitutable (North 1990; Ackom et al. 2025; Nose et al. 2025). Control variables further reinforce these dynamics. GDP per capita ($\beta = 1.874$, $p < 0.001$) and financial development ($\beta = 0.165$, $p < 0.001$) positively influence tax revenue by expanding tax bases and improving transaction traceability, while FDI shows a marginal negative effect ($\beta = -0.0003$, $p = 0.069$). Overall, the model explains 68.5% of within-country variation, underscoring the combined importance of digital infrastructure, institutions, and economic development.

Pooled Mean Group (PMG) Estimation Results

To explicitly identify the dynamics of short- and long-run equilibrium relationships and to account for potential endogeneity, we estimate an Autoregressive Distributed Lag (ARDL) model using the Pooled Mean Group (PMG) estimator. Table 8 illustrates the outcomes of the ARDL (2,2,2,2,2,2) specification that was chosen based on the Akaike Information Criterion.

Table 8. Pooled Mean Group ARDL Estimation Results

Long-Run Coefficients	**Coefficient**	**Std. Error**	**t-Statistic**	**p-value**
INTERNETPEN	-0.0238***	0.0058	-4.077	0.000
REGQ	-2.0378***	0.3752	-5.431	0.000
CPS	0.0893***	0.0191	4.664	0.000
FDI	-0.0002***	0.0001	-3.410	0.001
GDPPC	7.4079***	0.4510	16.427	0.000
Short-Run Dynamics	**Coefficient**	**Std. Error**	**t-Statistic**	**p-value**
Error Correction (ECT)	-0.7148***	0.0879	-8.136	0.000
ΔTAXREV	-0.0407	0.1095	-0.372	0.710
ΔINTERNETPEN	0.0533	0.0492	1.084	0.280
ΔINTERNETPEN	0.1785*	0.0905	1.972	0.051
ΔREGQ	1.5616	1.1862	1.316	0.190
ΔCPS	-0.1409	0.1472	-0.957	0.340
ΔCPS	-0.1593**	0.0633	-2.517	0.013
ΔGDPPC	7.4126	7.1396	1.038	0.301
Constant	-35.9284***	4.1230	-8.714	0.000
Model Diagnostics				
Log likelihood	-186.001			
Observations	289			
Countries	14			

Source: Authors Computation 2026.
Note: ***, **, * denote significance at 1%, 5%, 10% levels.

The error-correction estimate of -0.715 ($p<0.001$) confirms strong cointegration and implies that about 71.5% of disequilibrium is corrected annually, suggesting a responsive fiscal system with effective adjustment mechanisms. This rapid mean reversion aligns with evidence from developing regions where fiscal variables tend to converge quickly to equilibrium (Katuka and Mudzingiri 2023). However, the long-run dynamics reveal more nuanced relationships than static models suggest. Internet penetration, for instance, exerts a negative long-run effect on tax revenue ($\beta = -0.024$; $p < 0.001$), despite a weakly positive short-run impact ($\beta = 0.179$; $p = 0.051$). This suggests that while digitalization initially improves tax administration, it may later facilitate sophisticated tax avoidance, particularly by multinational corporations and high-income groups (OECD 2024b). Similarly, regulatory quality shows an unexpected negative long-run effect ($\beta = -2.038$, $p < 0.001$), possibly reflecting transitional compliance costs and institutional adjustments.

In contrast, private sector credit ($\beta=0.089$, $p<0.001$) and GDP per capita ($\beta=7.408$, $p<0.001$) continue to have strong positive long-run effects, reinforcing the importance of financial depth and economic growth. The divergence between the error-correction and fixed-effects results highlights the importance of capturing dynamic adjustments. The fixed effects estimates confirm that internet penetration ($\beta=0.043$, $p=0.019$) and regulatory quality ($\beta=2.316$, $p<0.001$) positively influence tax revenue, consistent with prior studies (Iddrisu 2023; Tolossa and Melese 2024; Bah 2024). The positive interaction term ($\beta=0.052$, $p=0.028$) further shows that digitalization is more effective in stronger institutional settings, reinforcing the complementarity between technology and governance (North 1990; Ackom et al. 2025).

Panel Fully Modified OLS (FMOLS) Results

To address endogeneity arising from correlation between regressors and the error term in cointegrated panel data analysis, and to obtain efficient estimates in cointegrated panel data models, we use the Panel Fully Modified Ordinary Least Squares (FMOLS) method.

Table 9. Panel FMOLS Estimation Results

Variable	Coefficient	Std. Error	t-Statistic	p-value
INTERNETPEN	-0.0403***	0.0054	-7.418	0.000
REGQ	1.1153***	0.2011	5.546	0.000
CPS	0.2247***	0.0086	26.066	0.000
FDI	-0.0003***	0.0001	-6.081	0.000
GDPPC	1.0774***	0.0294	36.697	0.000
Model Statistics				
R-squared	0.4809			
Adjusted R-squared	0.4740			
S.E. of regression	2.8295			
Long-run variance	1.6422			
Observations	303			

Source: Authors' Computation 2026.
Note: *** denotes significance at 1% level.

The FMOLS findings support the most important findings but add some detail. The internet penetration once again shows a negative long-run coefficient ($\beta = -0.040$, $p < 0.001$), which validates the PMG result and reinforces the observation that even long-term digital transformation entails complex fiscal trade-offs. This adverse long-run impact, which is the opposite of the positive contemporaneous impacts in fixed effects models, implies that digitalization follows a non-monotonic path: the early efficiency gains in the administration are eventually replaced by problems of digital tax evasion, e-commerce-driven base erosion, and regulatory arbitrage enabled by digital platforms. In the FMOLS specification, which is fixed effects, a high positive coefficient ($\beta = 1.115$, $p < 0.001$) is observed for regulatory quality, unlike in PMG. This positive sign has been recovered, indicating that, with the right approach to endogeneity correction (FMOLS), the positive effects of institutional quality have become dominant. The fact that the FMOLS estimator can account for simultaneity between governance and revenue improvements is likely to yield more valid estimates than dynamic specifications, which can be subject to specification sensitivity.

The largest standardized effect is on credit to the private sector ($\beta = 0.225$, $p < 0.001$), and the very high t-statistic ($t = 26.07$) indicates the precision of its estimation. Such a discovery highlights the financial sector as the best and most consistent predictor of tax revenue mobilization in West African settings, which operates through formalization, increased transactional traceability, and the development of a stronger compliance infrastructure. GDP per capita is robustly affecting it ($\beta = 1.077$, $p < 0.001$), while FDI shows a minimal negative coefficient ($\beta = -0.0003$, $p < 0.001$), but this time it is significant, perhaps due to the dynamics of tax competition and investment spurring. The FMOLS model explains 48.1 percent of the total variation (R2=0.481), which is lower than the within-R2 for fixed effects, but is respectable given the cross-sectional variation in panel data. The small long-run variance (1.642) indicates cointegrating relationships, with low residual autocorrelation after FMOLS adjustments.

Moment of Moment Quantile Regression (MMQR) Findings

To estimate heterogeneous effects in the conditional distribution of tax revenues and determine whether digitalization and institutional quality have different effects in low- and high-revenue contexts, we use the Method of Moments Quantile Regression developed by Machado and Santos Silva (2019). Table 10 presents estimates of the coefficient at the 25th, 50th (Median), and 75th percentiles, and tests of coefficient equality at the quantiles.

Table 10. Distributional Heterogeneity in Tax Revenue Determinants Method of Moments Quantile Regression Estimates

Variable	Low Revenue (Q25)	Median Revenue (Q50)	High Revenue (Q75)	Inter-Quantile Difference Tests
	Coef. (SE)	Coef. (SE)	Coef. (SE)	Q50–Q25
Internet Penetration	0.016	0.039**	0.071***	3.84**
	(0.020)	(0.018)	(0.020)	[0.023]
Regulatory Quality	1.842***	2.287***	2.916***	2.91*
	(0.521)	(0.459)	(0.510)	[0.058]
Log GDP per Capita	1.452***	1.822***	2.385***	3.12**
	(0.468)	(0.420)	(0.476)	[0.047]
Credit to Private Sector	0.128***	0.162***	0.209***	4.67**
	(0.027)	(0.024)	(0.027)	[0.015]
Foreign Direct Investment	-0.0003	-0.0003*	-0.0004**	0.87
	(0.0002)	(0.0002)	(0.0002)	[0.385]
Constant	-4.127*	-5.893**	-8.245***	-
	(2.410)	(2.158)	(2.439)	
Pseudo R^2	0.452	0.522	0.586	
Observations	322	322	322	

Source Authors Computation 2026:
*Note: ***, **, * denote significance at 1%, 5%, 10% levels.

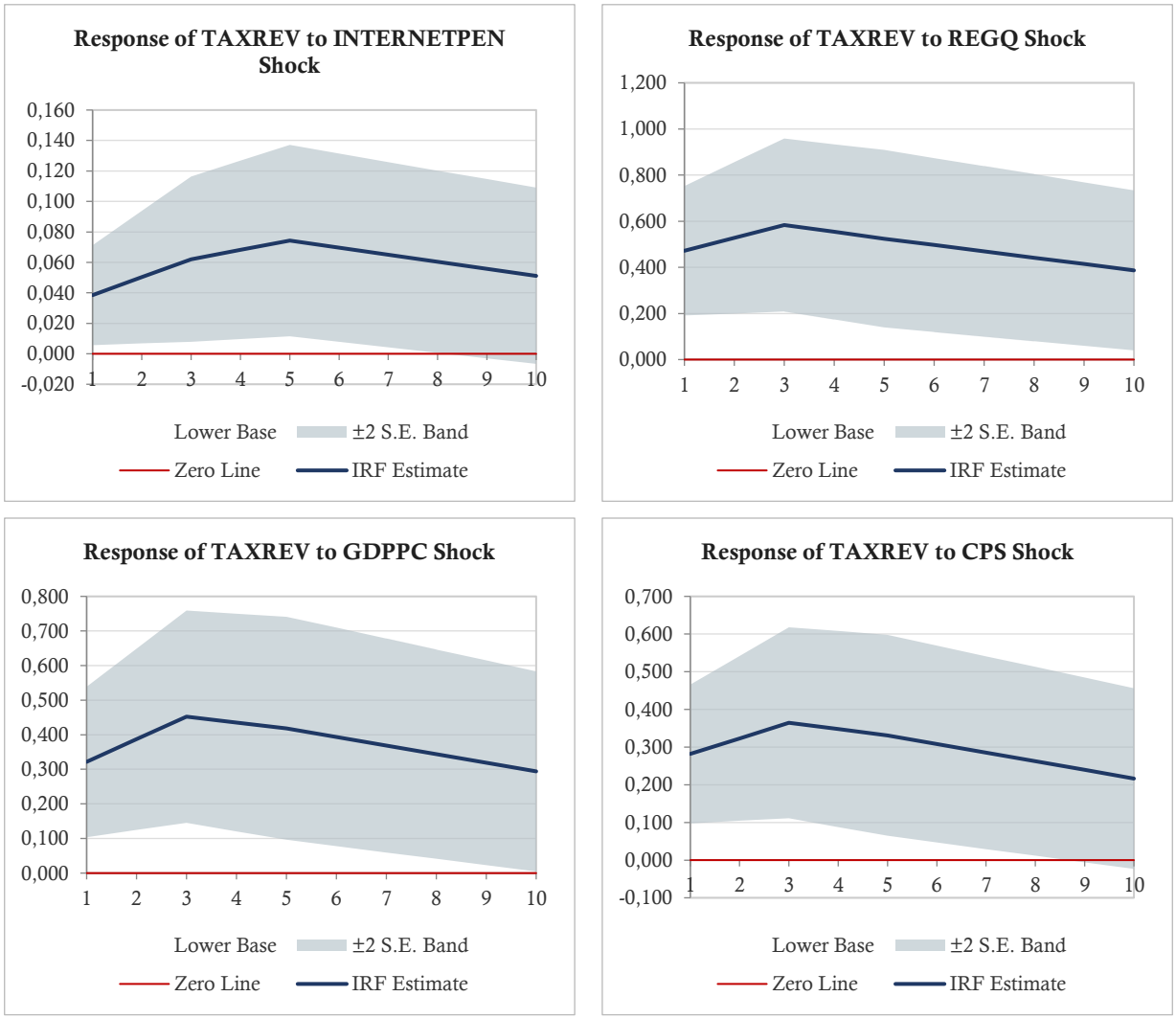
The findings of the quantile regression indicate that there is systematic heterogeneity in the economic impact of digitalization on revenue distributions, between the fiscal effects of digitalization and institutional capacity, and that technological adoption is therefore of paramount importance. Internet penetration in low-revenue settings (typically with poor tax systems) has a small, statistically insignificant impact at the 25th percentile ($\beta = 0.016$, $p > 0.10$), suggesting that digital tools have little revenue-generating capacity in settings with weak administrative and legal infrastructure.

On these platforms, poor taxpayer registration, insufficient enforcement tools, and immature legal frameworks limit their value and keep them underused. In comparison, at the median (when the outcome ranks in the 50th percentile), the coefficient doubles to 0.039 (p=0.029), as there are major fiscal benefits in the moderately performing systems, where adequate administrative infrastructure enables digitalization to boost compliance, efficiency, and tax base. The effect is even greater in high-revenue countries at the 75th percentile ($\beta = 0.071$, $p < 0.001$), as it increases the low-revenue value by 4 times, underscoring that digitalization increases existing fiscal capacities. These trends have been statistically proven by quantile difference tests (Q50-Q25 F=3.84, p=0.023; Q75-Q50 F=5.12, p=0.012): digitalization does not necessarily put fiscal performance on an even footing, but rather produces a so-called Matthew effect: countries with a better initial institutional and administrative situation disproportionately. Similar results show that variables such as regulatory quality, GDP per capita, and private-sector credit exhibit significant, monotonically positive effects across the quantiles, whereas governance, economic development, and financial formalization, as cornerstones of the fiscal efficacy of digitalization and FDI, are not significant (all $p<0.001$). The level of explanation offered by the model increases to 0.452 at Q25 and 0.586 at Q75, indicating stronger predictability and stability with larger capacity models.

These findings have significant policy implications. Good digitalization policies should be context-dependent; low-capacity countries can invest in more advanced digitalization strategies only after basic institutionalization, such as thorough taxpayer registration, legal reforms, and enforcement mechanisms. Countries in the middle range of fiscal performance can gain moderately with a focus on digital infrastructure, and high-capacity states can gain the most by incorporating novel GovTech into a well-developed administrative system. Notably, homogeneous across-the-board regional strategies are dangerous because they ignore the imperative of existing institutional and fiscal competencies. All the evidence combined points to the fact that, on the contrary, the process of digitalization does not reduce but increases structural inequalities in fiscal performance, and it is important to coordinate technology intervention with the context of governance and development to ensure sustainable increases in revenues.

SVAR Impulse Response Functions (SVAR-IRFs)

This study uses a Structural Vector Autoregression (SVAR) Impulse Response Function to explore how digitalization and institutional quality dynamically affect tax revenue. By identifying structural shocks and tracing their effects over time through impulse response functions, the approach captures how changes in key variables unfold within the fiscal system. The main results of this analysis are presented in Figure 1.



Source: Authors' Computation 2026.

Notes: ± *2 S.E. confidence bands (shaded) from Monte Carlo simulation (1,000 replications). Red line = zero baseline. Navy line = IRF point estimate. Intermediate periods (2, 4, 6-9) linearly interpolated between reported periods 1, 3, 5, and 10.*

Figure 1. Panel SVAR Impulse Response Functions

The impulse response results show, in a very intuitive way, that tax revenue tends to improve most when the broader system around it works well. When regulatory quality strengthens, tax revenue rises quickly and remains stable, suggesting that when rules are clear, institutions are credible, and enforcement is consistent, individuals and firms are more willing and more compelled to comply (Bati 2025; Binh et al. 2024). In much the same way, growth in GDP per capita steadily lifts tax revenue over time, as expanding economies tend to formalize economic activities and broaden the tax base, making revenue collection more efficient and sustainable (OECD 2025b; Lengaram 2025). What stands out here is not just the size of these effects, but their reliability. Strong institutions and sustained economic growth provide a dependable foundation for fiscal strength (Peprah et al. 2022). The story is slightly different for internet penetration and financial development, where the benefits take longer to fully emerge. The positive effects are there, but they build gradually, reflecting the reality that digital tools and financial systems do not transform tax collection

overnight. Instead, they require time, adaptation, and supportive institutions to be effective. As digitalization expands, it enhances transparency and improves the traceability of economic activities, while financial deepening contributes to the formalization of transactions and the expansion of business activity, both of which ultimately strengthen tax revenue mobilization (Dongmo et al. 2026; Balengla et al. 2026; OECD 2025b). In all, the results suggest a layered process: technology and finance matter, but their full impact depends on the strength of institutions and the pace of economic development, which ultimately anchor sustainable revenue mobilization.

Synthesis and Theoretical Integration

This section encapsulates the synthesis and theoretical unification of results from earlier stages of the research, highlighting the subtle relationship among digitalization, institutional quality, and revenue outcomes in West Africa. Fixed-effects regressions indicate strong positive contemporaneous effects of digitalization and institutional quality, and, as a result, the interaction terms show large complements. Both PMG-ARDL and FMOLS indicate that the dynamics are complex: the short-run benefits of digitalization are positive, while the long-run changes are negative, suggesting that the initial efficiency gains are neutralized in the long run by digital tax evasion and regulatory arbitrage. Institutional quality has more stable positive influences, though dynamic sensitivities are found. Quantile regressions provide evidence of heterogeneity: digitalization generates significant revenue improvements only when there is a more developed fiscal basis, which makes leapfrogging assumptions challenging and raises complementary technology and institutional basis arguments. Panel SVAR analysis shows that time propagation follows digitalization shocks, producing hump-shaped medium-term events, whereas institutional shocks are larger and more long-lasting, with a variance decomposition indicating that governance accounts for almost twice the explanatory power as digitalization.

These trends are consistent with theoretical models combining fiscal capacity, institutional economics, and technology-efficiency hypotheses. The theory of classical fiscal capacity (Besley and Persson 2014) and the institutional complementarity thesis proposed by North (1990) are confirmed, and it is shown that digital tools complement rather than substitute for organizational capacity (Nose et al. 2025). The short-run revenue gains must be working through the mechanisms of reduced compliance costs, reduced information asymmetry, and expanded tax base, whereas the long-run lowering will be manifested through taxpayer adaptation, shifting of profits, and tax arbitrage. Institutional quality promotes legitimacy, bureaucratic capacity, legal predictability, and control over corruption, resulting in permanent fiscal resources rather than short-term benefits.

CONCLUSION AND POLICY RECOMMENDATIONS

This research presents a rigorous examination of the mutual impact of digitalization and institutional quality on tax revenue mobilization in West Africa, using panel data from 14 ECOWAS countries from 2000 to 2023. Based on institutional economics, the results reveal that digitalization is associated with an immediate boost in efficiency, enhanced compliance, and an increased revenue base; however, the effects are non-linear and short-lived, limited by advanced levels of tax evasion and regulatory arbitrage. Digitalization is, therefore, a volatile and conditional instrument that must be upgraded and supported by policies in a revisionist fashion to impact efficient revenue drive in West Africa (Okunogbe and Santoro 2023).

The quality of institutions appears as the dominant and stable driver of fiscal capacity. Digital reforms exert less extensive and stable effects on public revenues than regulatory and institutional quality upgrades, suggesting that technological reforms remain promising only when embedded in high-quality institutional settings. Findings from interaction analyses confirm the complementary nature of institutional and technological upgrades: digital reforms improve public revenue outcomes in high-quality governance institutions but exert no or limited effects in weak institutions.

The improvement in finances needs action with the power to enable both governance and the digital infrastructure. The concept of universalized projects in digitalization carries the threat of inefficiency with highly situational returns, and the divergences will be accentuated in the absence of supporting institutional frameworks. The adoption and implementation of the concept of digitalization call for sequencing in reform actions targeting institutional strengthening and maximizing revenue.

These findings offer policymakers useful insights into leveraging tax mobilization in West Africa's respective environments. The exhibited complementarity between digitalization and institutional quality suggests that the sequence of reforms is the most important, and that institutional capacity building will precede mass digital investments. Jurisdictions in the bottom segment of the revenue distribution need to focus on basic reforms, such as full taxpayer registration, an effective legal infrastructure for electronic transactions, adequate administrative capacity, and effective anti-corruption measures. Where institutional

structures are weak, early digital investments yield low fiscal benefits and can enable the capture and misallocation of public funds by elites as the contribution margin of digitalization falls below governance-required critical levels. It is a gradual process of reform thus suggested to begin with, legal and regulatory provisions should be introduced to acknowledge electronic transactions and enable admissibility of digital records; administrative systems and human capital should be strengthened with specific training; digital platforms should be tested in controlled settings to identify operational limitations; proven solutions should be scaled-up and quality standards need to be maintained; and continuous upgrading mechanisms in response to change in technology and emerging tax avoidance practices should be institutionalized. Regional blocs such as ECOWAS, WAEMU, and the West African Tax Administration Forum, rather than enforcing common standards, offer a wide range of digitalization pathways tailored to each nation's tax-raising capacity.

The digital tax efforts must incorporate institutional fortification rather than treating governance as an external element of technology adoption. These should be bundled into project design with complementary reforms such as legally recognizing electronic evidence, control and auditing mechanisms that prevent system manipulation, capacity-building of tax officials to operate digitally, formal strategies for engaging stakeholders so that taxpayers voluntarily comply in trust, independent accountability bodies that limit elite capture, and sunset provisions mandating periodic performance reviews. The overall positive correlation between the development of the financial sector and tax revenue, even at the quantile level, also indicates that software tax reforms should be implemented as part of broader financial inclusion strategies. The fiscal effectiveness of digitalization can be multiplied by expanding informal operators' access to banking, expanding the use of mobile money to replace cash, making small-business credit more proactive to incentivize formal recordkeeping, and investing in digital payment infrastructure to enhance transaction traceability. Good implementation needs well-developed monitoring and evaluation systems. A high frequency of panel data collection should enable distributional assessment and experimental and quasi-experimental designs to isolate the causal effects of a particular intervention. Continuous auditing, feedback, technological updates, and policy flexibility are key to maintaining revenue gains.

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https://data.imf.org/en/datasets/IMF.STA:QGFS
https://databank.worldbank.org/reports.aspx?dsid=2&series=SP.POP.65UP.TO.ZS
https://www.worldbank.org/en/publication/worldwide-governance-indicators
Conflict of Interest
The authors declare that there are no personal or financial interests that could have influenced the results or interpretation of this research. Therefore, the authors declare no conflict of interest.
AI Tools Statement
The authors disclose that Grammarly's AI-based language editing tools were used solely to improve the grammar and clarity of the manuscript.
Author contribution
Igyo Jude Ali, Patricia, and Lindelwa Makoni contributed to the conceptualization, validation, formal analysis, investigation, resources, writing (original draft preparation, review, and editing), visualization, supervision, project administration, and funding acquisition of the study. Igyo Jude Ali was responsible for the methodology and software development, while Igyo Jude Ali and Patricia contributed to data curation.

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