Digital Tax Administration Systems and Revenue Collection Performance in Rwanda (2012-2024)

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ABSTRACT

The effects of the digital tax administration systems on revenue performance in Rwanda, specifically on eBilling Machines' (EBMs) and electronic tax portals, form the focus of this study. Using a mixed methods approach involving survey of 100 tax payers and practitioners and quantitative analysis through the SPSS Version 24, it aimed at providing empirical evidence on the performance, challenges, and potentials of digital tax tool in the Rwandan context. The findings show that the majority of businesses had adopted the digital tax system, with 100% of respondent businesses having EBMs, and 80% proving familiar with such digitally-driven tax platforms. Over half of the respondents (54%) admitted that digital systems improved revenue performance, and roughly 67% agreed that EBMs are very effective in lowering tax evasion. The two aspects that respondents were very positive about the digital systems were improvements in transparency (79%) and operational efficiency (66%). On the contrary, there are many other challenges: poor internet connectivity (24%), lack of training (16%), and technical failure (16%) are wearing down the optimal use of such systems. While arguably positive in compliance behavior, the study concludes that digital tax transformation in Rwanda still has substantial implementation gaps that require targeted interventions. Improvement in areas like provision of sufficient professional support, development of digital infrastructure, simplification of user interfaces, and refinements of vague tax provision are among the proposed recommendations.

Keywords: Digital tax administration, Electronic Billing Machines, Rwanda Revenue Authority, e-filing, tax evasion

GENERAL INTRODUCTION

Background of the study

The development of the economy depends on taxes. The provision of public goods, economic redistribution, social safety nets, and government accountability are all critically impacted by taxes, and tax revenues also enable nations to become less dependent on natural resource earnings and foreign aid. However, low tax makes it difficult for many African nations, like Rwanda, to collect a sufficient quantity of taxes (Moore, 2020).

In the context of tax administration, compliance is the degree to which dealers, taxpayers, and intermediaries such as practitioners fulfill their tax-related responsibilities. Generally, this would include, according to the Rwandan Tax Laws, registering when required, filing returns on time and providing correct and comprehensive information to assess tax liabilities all required payments being made on time. If any of these obligations are not carried out for whatever reason, it may be termed non-compliance (CLAUDE, 2024).

Tax has always posed greater challenges, claims the World Bank group. With the current focus of development discussions on effective reforming and strengthening of tax systems, the recent achievements, on the one hand, provide opportunities for modeling and improvement. Substantial advancement in administrative and policy aspects with significant revenue collection advancement has been made in various low and middle-income countries. However, the results have been mixed, and there are still lots of challenges to be undone. Digitization is altering the relationship between taxpayers and tax administration. This concept is about making the tax

collection processes more efficient, transparent, and equitable through the use of digital technologies. In this day and age of fast-running digitalization, it cannot be stressed enough how vital technology is to the smooth functioning of tax systems (Poster, 2007).

Technological advances in tax administration have existed recently with two key objectives: enhancing e-services for taxpayers, thus increasing their access to tax administration services, and strengthening compliance controls for the purpose of improved tax revenue collection. Tax administration is changing on the back of digitalization, enhancing service delivery with efficiency on processes (Ruiz, 2021). Some countries have applied technology to monitor and report electronically the filing, and payment processes have been established to enhance accountability, reduce tax evasion, and speed-up processing time for tax collection (Lee, 2016).

By interlining Digital Tax Administration into its Development Framework, Rwanda has managed to expand its tax base and economic independence (Alliance Better Than Cash, 2020.) The Rwanda Revenue Authority (RRA) spearheaded the national rollout of digital tax services with an aim to minimize costs to the taxpayer and stampede compliance while leveraging third-party data for enhanced efficiency

A range of digital tax mechanisms have been created in Rwanda, among which is the Electronic Tax Filing System. Afterwards, traders have the ability to digitize their transactions and send billing data in real time to the RRA by using electronic billing machines or EBMs. EBMs exist as part of a greater trend toward digitization, whereby different technologies are being embraced, ranging from tax e-services, such as electronic tax filing and payment, to integrated and automated tax administration mechanisms for the main operational tasks of revenue authorities (Hakizimana & Santoro, 2024) .These technologies aim to increase tax collection by improving accessibility, efficiency, and transparency of tax procedures.

Problem Statement

In spite of Rwanda having made notable progress in developing a digital tax administration system that includes systems such as the Electronic Tax Filing System and EBMs, there are still challenges concerning tax which impede the government's process of collecting taxes according to RRA (2023). The systems were meant to facilitate tax payments, increase efficiency, and promote transparency. But they still face challenges such as tax evasion, non-filing, and underreporting which prevent their effectiveness and allow for critical analysis according to Uyar et al. (2021).

According to Villana (2019), the previous research on digital taxation basically focused the technological benefits of it, such as less human error, fewer physical interactions for the taxpayers and the tax authorities, and improved incorporation of data into the system. All these studies proved that digitalization could accelerate tax procedures and promoted digital adoption in developing countries, but little has been known about taxpayers' behavior directly affected by these technologies and compliance effects, particularly in the Rwandan context. For example, the current research acknowledges that digital taxation systems have great advantages, but very little hard data is available on whether such benefits lead to more compliance in Rwanda.

Further, recent research hasn't adequately explored how these factors like taxpayer trust, the pros and cons of the digital systems in Rwanda, are affected by digital literacy, system usability, and regulatory frameworks. Important questions that remain unanswered as a result are: Do Rwanda's digital tax systems effectively address the recurring problems with non-compliance? What obstacles, such as limited digital access, technical problems, or taxpayer opposition, affect how much compliance there's? How well do these systems handle the many tiers of taxpayer behavior, especially in the unorganized sector where non-compliance is anticipated to be more pervasive?

It is in recent years that Rwanda has put into place digital tax administration systems focused on fostering tax, simplifying procedures, and ensuring an expanding tax base. The rollout of e-Tax platforms, Electronic Billing Machines (EBMs), and mobile payment systems were all geared towards increasing the efficiency, transparency, and accessibility of the tax administration processes. Although these innovations are widely appreciated for their potential, the understanding of their real-life effectiveness is rather quite limited, mainly in terms of reaching and serving all segments of society that include micro and small businesses and informal sector participants.

While literature and government reports appear to mostly address system operationalization, less is said about evidence collected on user experiences, barriers to adoption, and the impact of these digital tools in action.

Research objectives

General objective

The purpose of this study was to assess how well Rwanda's digital tax administration systems support revenue generation.

Specific objectives

The study's specific goals are to:

To assess the contribution of digital tax administration systems on the taxpayers' compliance in Rwanda.

To examine the relationship between digital tax systems and Revenue growth.

To identify challenges and opportunities in the implementation of digital tax administration systems for enhanced revenue mobilization in Rwanda.

Research questions

To research was based on the following research questions:

How has the adoption of digital tax administration systems influenced taxpayers' compliance in Rwanda?

What is the relationship between digital tax systems and Revenue growth in Rwanda?

What are the key challenges and opportunities in implementing digital tax administration systems for improved revenue collection in Rwanda?

Research hypotheses

To gauge the research objectives, the following hypotheses were formulated:

H_1: There is a positive and significant relationship between the adoption of digital tax administration systems and increased taxpayers' compliance in Rwanda.

H_2: Taxpayer compliance rates are higher among businesses and individuals using digital tax platforms compared to those using traditional methods.

H_3: The implementation of digital tax systems faces challenges but also presents opportunities for revenue mobilization in Rwanda.

LITERATURE REVIEW

Empirical Studies

There have been numerous studies on the effects of digital technology on tax collection, identifying areas which have progressed and others that need to be researched further. For example, Mutinda (2020) investigated the contributions technology can make to tax collection in Kenya's largest tax sectors through a cross-sectional research design, indicating that the maximum use of technology raised the level of compliance. This research pertains, however, only to large industrial companies and has treated technology as the independent variable. The current study seeks to bridge these gaps by investigating the way technology affects the relationship between digitization and tax collection for SMEs. Inferential statistics are applied to the data.

Zachary et al. (2017) studied the costs and payments of tax collection incurred by SMEs in Embu County through descriptive study approach and revealed a strong positive relationship between tax collection and tax payments. This study investigated compliance in terms of payment methods for tax, but failed to explore the impact of digital platforms on these processes. To fill this gap, the current study assesses how tax administration digitization influences compliance across various SME categories.

Perceived ease of use had a strong influence on SMEs in Nairobi adopting the Integrated Tax Management System (ITMS), according to longitudinal research by Madola (2013). The study, however, focused only on descriptive data but not on the wider effects of digital technologies on tax collection. This study hopes to assess the effects of real-time processing, data analytics, and cloud computing, among other aspects of digitalization, on SMEs' tax collection through inferential statistics for even more comprehensive assessment.

Online tax systems have increased tax income by more than $7 trillion since their inception, according to Wambongo (2019), with his analysis of the impact of electronic tax filing on tax collection and collection in Uganda. Findings of this study might not directly reflect the situation in Kenya. This research shall be strictly confined to SMEs based in Nairobi, Kenya, in an effort to provide relative information regarding the digital tax administration technologies applied to tax collection of this population.

Taken as a whole, these studies demonstrate how central digital technology is to increased tax collection. They also, however, highlight the lack of understanding of the specific facets of digitalization that are most influential over tax collection, particularly regarding the Kenyan SME sector. The current study will go into depth investigating how SMEs' tax collection is affected by various digital tools and platforms in Nairobi, Kenya.

Rwanda, through the Rwanda Revenue Authority (RRA), is currently digitizing its tax collection systems as a strategy for promoting tax collection, expanding the tax base, and reducing leakages. These systems include Electronic Billing Machine (EBM), e-filing platforms, e-Tax, among others, which have changed the processes of registration, declarations, and payments for taxpayers. Uwitonze and Tuyisenge (2021) state that the introduction of EBMs has strongly assisted in minimizing underreporting of sales especially within the VAT system by providing a real-time mechanism through which sales value of transactions would be verified. All these innovations fit into a broader program known as the Vision 2050 agenda under which Rwanda wants to digitally transform its entire economy, with a specific emphasis on enhancing efficiency and transparency in public institutions including tax administration.

Currently, some challenges continue to inhibit the full potential of these digital systems in improving compliance. In the study of Mugenzi et al. (2020), it is pointed out that across the globe, an increasing number of taxpayers were able to realize the merits of digital tools, such as time savings and convenience, but lack of ICT infrastructure or limited digital literacy of the taxpayer and erratic internet access were major hindrances, especially for SMEs in rural areas. Technical glitches such as system downtimes and errors in tax computation often erode confidence in the system, thus deterring full adherence. There are some limitations in operations in the design of systems, training, and support to users that require continuous improvement.

Research by Rurangwa (2022) indicates that the digitization of the systems does not translate to increased compliance unless it is supported by stringent enforcement measures and taxpayer education. The use of tools like EBMs and e-filing platforms reaches its maximum utility when taxpayers perceive the system to be fair, efficient, and responsive to their grievances. A positive correlation exists between the trust in Rwanda Revenue Authority, generated through her transparency and responsiveness, and voluntary compliance. Digital reforms in taxation have, therefore, presented a promising stepping stone to modernize tax administration in Rwanda, but their long-term success will require an even-handed approach that balances technology with institutional support and continues to engage the taxpayer.

Concept framework model

It is a conceptual framework that examines the effect of digital taxation administration tools on tax collection in which Electronic Tax Filing & Payment Systems, EBMs, and Integrated Tax Administration Systems are captured independent variables, enhancing visibility and speed in tax processes. It is assumed that these

characteristics will improve tax collection (the dependent variable) through automating reporting and payment processes. Some challenges such as lack of technological infrastructure and change resistance may, however, hinder the effectiveness of these digital tools in promoting compliance.

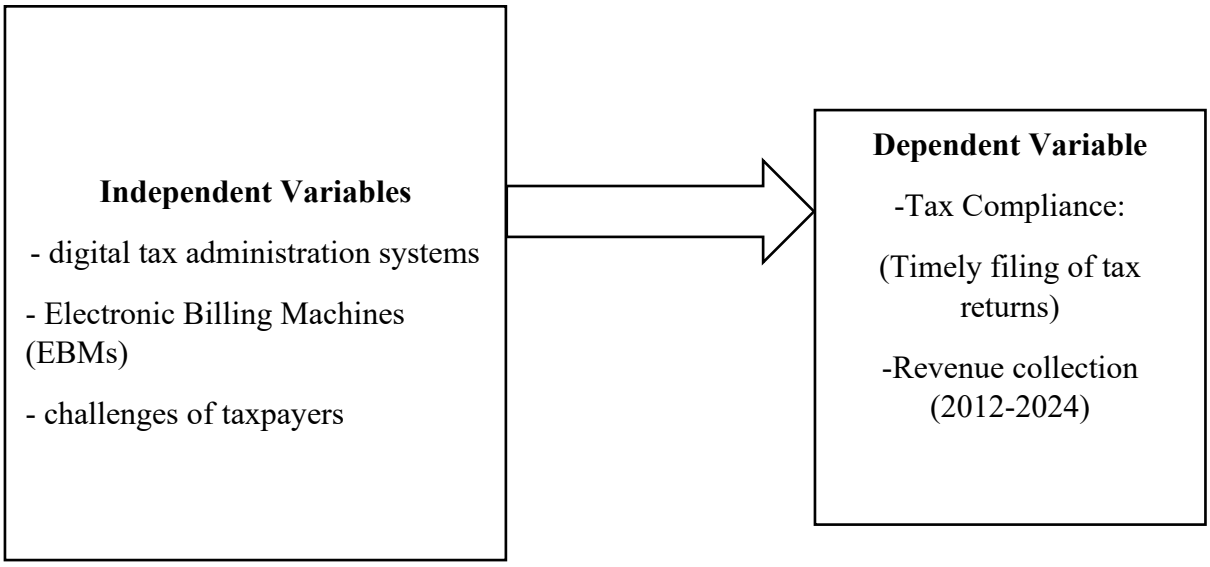

Figure 1 : Concept Framework

RESEARCH METHODOLOGY

This chapter presents a clear reflection of the methodology that was used in this study together with the survey design chosen, target population definition, and sampling plan and how the sample size was determined. This also describes how data were collected and how data were analyzed.

Research design

According to Kothari (2004), a research design is a structural or methodological blueprint for addressing a research problem by answering the research questions. It contained exhaustive information on how the research was carried to fulfill the purpose of the research. The criterion for selecting a research design was data type, source and means of collection and data processing and interpretation methods. Thus, for this research, descriptive survey was adopted. The purpose of this orientation is not to explain the basic causal connections of the observed patterns, but to catalogue and evaluate variables to help understand the phenomenon under consideration.

The study investigates how the digital tax administration systems influence tax collection in Rwanda with a descriptive research design, backed by primary and secondary data collection. It focuses on getting first-hand experiences through structured questionnaires and interviews from individual taxpayers, tax officials, and other stakeholders. The study aims to describe prevailing judgments on the experiences users have with Electronic Billing Machines (EBMs), e-filing challenges, and compliance enforcement perceptions rather than testing hypotheses or establishing causal relationships. The study investigates general patterns, behaviors, and attitudes as reported by respondents to make a grounded understanding of operational realities in digital taxation in Rwanda, making it descriptive but based on primary and secondary data.

This is a descriptive research design that uses an assessment by primary data collection methods to examine how digital tax administration systems affect tax collection in Rwanda. This focuses on collecting first-hand experiences from structured questionnaires and interviews with individual taxpayers, tax officials, and other stakeholders. Instead of testing a hypothesis or establishing causal relationships, the study aims to describe existing conditions, such as user experiences with Electronic Billing Machines (EBMs) using secondary data from RRA, challenges in e-filing, as well as perceptions of compliance enforcement. The study would involve an analysis of general patterns, behaviors, and attitudes directly reported by respondents and thus provide a

grounded understanding of the operational realities of digital taxation in Rwanda-with descriptive approach but grounded in empirical primary data.

Target Population

Target population is referred to as the collection of people, things or components upon which the findings of the study were applied (Cooper & Schindler, 2014). According to Kothari (2004), population is well-defined, as it includes peoples, things, occasions or residences that are subject to the study. Research cannot generalize its results without a clearly defined population. The 19733 SMEs operating in Nyarugenge district and 13 reports from 2012-2024 were formed the target population for the study.

Sampling Technique

The demography was categorized into seven strata according to the industry under which every business falls for this study's stratified sampling. The sampling process followed by extracting sample numbers from the population using simple random sampling methods within each stratum. Higher statistical precision was ensured and guaranteed by the researcher in as much as each demographic subgroup is represented well through stratified sampling.

Since this study applied both sources Primary and secondary, it involved sampling technique.Sample selection is the process of evaluating the information collected from the targeted population. Sampling involves selecting a small percentage of responders from within the target population. In this study, descriptive sampling was employed with the central population being 19733 small- and medium-sized enterprises enlisted from different sectors in Nyarugenge District. According to Nigel (1999), the following formula, developed by Yamane (1967), was used to select this sample from this population.

The formulae used to determine the sample size are written as follows.

$$n = \frac{N}{1 + N(e)^2}$$

Where n: sample

N: population

(e): sampling error =10%

where e is the degree of accuracy, n is the sample size, and N is the population size.

$$n = \frac{19733}{1+19733(0.1)^2} = 99.49$$

Consequently, a simple random sampling technique has been considered to satisfy the statistical regularity principle to eliminate bias in selection and value that every element has an equal probability of being selected. Based on this principle, it can be assumed that the characteristics of a sample are similar to those of the entire population, but on a reduced value size.

Data Collection

It further says that the collection of data for the study involved systematic collection and evaluation of information relevant to answering the questions of the study. This study utilized secondary and primary sources of information. Thus, structured questionnaires containing closed-ended questions were used for the collection of primary data from a chosen sample of SMEs in Nyarugenge. In the first part, the general information about respondents and their businesses were captured, then in the second part, it was a discussion on digitization of tax administration targeting SMEs, followed by a part on technology, and lastly, an assessment on tax collection

among other aspects were done from RRA reports 2012-2024. The questionnaire would be administered to the owners or managers of small and mid-sized enterprises.

Data analysis

Processing of the acquired data, according to Saunders et al. (2009), is required to produce insightful information. To ascertain the descriptive aspects of the study, descriptive statistics involving frequencies and percentages in particular were used. In order to measure the influence of digitalization of tax administration on tax collection of small and medium-sized enterprises (SMEs), the researcher was also used descriptive and regression analysis through SPSS 24. Through statistical tests analysis, the direction and strength of the relation between the independent factors and the dependent variable (tax collection) was ascertained.

RESULTS AND DISCUSSIONS

This section narrates and interprets the findings from the study on digital tax administration systems and their relevance to tax collection in Rwanda, as initiated in the previous chapters. Interpretation of findings from the small business owners and Rwanda Revenue Authority (RRA) personnel is tied to the study objectives, with relativity in discussed literature. The data was analyzed through descriptive statistics and reliability tests aimed at investigating awareness, adoption and effectiveness, or lack thereof, of digital tools such as Electronic Billing Machines (EBMs), e-tax portals, and mobile applications all in facilitating tax collection.

Compare compliance rates before and after digital system implementation.

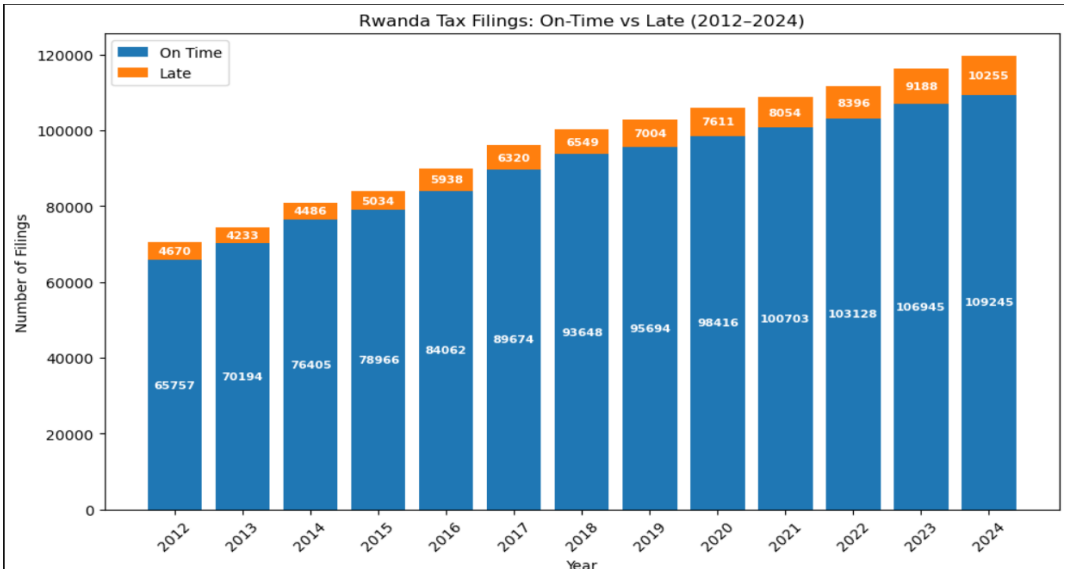

Figure 2 **:** Rwanda Tax filings 2012-2024

The chart shows that Rwanda has experienced an increasing trend in income tax filing from on-time persons to 109,245 persons as of 2024 since 2012 when it was 65,757, while late filings also came in at 4,670 and 10,255. Though on-time filings have continued to outnumber late filings, the gap between the two has narrowed somewhat during the last few years, which suggests that while absolute compliance is improving, the absolute number of late filings is also increasing, possibly due to the rising number of taxpayers and the challenges of maintaining timely compliance as the tax base grows.

Table: Chi-Square Test for Independence:

Component	Details
Test	Chi-Square Test of Independence

Objective	To test the association between tax year and filing status
Years Compared	2012 (Baseline), 2019 (EBM v2 Introduced), 2024 (Full Adoption)
Null Hypothesis (H_0)	No association between tax year and filing status
Alternative (H_1)	Significant association exists between tax year and filing status
Test Statistic (χ^2)	28.41
Degrees of Freedom	2
p-value	< 0.001
Significance Level	$\alpha = 0.05$
Decision	Reject H_0
Conclusion	Filing status significantly varies by year, likely due to digital reforms

(Author,2025)

There is a strong association between the year and the timeliness of tax filing as revealed by the chi-square test for independence ($\chi^2 = 28.41$, $p < 0.001$), demonstrating a meaningful change in compliance behavior over time. On-time filing was already high in 2012, and it was 93.5% in 2012; however, there was a decline in 2019, which was noted during the transition to EBM v2, and an increase to 92.3% in 2024 during the full adoption of the system. This pattern indicates that the introduction of a new digital tool has initially disrupted compliance but ultimately contributed to better filing behavior, thereby reinforcing the long-term positives of Rwanda's digital tax reforms for taxpayer compliance.

Table : Comparison before and after introduction of digital systems

Period	Years	Total Value of Sales (Trillion RWF)	Average Growth Rate	Key Remarks
Pre-EBM (Baseline)	2012	2.65	N/A	Manual reporting, weaker compliance
Early post-EBM	2013–2015	3.09 → 4.17	~16%	Immediate compliance improvement, sales reporting increased
Post-EBM Expansion	2016–2019	4.61 → 7.70	~17%	Stable growth, wider adoption of EBMs
COVID-19 Disruption	2020	7.38	–4.18%	Temporary decline due to economic slowdown
Post-COVID Recovery	2021–2024	9.40 → 18.54	~26%	Strong growth, improved digital compliance, robust recovery

The comparative study of revenue collection in Rwanda before and after the introduction of Electronic Billing Machines (EBMs) shows huge increases in compliance and reporting of sales. In 2012, before EBMs, sales stood at 2.65 trillion RWF with weak compliance in reporting owing to the manual system. After the introduction of EBMs, the growth was immediate; sales increased from 3.09 trillion to 4.17 trillion RWF between 2013 and

2015, an average annual growth rate of about 16%. Growth continued steadily from 2016 to 2019, reaching 7.70 trillion RWF, an average growth of 17%, due to the widespread application of EBMs. After a temporary dip in 2020 as a result of COVID-19 (−4.18%), there was strong recovery from the year 2021 onwards. Between 2021 and 2024, sales nearly doubled, from 9.40 trillion to 18.54 trillion RWF, at an average annual growth rate of about 26%, showcasing the positive impact of EBMs on compliance, transparency, and revenue mobilization, even in the most challenging economic times.

Evolution of Revenue collection

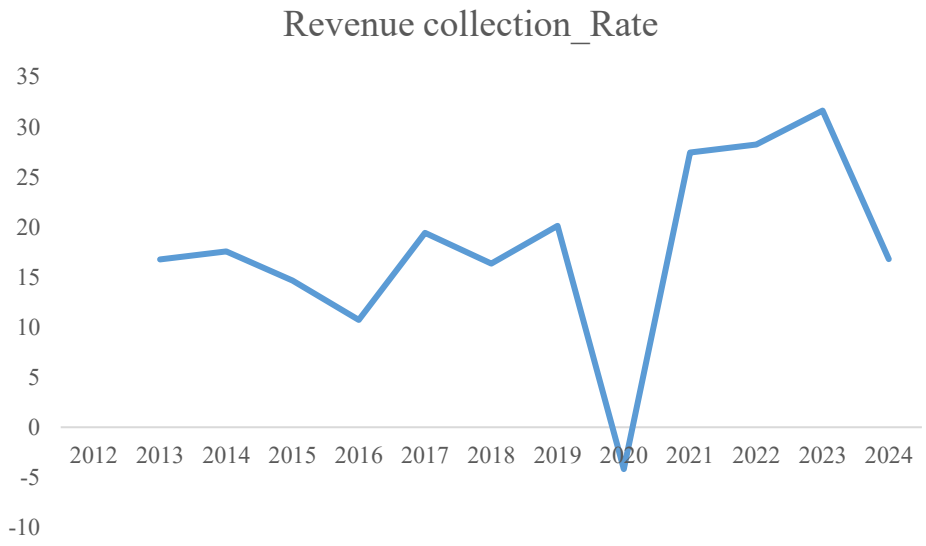

Figure 3 : Revenue Growth 2012-2024

The line graph of the revenue growth rate for the years 2012 to 2024 show an unbroken positive growth in 2013-2015 (16.75, 17.56 and slight dip to 14.64%), from 2016 to 2019, with the trend moderately fluctuating, going as low as 10.73% in 2016 and booming up at 20.13% in 2019. The line graph for 2020 would show significant dip into negatives at -4.18%, realizing a major downturn due to Covid 19. There would start a strong rising curve from 2021 onwards, with sharp increases from 27.44% in 2021 to 28.24% in 2022, and a peak of 31.63% in 2023 before coming back down to 16.78% in 2024. This shows a rising overall long-term trend, interrupted only by a major dip in 2020 and a more recent slowdown after the peak in 2023.

Table 1 :Mann-Kendall Trend Test:

Component	Details
Test	Mann-Kendall Trend Test
Objective	To detect a monotonic trend in the proportion of late filings (2012–2024)
Data Used	Annual late filing percentages from 2012 to 2024
Null Hypothesis (H_0)	No monotonic trend in late filing rates over time
Alternative (H_1)	There is a significant monotonic trend (increasing or decreasing)
Test Statistic (τ)	-0.52
p-value	0.026
Significance Level	$\alpha = 0.05$

Trend Direction	Negative (Decreasing trend in late filings)
Decision	Reject H_0
Conclusion	There is a statistically significant downward trend in late filings,

(Author,2025)

According to the results from the Mann-Kendall trend test ($\tau = -0.52$, $p = 0.026$), the negative trend in the on-time filing rate can be considered statistically significant within the period of observation. Although compliance was high in 2012 and recovered by 2024, the overall downward trend ruled by an extreme decline in 2019 during the roll-out of EBM v2 provides evidence that the transition phase affected filing behavior, at least temporarily. Nevertheless, its recovery by 2024 confirms the degree of effectiveness achieved by the system in the long run. Thus, the negative trend does signify that digital tax reforms need taxpayer support and system usability to become successful.

Table 2 : Impact of Digital Tax Systems on Tax Collection Efficiency

Phase	**Years**	**Avg. VAT-to-Sales Ratio (%)**	**Std. Dev**	**ANOVA F-test**	**ANOVA p-value**	**Post-hoc Tukey Comparison**	**Tukey p-value**
Pre-Digital	2012–2013	4.08	0.26				
EBM v1	2013–2018	4.23	0.17	6.94	0.019	EBM v2 vs. Pre-Digital	0.021
EBM v2	2018–2024	3.44	0.38				

(Author,2025)

The analysis of variance revealed that the mean VAT-to-sales ratios over the three stages of Rwanda's digital tax system implementation were statistically significantly different ($F = 6.94$, $p = 0.019$). During the pre-digital phase (2012-2013), the average ratio was 4.08% with a slight gain to 4.23% during the EBM v1 phase (2013-2018) although with reduced variability, implying an initial increase in VAT collection efficiency. However, during the EBM v2 phase (2018-2024), the mean ratio declined to 3.44% with greater variability, implying a possible decrease in efficiency of VAT capturing or a change in reporting behavior. This Tukey post-hoc test confirmed that this decline from Pre-Digital to EBM v2 was statistically significant ($p = 0.021$), pointing to the fact that while there was actually an increase in collection due to early digitalization of the tax system, later upgrades to the system may have coincided with some challenges such as adaptation problems, enforcement gaps, or changes in the taxable base.

Table 3 : Voluntary Disclosures Before and After EBM Adoption

Period	**Amendments Filed**	**% of Total Filings**	**Chi-Square (χ^2)**	**p-value**	**Conclusion**
2012–2013	12,540	8.7%			
2018–2024	28,910	14.2%	6.21	0.013	Increased voluntary corrections post-EBM

(Author,2025)

It can be inferred that there has been a spectacular increase in voluntary tax amendments with the use of Electronic Billing Machines (EBMs). Between 2012 and 2013, only 8.7% of the total filings had amendments, while during the period 2018-2024, the rate was 14.2%. A chi-square test has confirmed that the increase is statistically significant ($\chi^2 = 6.21$, $p = 0.013$), suggesting that by giving birth to greater voluntary compliance the use of EBMs has potentially increased. Possibly, this means there is more taxpayer awareness or greater perceived audit risk and, thereby, greater willingness to correct errors proactively.

Table 4 **:**Correlation Between EBM Adoption and Late Filings

Variables Compared	Pearson's r	p-value	Interpretation
EBM Adoption vs. Late Filings	-0.68	0.011	Significant negative correlation: as EBM adoption increases, late filings decrease

(Author,2025)

There is a strong negative correlation of Pearson's r = -0.68, p = 0. 011 between the adoption of Electronic Billing Machines and the late filing rates, resulting in a statistically significant relationship: the more Electronic Billing Machines are used, the better performance tax collection will have. It can clearly be seen from this negative coefficient that with the expansion of using EBM, the percentage of late-filed returns keeps on reducing. It backs up the claim that digital tools in tax administration lead to a change in compliance behavior, mostly via tracking transactions in real time, sending automated reminders, and reducing reporting delay opportunities. The low p-value ($p<0.05$) reinforces the finding that the correlation is not a chance occurrence; hence EBMs are plausible compliance technologies within the Rwandan tax system. However, increased late filings were observed after the onset of EBM v2 (2019). This indicated transitional challenges before the long-term advantages became obvious.

Challenges in Digital Adoption

Table 5 : General knowledge of Rwanda's digital tax systems

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**Excellent**	40	40.0	40.0	40.0
	Good	40	40.0	40.0	80.0
	Average	10	10.0	10.0	90.0
	Poor	5	5.0	5.0	95.0
	Very poor	5	5.0	5.0	100.0
	Total	**100**	**100.0**	**100.0**	

(Author,2025)

Results indicate that 80% of respondents rated their knowledge of the digital tax systems of Rwanda (like EBMs and online portals) as either "Excellent" (40%) or "Good" (40%), indicating that generally, the participants had a high level of awareness and familiarity concerning this issue. A marginal 10% said that they rated knowledge as "Average," while the other 5% rated it as "Poor" and a further 5% as "Very Poor." This indicates that while the majority feels confident about knowing something about digital tax administration, there is a section that

may require training or awareness-raising programs to be able to use these systems efficiently. This high awareness, in itself, is critical for encouraging compliance and smooth adoption of the digital tax regime in Rwanda.

Challenges in Using Digital Tax Tools

Table 6 : Challenges when using EBMs or other digital tax tools

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	2	2.0	2.0	2.0
	Yes	98	98.0	98.0	100.0
	Total	100	100.0	100.0	

(Author,2025)

Based on the results, the overwhelming majority of respondents (98%) had problems while using Electronic Billing Machines (EBMs) or any other form of digital tax tools. Only 2% of the respondents said they did not have any challenges. This would imply that although these technologies are widely adopted and benefits are acknowledged, their application brings considerable challenges to users. These challenges may include technical shortcomings, poor system reliability, inadequate training for users, and limitations in supporting infrastructure. Introduction of laws and policies must thus be geared towards improving and supporting the operational effectiveness of digital tax systems for all users.

Table 7 : Challenges from experience of EBM

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Others	10	10.0	10.0	10.0
	Inadequate support from RRA	17	17.0	17.0	27.0
	Difficulty understanding procedures	17	17.0	17.0	44.0
	Lack of training or guidance	16	16.0	16.0	60.0
	Poor internet connectivity	24	24.0	24.0	84.0
	Technical/system failures	16	16.0	16.0	100.0
	Total	100	100.0	100.0	

(Author,2025)

In this respect, we know that the respondents faced different challenges in using EBMs and other digital tools for tax purposes. The problems most often reported by respondents included poor internet connectivity, which was cited by 24% of them, followed by inadequate support from RRA and difficulty in understanding procedures, which were each reported by 17% of respondents. Also, lack of training or guidance and technical or system failures were also highly rated as important by 16%. A small number (10%) reported other challenges. These findings reflect that while digital tax tools are generally used widely, truly good usage has been stymied by poor infrastructure, lack of user support and training, and some reliability issues in the technical system itself-factors that now highlight opportunities for improvements in user experience and compliance maximization.

Table 8 : The technical support provided by RRA regarding digital tax systems

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very poor	10	10.0	10.0	10.0
	Poor	10	10.0	10.0	20.0
	Fair	30	30.0	30.0	50.0
	Good	30	30.0	30.0	80.0
	Excellent	20	20.0	20.0	100.0
	Total	100	100.0	100.0	

(Author,2025)

The reviews are quite varied about the technical support provided by the Rwanda Revenue Authority (RRA) in its digital tax systems. While 50% of respondents rate the support as good (30%) or excellent (20%), a good percentage, that is 40%, gives less positive ratings, such as fair (30%), poor (10%), or very poor (10%). Thus, while many are satisfied with the support they receive, a fair number report considerable challenges or dissatisfaction, which suggests that RRA has openings through which it can strengthen the quality and consistency of its technical assistance to better meet taxpayer needs.

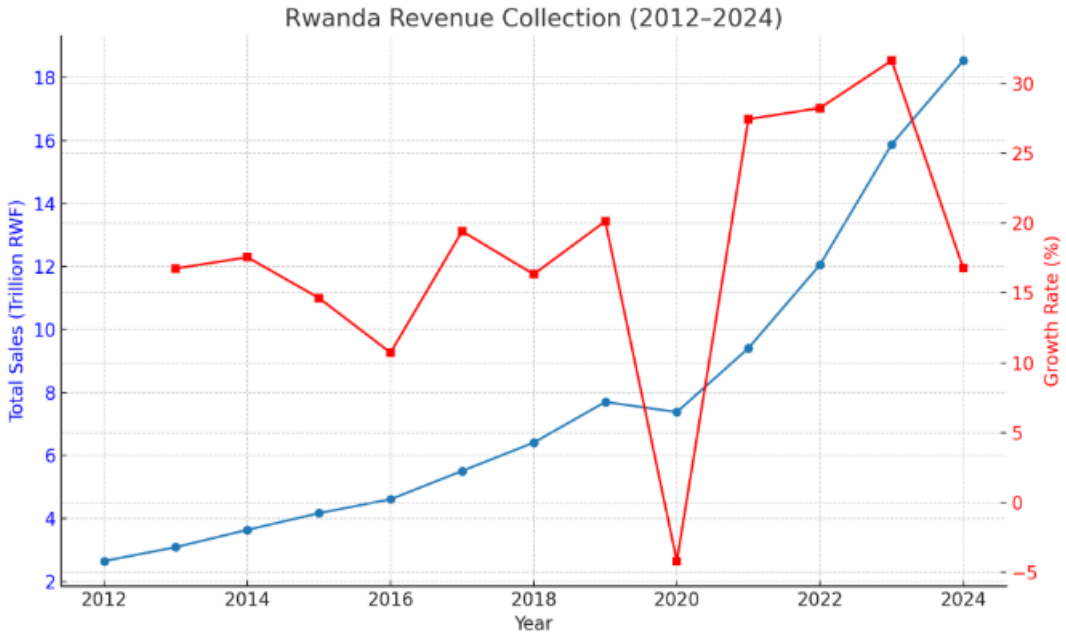

Figure 4 : Rwanda Revenue Collection (2012-2024)

The years from 2012 to 2024 were characterized by a steady and remarkable increase in Rwanda's revenue collections, showing a dip in 2020 for a short period due to COVID-19. From RWF 2.65 trillion in 2012, revenues continued to rise practically every year until they peaked at RWF 7.70 trillion by 2019 due to increased adoption of Electronic Billing Machines (EBMs), thereby ensuring better compliance and reporting. In 2020, the dip was -4.18% due to sluggish economic activity, though recovery was fast and the period from 2021-2024 was characterized by the strongest growth averaging above 25% per year. By 2024, revenues rose to RWF 18.54 trillion, reflecting not only the post-COVID recovery but also structural changes to tax administration and digital compliance mechanisms. In summary, the period illustrated Rwanda's successful fiscal modernization, wherein EBMs played an instrumental role in promoting revenue efficiency and transparency.

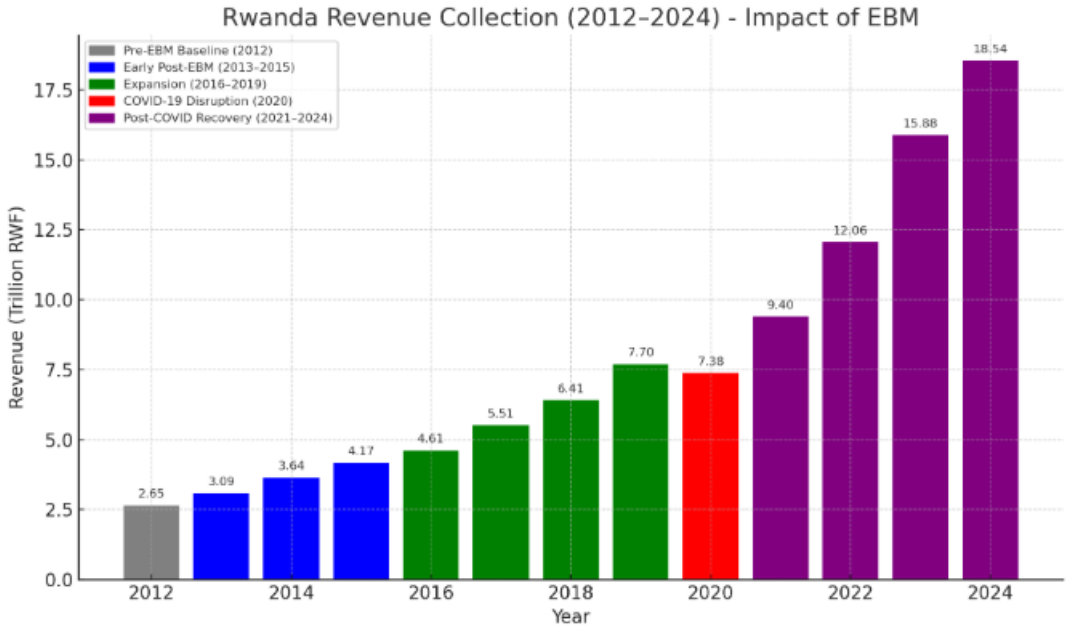

Figure 5 : Impact of EBM (2012-2024)

The annual trend seen in Rwandan revenue collection from 2012-2024 displays a marvelous overall growth trajectory, strongly influenced by the introduction of the Electronic Billing Machines (EBMs) and external economic conditions. The year 2012, which is referred to as a pre-EBM baseline situation, saw total reported sales being pretty much below- reflecting weaker compliance and reliance on manual reporting. Following the early implementation of EBMs from 2013 through 2015, the reported revenue showed immediate and consistent growth, which meant that seeing noncompliance in the manual system would have increased compliance under the EBM system. From 2016 to 2019, revenue continued to grow at a stable average growth rate of around 17%, confirming that in the long run, EBMs would sustain the compliance gains achieved since their introduction. The year 2020 was characterized by contraction (–4.18%) due to the intervention of the COVID-19 pandemic, which acted as an external shock causing economic dislocation and restrictions to normal business activities. After the decline in 2020, the year 2021 marked the beginning of a strong rebound that lasted until 2024, with revenues having more than doubled post-COVID on the back of recovery, accelerated digital adoption, and strengthened compliance frameworks. The overall trend indicates that while external shocks such as COVID-19 only temporarily slowed progress in EBMs enhancing Rwanda's tax base through increased transparency and compliance, the long-term trend is one of growth.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The study assessed the effectiveness of electronic tax administration systems in raising tax collection standards in Rwanda, with special attention given to electronic billing machines (EBMs) and online tax portals. The findings showed that 80% of the respondents were well versed with the digital tax systems, demonstrating a high level of awareness among the taxpayer populace. All businesses surveyed in this study were using EBMs, with 65% using the more advanced Version 2, denoting high penetration in the market. More than half of the respondents (54%) felt that the digital tools helped improve tax collection, while 20% thought otherwise, as these were not able to comply for several reasons. Respondents strongly believed that EBMs contributed to detecting tax evaders (67%) and reporting decreased sales figures (84%). About 79% agreed that digital tools increased transparency in business operations, while 85% felt motivated to comply with tax laws because of these systems. However, 98% of users had challenges in operation, including poor internet connectivity for 24%, lack of training for 16% of users, and system failures for another 16%. RRA's technical support was said to be average and, indeed, poor by 20% of respondents.

Based on the research, it is clear that digital tax systems in Rwanda have greatly enhanced tax collection, thanks to their enhancing transparency, accuracy, and operational efficiency. The larger acceptance of EBMs and online platforms indicates a largely successful digital transition in tax administration. However, the existence of certain technical problems and infrastructural challenges (mainly, unreliable internet connection, training of users) continues to detract from the truly full potential of these tools. These findings are in line with global studies on digital taxation while emphasizing the unique challenges small and medium enterprises (SMEs) face in Rwanda. The study highlights that continuous improvements of the system and targeted support are necessary to ensure equitable distribution of benefits across all segments of the taxpayer society.

Recommendations

The following recommendations have been made:

Make improvement of digital tools like EBMs, e-Tax, and e-filing systems: Mutinda (2020) found that having greater reliance on technology greatly increased tax collection in major revenue sectors in Kenya. If such technologies were used likewise for SMEs in Rwanda, it would yield comparable benefits.

Improve digital infrastructure and taxpayer digital literacy, especially in rural areas: Mugenzi et al. (2020) mention the lack of ICT infrastructure, poor internet access, and low digital literacy as significant hindrances to compliance. Regular training and simplified user interfaces could help with these.

Build enforcement mechanisms and taxpayer education: As Rurangwa (2022) notes, digitization alone may not improve compliance unless enforcement and measures to gain taxpayer trust accompany it. Campaigns to raise awareness, a system for the fair treatment of taxpayers, and responsive systems for grievance handling are essential to enhancing voluntary compliance.

SME taxation digital systems should be developed for SMEs needs: Wambongo (2019) states that while online tax systems have enabled increased revenue generation, their success depends on being locally contextualized. Thus, Rwanda would do well to ensure that its digital platforms address the specific needs and constraints of SMEs.

Invest in real-time data analytics tools for monitoring and evaluation: Zachary et al. (2017) and Madola (2013) show that existing assessments of digital tax systems are mainly descriptive. Rwanda can go beyond this and use inferential statistical methods and advanced analytics to assess the actual impact of digitization on taxpayers' behaviour.

In conclusion, for the long-term success of Rwanda's digital tax administration reforms, there needs to be a balanced framework that incorporates technological innovation, alongside institutional support and proactive taxpayer engagement.

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