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The Effect of Digitalisation on Tax Revenues from International Transactions in Sub-Saharan Africa

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Abstract

This study looks at how digitalisation affects the tax revenues that Sub-Saharan African countries collect from international transactions. Using data from 31 countries between 2004 and 2021, we applied a System GMM method to estimate a dynamic panel model, and used 2SLS to check the robustness of our results. What we found is encouraging: digitalisation significantly boosts tax revenues from cross-border activities. Specifically, a one-unit increase in our ICT index is associated with a 0.698% rise in these revenues. Breaking it down further, mobile telephony turns out to be the most powerful driver, followed by fibre optics, fixed-line telephony, and internet penetration. These findings hold up under alternative estimation techniques. Unlike most previous research that looks at total tax revenues or domestic taxation, we zoom in specifically on revenues from international transactions; an angle that has been largely overlooked in developing economies. Our results suggest that digitalisation helps customs and tax administrations work more efficiently, improves the monitoring of cross-border trade, and ultimately strengthens a country's ability to collect revenue. For policymakers in Sub-Saharan Africa, this means that investing in digital infrastructure; especially mobile telephony is a practical way to improve tax collection from international trade.

Key words: Digitalisation, Tax revenues, international transactions, Sub-Saharan Africa, System GMM.

CODE JEL: F38; O33; P45

Résumé

Cette étude examine comment la digitalisation influence les recettes fiscales issues des transactions internationales en Afrique subsaharienne. À partir d'un panel de 31 pays sur la période 2004-2021, et en utilisant la méthode System GMM (vérifiée par 2SLS), nous montrons que la digitalisation a un effet positif et significatif sur ces recettes : une augmentation d'une unité de l'indice TIC entraîne une hausse de 0,698 % des recettes douanières. La téléphonie mobile s'impose comme le principal moteur, devant la fibre, la téléphonie fixe et l'internet. Contrairement à la plupart des travaux antérieurs centrés sur la fiscalité globale ou intérieure, cette recherche met l'accent sur les recettes liées aux échanges internationaux – un aspect peu exploré dans les économies en développement. La transformation numérique aide les administrations douanières et fiscales à mieux tracer les flux transfrontaliers et à capter davantage de ressources. En clair, investir dans les infrastructures numériques, et surtout dans la téléphonie mobile, est une stratégie concrète pour améliorer durablement la mobilisation des recettes fiscales issues du commerce international en Afrique subsaharienne.

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Mots clés : Digitalisation; recettes fiscales des transactions internationales ; Afrique subsaharienne; GMM en système.
JEL Codes: F38; O33; P45

1. Introduction

Digital technologies have reshaped almost every aspect of our lives – from how we work and trade to how governments collect taxes. Over the last twenty years, the spread of information and communication technologies (ICTs) has been breathtaking. In 2005, fewer than one billion people were online; by 2024, that number had climbed to 5.6 billion; nearly 68% of the world's population (ITU, 2024). At the same time, digital trade has exploded, with digitally delivered services making up a growing share of global commerce (WTO, 2024). For governments, this transformation opens up new possibilities: modernising tax and customs systems, tracking economic transactions more accurately, and raising domestic revenues more effectively.

Nowhere is this more relevant than in Sub-Saharan Africa. Across the region, mobilising public revenue remains a stubborn challenge. Despite reforms, most countries still have low tax-to-GDP ratios – less than 16% on average, compared with over 34% in OECD countries (OECD/African Union/ATAF, 2024). Yet taxes on international trade remain a vital source of income for many African economies. At the same time, digital connectivity has grown remarkably: internet penetration rose from under 2% in 2000 to about 39% in 2023, and mobile subscriptions reached nearly 87 per 100 people (ITU, 2024). This twin evolution (fiscal needs and digital growth) raises a natural question: can digitalisation help governments collect more revenue from cross-border transactions?

On the one hand, the promise is clear. Digital tools like electronic customs clearance, online declaration platforms, and automated risk management can cut administrative costs, increase transparency, reduce fraud and corruption, and strengthen oversight of trade flows. On the other hand, the reality may be messier. Some theories like Solow's productivity paradox warn that technology investments don't always pay off if the right conditions aren't in place. Institutional theory adds that weak governance or limited administrative capacity can undermine even the best digital systems. And there's a risk that digitalisation might also create new loopholes for tax avoidance or cyber-fraud if regulations don't keep up.

The empirical evidence is mixed. Many studies find that digitalisation boosts tax revenues by improving efficiency and compliance. Others show weak or inconsistent effects, heavily dependent on country context – governance quality, human capital, digital literacy. A few even point to non-linear patterns, where benefits taper off or reverse once technology outruns regulation.

So far, most research has focused on total tax revenues or domestic taxation. But what about tax revenues from international transactions? This is a crucial gap, especially for Sub-Saharan Africa, where such revenues still matter a great deal. This study sets out to fill that gap. We ask: To what extent does digitalisation influence the mobilisation of tax revenues from international transactions in Sub-Saharan Africa? Our hypothesis, grounded in Fiscal Modernisation Theory and the Theory of Tax Compliance, is that digitalisation has a positive and significant effect.

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We use a panel of 31 Sub-Saharan African countries from 2004 to 2021 and employ System GMM. Our contributions are threefold: (1) we focus specifically on revenues from international transactions, not just aggregate taxes; (2) we provide new macroeconomic evidence for a region where empirical work is still scarce; and (3) we disaggregate digitalisation into its components – mobile telephony, fixed-line telephony, internet penetration, and fibre optics – to see what drives fiscal capacity most.

The rest of the paper is organised as usual: a review of theory and evidence, then methodology, results, and finally conclusions and policy implications.

2. Literature Review

2.1. Theoretical Foundations

To understand how digitalisation might affect tax revenues from international transactions, we need to bring together several complementary perspectives. Some point toward gains, others toward limitations and the truth likely lies somewhere in between.

Fiscal Modernisation Theory (inspired by Max Weber) sees digitalisation as a tool for rationalising public administration. Electronic filing, automated customs clearance, and digital payments reduce transaction costs and improve transparency. When applied to cross-border trade, these systems help track goods more accurately, assess taxable bases more reliably, and cut revenue losses from inefficiency or fraud. But the catch is that these gains depend on effective implementation – technology alone isn't magic.

The Theory of Tax Compliance (Allingham & Sandmo, 1972) adds a behavioural twist. Tax evasion is a rational choice: people compare the benefits of cheating against the risk of getting caught. Digitalisation shifts that calculation by making detection more likely through electronic invoicing, real-time tracking, and integrated databases. That should discourage evasion and encourage voluntary compliance. But again, this works best where enforcement capacity is real and digital systems are widespread.

Institutional Theory (North, 1990) sounds a cautionary note. Institutions (the rules, norms, and enforcement mechanisms) shape what technology actually delivers. In settings with transparency, competence, and rule of law, digitalisation can boost accountability and revenue. In corrupt, weakly regulated environments, digital tools may be underused, manipulated, or bypassed. So the outcome depends heavily on governance quality.

The Technology Acceptance Model (Davis, 1989) reminds us that technology is only as good as people's willingness to use it. If customs officers, taxpayers, or officials find digital systems difficult or unhelpful, adoption will lag. Where digital literacy is low or infrastructure patchy, resistance can seriously blunt the fiscal benefits.

Taken together, these theories suggest multiple, sometimes opposing channels through which digitalisation could affect tax revenues. That's why empirical investigation made country by country, context by context, is so important.

2.2. Empirical Review

Empirical studies that focus directly on digitalisation and tax revenues from *international transactions* are still rare. Most work instead looks at customs modernisation or aggregate tax revenues. Still, the available evidence is instructive.

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Several studies show positive effects. Heijmann et al. (2020) found that big data and advanced monitoring improved Dutch customs controls. Salixova (2021), Nemirova & Savelyeva (2020), and Zasko et al. (2021) similarly report that digitalising customs procedures boosts transparency, risk management, and revenue collection.

But African evidence is more nuanced. Chalendard & Fernandes (2020) showed that Madagascar's SYDONIA system improved information and fraud detection, but corruption and weak capacity limited its impact. Addo (2021) found efficiency gains in Ghana, but institutional and political constraints kept revenue benefits modest. So digital tools can work, but governance matters.

Looking more broadly at tax revenues, Koyuncu & Ünver (2017), Houssa et al. (2017), and Ongo Nkoa & Song (2022) find positive effects from ICT development, driven by better administration and compliance. Yet Brun et al. (2020) find only weak effects, while Ogbo et al. (2022) and Mallick (2021) stress that benefits depend heavily on complementary factors like institutional quality, skills, and infrastructure.

Recent work also points to non-linearities. Adegboye et al. (2022) find that positive impacts may decline beyond certain thresholds. Hanrahan (2021) warns that highly digitalised economies with weak regulations can see new forms of tax avoidance. So the fiscal payoff of digitalisation isn't automatic; it requires adaptive governance.

In short, the literature supports the idea that digitalisation *can* strengthen revenues from international transactions, but the magnitude varies greatly and depends on context. And crucially, macroeconomic analyses focusing specifically on Sub-Saharan Africa's international transaction revenues remain scarce; which is exactly why our study is needed.

3. Methodology

3.1. Model Specification

Our modelling rests upon a framework. This framework is fiscal. It demonstrates something specific. Effective ICT use can have effects. These effects are positive. They concern collection. Specifically, customs-related tax revenue collection.

Our model's reduced-form specification appears below. Equation (1) illustrates this:

$$lnRFP_{it} = \alpha + \beta TIC_{it} + \lambda lnX_{it} + V_t + \mu_i + \varepsilon_{it} \quad (1)$$

Where:

- **RFPit** denotes the dependent variable of the study, namely customs tax revenue. This variable corresponds to taxes levied on international trade transactions and includes import and export duties, revenues derived from import and export monopolies, gains generated from foreign exchange operations, as well as taxes imposed on foreign exchange transactions. Customs tax revenue is measured in US dollars (USD).

- **ICTit** refers to the level of development of Information and Communication Technologies in country *i* at time *t*. This variable is measured through a composite index constructed using Principal Component Analysis (PCA). The index captures several key dimensions of digitalisation, including mobile telephony, fixed-line telephony, fibre-optic infrastructure, and Internet access.

- **Xit** represents the set of control variables included in the model to account for other factors that may influence tax revenues derived from international transactions.

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– **Foreign Direct Investment (FDI)** constitutes a determinant whose effect on tax revenue remains ambiguous in the empirical literature. On the one hand, some studies, such as Ahmed and Muhammad (2010), argue that FDI enhances public revenue mobilisation by expanding the tax base and stimulating economic activity. On the other hand, scholars such as Zucman (2015) emphasise the possibility of a negative effect arising from tax exemptions granted to foreign investors and from international tax avoidance and profit-shifting strategies.

– **Official Development Assistance (ODA)** also exhibits mixed effects. A first strand of the literature suggests that external aid may substitute for domestic revenue mobilisation efforts, thereby reducing governments' incentives to strengthen tax collection systems (Morrissey & Thorrance, 2015; Morrissey, 2015; Thornton, 2014). Conversely, another perspective argues that aid conditionalities may encourage institutional and administrative reforms that improve domestic revenue mobilisation (Benedek et al., 2014; Cordella & Ulku, 2007; Gupta, 2007).

– **Inflation** is generally expected to exert a negative effect on tax revenue. High inflation tends to undermine macroeconomic stability, reduce the predictability of income streams, and weaken the effectiveness of tax collection mechanisms. This adverse relationship has been documented by Ofori et al. (2018).

– **Trade Openness (TO)** is measured as the ratio of the sum of exports and imports of goods and services to economic activity. Greater integration into international markets is expected to increase tax revenues associated with external trade by expanding the volume of taxable transactions. This positive relationship is highlighted by Gnangnon and Brun (2018).

– **Industrial Value Added (IVA)** is used as an indicator of the level of industrialisation within the economy. A larger contribution of the industrial sector to value creation generally reflects stronger productive capacity, greater trade activity, and a broader tax base, all of which are conducive to higher tax revenue mobilisation.

Furthermore, **μi** captures unobserved country-specific effects, while **vt** accounts for time-specific effects that are common to all countries in the sample. The term **εit** denotes the stochastic error term. Finally, **α**, **β**, and **λ** represent the parameters to be estimated.

The various econometric specifications adopted in this study are presented below through the corresponding model equations:

$$lnRFP_{it} = \alpha + \beta TIC_{it} + \lambda_1 lnIDE_{it} + \lambda_2 lnAPD_{it} + \lambda_3 Inflation_{it} + \lambda_4 DO_{it} + \lambda_5 lnVAI_{it} + V_i + \mu_t + \varepsilon_{it} \quad (2)$$

$$lnRFP_{it} = \alpha + \beta lnFibreop_{it} + \lambda_1 lnIDE_{it} + \lambda_2 lnAPD_{it} + \lambda_3 lnInflation_{it} + \lambda_4 DO_{it} + \lambda_5 lnVAI_{it} + V_i + \mu_t + \varepsilon_{it} \quad (3)$$

$$lnRFP_{it} = \alpha + \beta lnTelfixe_{it} + \lambda_1 lnIDE_{it} + \lambda_2 lnAPD_{it} + \lambda_3 lnInflation_{it} + \lambda_4 DO_{it} + \lambda_5 lnVAI_{it} + V_i + \mu_t + \varepsilon_{it} \quad (4)$$

$$lnRFP_{it} = \alpha + \beta lnTelmobil_{it} + \lambda_1 lnIDE_{it} + \lambda_2 lnAPD_{it} + \lambda_3 lnInflation_{it} + \lambda_4 DO_{it} + \lambda_5 lnVAI_{it} + V_i + \mu_t + \varepsilon_{it} \quad (5)$$

$$lnRFP_{it} = \alpha + \beta Internet_{it} + \lambda_1 lnIDE_{it} + \lambda_2 lnAPD_{it} + \lambda_3 lnInflation_{it} + \lambda_4 DO_{it} + \lambda_5 lnVAI_{it} + V_i + \mu_t + \varepsilon_{it} \quad (6)$$

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Theoretical and empirical evidence indicates influence. This influence is significant. It concerns key macroeconomic variables. These variables influence customs tax revenues. Consequently, our dynamic model will be specified. It will be specified as follows:

$$\boldsymbol{lnRFP_{it}} = \alpha + \boldsymbol{\beta_0 RFP_{it-1}} + \boldsymbol{\beta TIC_{it}} + \boldsymbol{\lambda lnX_{it}} + \boldsymbol{V_t} + \mu_i + \varepsilon_{it} \quad (7)$$

Table 1: Summary of Variables

Variables	Notation	Measurement	Authors	Sources
ICT	TIC	-	Construction	WDI
Fibre Optic	Fibreopt	Number of fibre optic users	UIT	WDI
Fixed-line Telephony	Telfixe	Number of fixed-line users	ITU	WDI
Mobile Telephony	Telmobil	Number of mobile phone users	ITU	WDI
Internet	Internet	Number of Internet users	ITU	WDI
Foreign Direct Investment	IDE	In US dollars	Ahmed & Muhammad (2010); Zucman (2015)	WDI
Official Development Assistance	APD	In US dollars	Morrissey & Torrance (2015); Morrissey (2015); Benedek et al. (2014); Cordella & Ulku (2007); Gupta (2007)	WDI
Inflation	Inflation	Rate (%)	Ofori et al. (2018)	WDI
Trade Openness	DO	In US dollars	Gnangnon (2018)	WDI
Value Added of Industrial Sector	VAI	In US dollars	Gnangnon (2018)	WDI

Source: Author

3.3. Data Sources

Data are collected from secondary sources. This study uses them. The period covered spans 2004 to 2021. A panel of 31 Sub-Saharan African countries is covered. Customs tax revenue data are obtained. These come from the World Bank. Specifically, the World Development Indicators database.

3.4. Description of the Estimation Method

The empirical model adopted in this study is fundamentally dynamic, which inevitably gives rise to important econometric challenges, most notably those related to endogeneity. This problem is primarily driven by the inclusion of a lagged dependent variable among the explanatory variables, a specification that mechanically induces correlation between regressors and the error term. In addition, the possibility of feedback effects running from the dependent variable back to the explanatory variables further strengthens simultaneity concerns, thereby increasing the risk of biased and inconsistent estimates if appropriate estimation strategies are not implemented.

To properly address these econometric issues, the analysis relies on the two-step Generalised Method of Moments (GMM) estimator, which is widely recognised in the literature as a particularly suitable approach for dynamic panel data models characterised by a large number of cross-sectional units (N) and a relatively short time dimension (T), as highlighted by Roodman (2009). Over recent years, this methodology has become a standard tool in macroeconomic and development economics research due to its ability to

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effectively mitigate reverse causality, omitted variable bias, and unobserved heterogeneity, all of which are especially prevalent in dynamic specifications.

The complexity of dynamic panel models stems from the presence of one or more lagged dependent variables included as regressors, which fundamentally invalidates the use of standard econometric techniques. In such a context, both Ordinary Least Squares (OLS) and traditional fixed-effects estimators become inconsistent and inefficient, since the lagged dependent variable is endogenous by construction and remains correlated with the error term even after controlling for unobserved heterogeneity. As a result, more advanced instrumental variable-based approaches are required in order to obtain reliable and consistent parameter estimates.

Within the class of GMM estimators developed for dynamic panels, two main approaches are commonly distinguished in the literature. The first is the difference GMM estimator proposed by Arellano and Bond (1991), which eliminates unobserved country-specific effects by transforming the model into first differences and subsequently instruments the differenced endogenous variables using their lagged levels. Although this approach has been widely applied, it may suffer from weak instrument problems, particularly when the variables exhibit high persistence over time, which can reduce estimation efficiency and reliability.

To overcome these limitations, Blundell and Bond (1998) develop the System GMM estimator, which combines the model in first differences with the model in levels, thereby exploiting additional moment conditions to improve efficiency. In this framework, lagged differences are used as instruments for the level equation, which enhances the strength and validity of the instruments, especially in finite samples. Empirical evidence provided by Blundell and Bond (1998) demonstrates that System GMM generally outperforms difference GMM, particularly in macroeconomic panels where variables are persistent and standard instruments tend to be weak.

4. Results and Discussion

Descriptive statistics are presented first. Econometric analysis results follow.

4.1. Descriptive Statistics

This section presents a descriptive statistical analysis of the variables used in the study, based on measures of central tendency and dispersion, namely the mean, standard deviation, minimum, and maximum values, as reported in Table 2 below. These statistics provide an initial overview of the structure and distribution of the data across the selected Sub-Saharan African countries.

The empirical results indicate that customs tax revenues exhibit a relatively high mean value of 3.40e+11, accompanied by a substantial standard deviation of 6.83e+11, which suggests pronounced heterogeneity across countries and over time, reflecting significant disparities in fiscal capacity within the region. This variability may be partly explained by differences in trade openness regimes and the implementation of free trade policies, which, in some cases, have contributed to the reduction of customs-related revenues by lowering tariff barriers and reshaping the structure of international trade taxation.

Regarding the ICT index, the average value of 0.180302 reveals a generally low level of digitalisation across the sampled countries, while the dispersion of the data highlights

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marked cross-country heterogeneity. This pattern reflects persistent structural constraints related to insufficient technological infrastructure, including limited development of fibre optic networks, weak fixed-line telephony systems, low mobile network quality in certain areas, and restricted internet access. These constraints are further compounded by limited purchasing power in some economies, which reduces affordability and access to digital services, thereby contributing to the uneven diffusion of ICT across the region.

A closer examination of individual ICT components confirms these disparities, as fixed-line telephony records an average of 330,435.4 users, while mobile telephony shows a much higher mean of 1.23e+07 users, although both indicators display significant variation across countries, indicating persistent structural heterogeneity in telecommunications development. Similarly, internet usage, with an average value of 17.38443, remains relatively low and unevenly distributed, reflecting the limited penetration of digital technologies across the sampled economies and reinforcing the existence of a pronounced digital divide within the region.

Analysing the control variables provides further insights into the macroeconomic environment, beginning with Foreign Direct Investment (IDE), which has a mean of 8.06e+08 and exhibits high levels alongside persistent heterogeneity across the sample that can be explained by specific sub-Saharan African country policies designed to reduce tax burdens and attract foreign investors. Concurrently, Official Development Assistance (APD) displays a mean of 6.15e+11, which underscores the fragility of these sub-Saharan African economies where domestic resources remain insufficient to meet development financing requirements, thereby resulting in a structural dependence on ODA.

In terms of macroeconomic stability, inflation registers a relatively low mean that reflects the political stability and prudent management of both monetary and fiscal policies demonstrated across the region. This stability operates alongside a high mean for Trade Openness (DO), quantified at 2.33e+14, which indicates that these countries are heavily oriented towards export and import activities supported by international trade policies and regional economic integration. Finally, the value added of the industrial sector maintains a mean of 6.13e+13, an outcome fostered by high investment levels directed towards this sector and the abundant natural resources that these sub-Saharan African countries possess.

Table 2: Descriptive Statistics

Variable	Obs	Mean	Std.Dev	Min	Max
RFP	558	3,40e+11	6,83e+11	2,89e+07	5,75e+12
TIC	558	0,180302	0,1621711	0	1
Fibreop	558	91184,36	230929,5	22	1706313
Telfixe	558	330435,4	764206,3	800	4903000
Telmobil	558	1,23e+07	1,70e+07	39451	1,07e+08
Internet	558	17,38443	20,20296	0,1553345	161,8491
IDE	558	8,06e+08	2,25e+09	-7,40e+09	4,13e+10
APD	558	6,15e+11	1,38e+12	4,07e+07	1,15e+13
Inflation	558	0,092398	0,3142696	-0,1685969	5,572018
DO	558	2,33e+14	2,34e+15	4,38e+09	4,07e+16
VAI	558	6,13e+13	6,17e+14	3,54e+08	1,07e+16

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Source: Author's calculations using Stata 14

4.2. Correlation Analysis

This section presents a descriptive correlation analysis aimed at examining the pairwise relationships between the dependent variable, the set of explanatory variables, and the control variables included in the study, while providing a preliminary overview of the direction and intensity of associations among key variables prior to the econometric estimation, as reported in Table 3.

Overall, the correlation matrix reveals a heterogeneous pattern of relationships between digitalisation indicators and customs tax revenues, as the ICT index, together with certain components such as fixed-line telephony and internet penetration, exhibits a negative correlation with customs tax revenues, a result that may reflect the fact that improvements in digital infrastructure, while enhancing the efficiency of trade facilitation and reducing transaction and compliance costs, can also be associated with a decline in tariff-based revenues in contexts where trade liberalisation policies have reduced import duties and restructured customs taxation systems.

In contrast, other dimensions of digital infrastructure, particularly mobile telephony and fibre optic development, display positive correlations with customs tax revenues, suggesting that certain aspects of digitalisation may contribute more directly to strengthening fiscal capacity through improved communication systems, enhanced monitoring of cross-border transactions, and greater efficiency in customs administration processes.

With regard to macroeconomic control variables, the results indicate that foreign direct investment (FDI) and inflation are negatively correlated with customs tax revenues, which may be explained by the use of tax incentives designed to attract foreign investors that tend to erode the tax base, as well as by the macroeconomic instability associated with inflation, which can weaken economic activity and reduce the volume of taxable imports over the period under consideration (2004–2021) across Sub-Saharan African countries.

Similarly, trade openness and value added of the industrial sector also exhibit negative correlations with customs tax revenues, a pattern that may be interpreted in light of trade liberalisation processes that reduce tariff revenues through lower import duties, as well as structural transformations in which industrial production becomes increasingly oriented toward export markets, thereby reducing the taxable base associated with imported goods subject to customs duties.

In contrast, official development assistance (ODA) shows a positive correlation with customs tax revenues, which may suggest that external financial support contributes to strengthening fiscal capacity in Sub-Saharan African countries, either by financing institutional reforms, improving administrative efficiency, or supporting the modernization of public revenue systems, including customs administrations, thereby enhancing the overall ability of states to mobilise tax revenues.

It is important to emphasise that these correlations are purely descriptive in nature and do not imply any causal relationship between the variables, as they only provide preliminary insights into the structure of associations within the dataset, which will be rigorously

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examined in the subsequent econometric analysis using dynamic panel estimation techniques.

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Table 3: Correlation Matrix

Variables	RFP	TIC	Fibreop	Telfixe	Telmobil	Internet	IDE	APD	Inflat~n	DO	VAI
RFP	1.0000										
TIC	-0.1292	1.0000									
Fibreop	0.0897	0.6625	1.0000								
Telfixe	-0.0867	0.6833	0.5996	1.0000							
Telmobil	0.0268	0.7008	0.7760	0.5979	1.0000						
Internet	-0.1394	0.7714	0.3208	0.1231	0.2385	1.0000					
IDE	-0.0617	0.3762	0.4553	0.3614	0.4769	0.1358	1.0000				
APD	0.4377	-0.0462	0.0792	-0.0397	0.2447	-0.1584	0.0158	1.0000			
Inflation	-0.0630	0.0635	0.0053	-0.0103	0.0657	0.0705	-0.0142	-0.0163	1.0000		
DO	-0.0348	-0.0249	-0.0330	-0.0397	-0.0150	-0.0070	-0.0310	0.0250	0.0061	1.0000	
VAI	-0.0353	-0.0455	-0.0334	-0.0377	-0.0314	-0.0311	-0.0310	0.0120	-0.0082	0.6757	1.0000

Source: Author's calculations using Stata 14

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4.3. Presentation and Interpretation of the Econometric Model Estimation Results

This subsection presents results. These concern estimations. The effects of ICT are estimated. These effects are on customs tax revenues. The context is Sub-Saharan African countries. The system GMM method performs these estimations.

Table 4 shows results. These concern ICT effects. Specifically, customs tax revenues are affected. The overall effect appears. This is measured by the ICT index. Individual ICT indicator effects appear too. The table appears below.

4.3.1. Interpretation of the Baseline Results

The estimation results consistently indicate that digitalisation contributes positively and significantly to the mobilisation of tax revenues derived from international transactions in Sub-Saharan Africa. This finding is particularly relevant given the structural characteristics of the region, where international trade taxes continue to represent an important source of public revenue due to the relatively narrow domestic tax base, the large size of the informal sector, and the limited capacity of tax administrations to effectively monitor economic activities. In many Sub-Saharan African countries, customs administrations constitute one of the most effective revenue collection agencies. Consequently, improvements in digital infrastructure can generate substantial fiscal gains by strengthening the monitoring and management of cross-border transactions.

The positive and statistically significant effect of the ICT index suggests that digitalisation enhances the capacity of governments to mobilise revenues associated with international trade. This result is consistent with Fiscal Modernisation Theory, which argues that digital technologies improve administrative efficiency through the automation of procedures, better information management, and reduced transaction costs. In the Sub-Saharan African context, where customs administrations have historically faced challenges related to weak administrative capacity, lengthy procedures, information asymmetries, and corruption, digital technologies provide an opportunity to modernise revenue collection systems. The deployment of electronic customs platforms, digital declaration systems, and automated risk-management procedures improves transparency and reduces opportunities for discretionary behaviour, thereby strengthening revenue collection. This result corroborates the findings of Ongo Nkoa and Song (2022), who show that ICT development contributes to fiscal mobilisation in Africa through improvements in governance and administrative performance.

The positive impact of digitalisation can also be explained through the Theory of Tax Compliance. In many Sub-Saharan African countries, customs fraud, under-invoicing, smuggling, and under-declaration of imports remain important challenges that undermine fiscal performance. Digital technologies increase the traceability of transactions and facilitate the cross-checking of information across customs, tax, and financial institutions. By increasing the probability of detection, digitalisation raises the expected cost of non-compliance and discourages opportunistic behaviour among economic agents. Consequently, customs administrations become more capable of identifying taxable transactions and reducing revenue leakages associated with informal and fraudulent trade activities.

The disaggregated results reveal that mobile telephony constitutes the most influential digital driver of revenue mobilisation. This finding reflects the specific pattern of digital

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development observed in Sub-Saharan Africa, where mobile technologies have expanded considerably faster than fixed-line infrastructure and broadband internet. In many countries of the region, mobile phones represent the principal means of access to digital services for households, businesses, and public institutions. The rapid diffusion of mobile technologies has facilitated the development of mobile money systems, digital payments, and electronic interactions with public administrations. These innovations improve the traceability of financial transactions and contribute to the gradual formalisation of economic activities, thereby expanding the taxable base associated with international trade. The prominence of mobile telephony in the results therefore reflects the distinctive trajectory of Africa's digital transformation, often characterised as a "mobile-first" development model.

Similarly, the positive effects associated with fibre optic infrastructure, fixed-line telephony, and internet penetration suggest that improvements in connectivity enhance the informational capacity of customs administrations. In a region where border management often involves multiple agencies operating with fragmented information systems, better digital connectivity facilitates data sharing, strengthens risk assessment procedures, and improves the monitoring of imports and exports. These findings support the predictions of Information Asymmetry Theory by indicating that digital technologies reduce informational gaps between economic agents and public authorities. They are also consistent with evidence from customs modernisation programmes implemented in several African countries through systems such as ASYCUDA, which have improved transparency, reduced clearance times, and strengthened customs controls.

The negative effect of foreign direct investment may reflect a structural feature of many Sub-Saharan African economies. In order to attract foreign capital, governments frequently grant generous tax exemptions, customs duty reductions, and preferential treatment to multinational firms. Although such policies may stimulate investment inflows, they often reduce the fiscal revenues directly associated with international transactions. This result suggests that the fiscal benefits of FDI may not materialise immediately and may be partly offset by revenue losses arising from investment promotion strategies. It also highlights the challenge faced by many African governments in balancing investment attractiveness with the need to preserve public revenue.

The positive influence of official development assistance indicates that external financial resources may strengthen fiscal capacity rather than substitute for domestic revenue mobilisation. In the African context, development partners frequently finance customs modernisation programmes, digital infrastructure projects, and administrative reforms aimed at improving public financial management. Several countries in the region have implemented digital customs reforms with support from international organisations and development agencies. Consequently, aid can indirectly contribute to improving customs efficiency and strengthening the collection of revenues derived from international transactions.

The negative effect of inflation highlights the vulnerability of revenue mobilisation systems to macroeconomic instability. Many Sub-Saharan African economies remain highly exposed to external shocks, commodity price fluctuations, exchange-rate volatility, and supply disruptions. These factors can reduce import demand, weaken trade activity, and

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consequently diminish the taxable base associated with international transactions. Furthermore, inflation may increase the administrative costs of revenue collection and complicate customs valuation procedures, thereby undermining fiscal performance.

The insignificant effect of trade openness reflects the complex nature of trade liberalisation in Sub-Saharan Africa. While greater openness may increase trade volumes, it is often accompanied by reductions in tariff rates resulting from regional integration agreements and multilateral trade commitments. The implementation of regional trade initiatives, including the African Continental Free Trade Area (AfCFTA), may further reinforce this trend by reducing customs duties while simultaneously expanding trade flows. The insignificant coefficient therefore suggests that the positive effects of increased trade volumes may be partially offset by declining tariff revenues.

Similarly, the absence of a significant effect of industrial value added may be explained by the relatively limited level of industrial transformation observed in many countries of the region. Industrial activities remain concentrated in a small number of sectors, often characterised by weak integration into regional and global value chains. Consequently, industrial expansion does not necessarily generate a proportional increase in revenues derived from international transactions. This result highlights the continuing dependence of many Sub-Saharan African economies on primary commodities and underscores the importance of structural transformation for broadening the fiscal base.

The findings suggest that digitalisation constitutes a strategic instrument for strengthening fiscal capacity in Sub-Saharan Africa. By improving customs administration, reducing information asymmetries, limiting opportunities for fraud, and enhancing the monitoring of cross-border transactions, digital technologies contribute to better mobilisation of revenues derived from international trade. However, the results also indicate that the effectiveness of digitalisation remains closely linked to broader institutional, infrastructural, and macroeconomic conditions, implying that technological investments must be accompanied by governance reforms, capacity building, and improvements in digital inclusion in order to fully realise their fiscal potential.

Table 4: Results of the Effect of ICT on Tax Revenues from International Transactions

VARIABLES	(1)	(2)	(3)	(4)	(5)
lnRFP(-1)	0.797***	0.903***	0.793***	0.770***	0.791***
	(0.0350)	(0.0480)	(0.0458)	(0.0382)	(0.0332)
TIC	0.698**				
	(0.284)				
LnFibreop		0.0637***			
		(0.0221)			
lnTelfixe			0.0615**		
			(0.0270)		
lnTelmobil				0.0819*	
				(0.0481)	
Internet					0.00835***
					(0.00204)
LnIDE	-0.0975***	0.0136	-0.0608	-0.105**	-0.0453
	(0.0205)	(0.0579)	(0.0445)	(0.0394)	(0.0279)
lnAPD	0.0800**	0.0565*	0.173***	0.0604	0.0997***
	(0.0297)	(0.0310)	(0.0325)	(0.0428)	(0.0330)

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Inflation	-0.0864***	-0.0116	0.368	-0.0869***	-0.0880**
	(0.0248)	(0.0335)	(0.247)	(0.0233)	(0.0422)
LnDO	0.0999	0.0690	0.212**	0.138	0.0141
	(0.0746)	(0.0603)	(0.100)	(0.0962)	(0.0925)
LnVAI	0.00155	-0.0446	-0.196*	-0.0247	0.0609
	(0.0658)	(0.0593)	(0.114)	(0.0848)	(0.0847)
Constant	1.986*	-0.670	0.403	1.721	1.445
	(0.976)	(1.554)	(0.923)	(1.087)	(1.083)
Observations	433	402	375	403	403
Countries' number	30	30	30	30	30
Instruments	22	22	22	22	22
ar1p	0.0729	0.0820	0.0909	0.0718	0.0759
ar2p	0.470	0.477	0.481	0.477	0.484
Hansenp	0.514	0.344	0.587	0.568	0.533

Source: Author's calculations using Stata 14. Standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

4.3.2. Presentation of Robustness Results

Robustness requires better assessment. We re-estimated results. An alternative technique was used. This is the instrumental variables method. Specifically, 2SLS was used. Control variables were added progressively. Table 5 presents results. These are robustness results. The 2SLS method estimated them. The table appears below.

Signs are consistent overall. These are coefficient signs. They match previous reports. Table 4 contained these. Specifically, the ICT index exhibits effects. These are positive effects. Individual indicators exhibit them too. These effects are statistically significant. The context is Sub-Saharan African countries. The outcome is customs tax revenues.

Table 5: Robustness Results Using the 2SLS Method

VARIABLES	LnRFP	LnRFP	lnRFP	lnRFP	lnRFP
TIC	3.933*				
	(2.360)				
lnFibreop		0.436**			
		(0.181)			
lnTelfixe			0.352*		
			(0.184)		
lnTelmobil				0.343*	
				(0.180)	
Internet					0.0283**
					(0.0134)
lnIDE	-0.360***	-0.476***	-0.363***	-0.411***	-0.243***
	(0.115)	(0.129)	(0.104)	(0.128)	(0.0554)
lnAPD	0.571***	0.447***	0.466***	0.381***	0.581***
	(0.0744)	(0.0496)	(0.0433)	(0.0636)	(0.0682)
Inflation	-0.947***	-1.104***	-0.898***	-0.972***	-0.990***
	(0.237)	(0.260)	(0.231)	(0.239)	(0.240)
lnDO	-0.0388	-0.221	-0.0666	-0.0307	-0.119
	(0.106)	(0.138)	(0.0987)	(0.106)	(0.0961)
lnVAI	0.208*	0.427***	0.310***	0.269***	0.289***
	(0.116)	(0.132)	(0.0884)	(0.0944)	(0.0908)
Constant	12.49***	13.77***	9.861***	11.84***	10.30***

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	(1.426)	(1.432)	(1.339)	(1.226)	(1.238)
Observations	533	497	533	533	533
R-squared	0.553	0.457	0.557	0.553	0.549
Rmse	1.694	1.849	1.686	1.693	1.701
chi2	704.9	549.9	712.4	706.3	700.5
Proba› chi2	0,0000	0,0000	0,0000	0,0000	0,0000

Source: Author's calculations using Stata 14. Standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Interpretation of Robustness through the Addition of Control Variables

Table 6 presents results. These are robustness results. The 2SLS method estimated them. The table appears below. Signs remain consistent overall. These are coefficient signs. They match Table 4 reports. The ICT index has effects. These are positive effects. Individual indicators have them too. These effects are statistically significant. The context is Sub-Saharan African countries. The outcome is customs tax revenues.

Table 6: Robustness Results with the Inclusion of Additional Control Variables

VARIABLES	(1)	(2)	(3)	(4)	(4)
lnRFP(-1)	0.733***	0.798***	1.078***	0.748***	0.730***
	(0.0331)	(0.0292)	(0.0458)	(0.0334)	(0.0425)
TIC	0.689***				
	(0.248)				
lnFibreop		0.0625**			
		(0.0246)			
lnTelfixe			0.0963***		
			(0.0249)		
lnTelmobil				0.0709*	
				(0.0372)	
Internet					0.0127***
					(0.00232)
lnIDE	-0.154***	-0.0744	0.0500	-0.135***	-0.0862**
	(0.0197)	(0.0477)	(0.0338)	(0.0419)	(0.0319)
lnAPD	0.0431*	0.0824***	0.0230	0.0788**	0.0712***
	(0.0248)	(0.0231)	(0.0307)	(0.0370)	(0.0152)
Inflation	-0.0649*	-0.0651***	0.0458**	-0.0834***	-0.0742***
	(0.0318)	(0.0181)	(0.0194)	(0.0194)	(0.0125)
lnDO	0.0449	-0.00504	0.356***	-0.109	-0.0306
	(0.0468)	(0.0494)	(0.0476)	(0.0684)	(0.0709)
lnVAI	-0.00780	0.0288	-0.284***	0.127**	0.0288
	(0.0394)	(0.0414)	(0.0449)	(0.0490)	(0.0453)
lnVASA	0.135***	0.0357	-0.132***	0.0639	0.147***
	(0.0347)	(0.0259)	(0.0266)	(0.0381)	(0.0479)
EFFIG	0.0582	0.00520	-0.207***	0.167***	0.0240
	(0.0761)	(0.0520)	(0.0542)	(0.0550)	(0.0761)
Constant	3.920***	2.228*	-3.795***	3.989***	2.615*
	(0.747)	(1.101)	(0.919)	(0.843)	(1.353)
Observations	433	402	375	403	403
Nombre de pays	30	30	30	30	30
Nombre d'instruments	28	28	28	28	28
ar1p	0.0741	0.0777	0.0940	0.0712	0.0736

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ar2p	0.472	0.484	0.451	0.487	0.490
Hansenp	0.348	0.229	0.433	0.909	0.391

Source: Author's calculations using Stata 14. Standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

5. Conclusion

This study set out to answer a straightforward but important question: does digitalisation help Sub-Saharan African countries collect more tax revenue from international transactions? Our answer, based on 31 countries over nearly two decades, is affirmative. Digitalisation and especially mobile telephony significantly boosts tax revenue from international transactions. This finding holds across different estimation techniques and after controlling for a range of macroeconomic factors.

What does this mean in practice? First, governments should prioritise the digital modernisation of customs administrations investing in electronic clearance systems, online declaration platforms, and cargo tracking tools at ports, airports, and border posts. Second, digitalisation's effectiveness depends on administrative capacity; so integrated information systems linking customs, tax authorities, and banks, plus better digital skills for staff, are essential. Third, trade, fiscal, and digital policies need to be better coordinated so that digital investments actually translate into sustainable revenue gains. Digitalisation is not a silver bullet. But when combined with good governance, adequate skills, and sound policies, it can be a powerful lever for strengthening fiscal capacity in one of the world's most challenging environments.

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Annexe

Échantillon de l'étude		
Angola	Kenya	Tanzania
Botswana	Lesotho	Togo
Burkina Faso	Madagascar	Uganda
Cabo verde	Malawi	Zambia
Cameroon	Mali	Zimbabwe
Central African Republic	Maurituis	
Cote d'Ivoire	Mozambique	
Republic of Congo democratic	Namibia	
Equatorial Guinea	Rwanda	
Ethiopia	Senegal	
Gabon	Seychelles	
Ghana	South-aFrica	
Guinea Bissau	Soudan	