

Increasing Tax Collection in African Countries

The Role of Information Technology

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Abstract

Many African countries struggle to collect an adequate amount of tax revenue to support needed investments in public services. This paper examines how African countries may take advantage of recent advances in technology to improve tax administration. It provides an overview of the potential and challenges of different tax categories in Africa: consumption taxes, real estate taxes, trade taxes, and

income taxes. It then describes the ways in which technology solutions may be deployed to address these challenges by helping to identify the tax base, monitor compliance, and facilitate compliance. Lastly, it provides insights from interviews with senior tax administrators across the continent on their practical experiences in adopting technology for taxation.

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Increasing Tax Collection in African Countries: The Role of Information Technology*

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1 Introduction

Taxes are important for economic development. Taxation lies at the crucial intersection between the provision of public goods, income redistribution, social safety nets, and government accountability. Tax revenues also allow countries to be less reliant on foreign aid and natural resource revenues. However, many African countries struggle to collect an adequate amount of taxes.

This paper examines how African countries may use recent advances in technology to improve tax administration. While digital transformation across different sectors has been occurring over the last few decades, the surge in remote work experiences and the need for social distancing precipitated by COVID-19 has accelerated the adoption of many technologies that already existed and spurred the development of others. As different sectors of government adopt technology solutions to increase efficiency and improve service delivery to citizens, tax administration presents an important application.

The paper begins with an overview of the challenges faced by African economies in maximizing key tax categories: consumption taxes, real estate taxes, trade taxes, and income taxes. It then describes the ways in which technology may be deployed to address these challenges. In particular, it applies the framework in Okunogbe and Santoro (forthcoming) to each of these tax categories to examine how technology may be used to define compliance, that is to identify the tax base; to monitor compliance, that is, to detect evasion when it occurs; and to facilitate compliance, that is, to make it easier for people to comply with their tax obligations. It combines an overview of the literature with case studies highlighting specific country examples. As a unique feature, the paper concludes with insights from interviews with senior tax administrators across the continent on their practical experiences and challenges in adopting technology for tax administration.

1.1 Features of Taxation in Africa

Tax collection in Africa is low, but similar to other regions at a similar income level (Figure 1). In 2018, the most recent year with wide data coverage, Sub-Saharan African countries collected 14 percent in taxes as a share of GDP (UNU-WIDER Government Revenue Dataset, 2021). This continent-wide average masks significant variation across countries. High- and upper-middle-income countries like Seychelles, Namibia and South Africa have rates as high as 28 - 33 percent whereas low-income countries like Chad, Democratic Republic of Congo and Ethiopia have rates as low as 7 percent. These numbers have remained stagnant over the last 3 decades, with African countries collecting an average of 12 - 15 percent of GDP as taxes from 1990 to 2020. Both the South Asia region and the Middle East and North Africa region have similarly low rates as Sub-Saharan Africa of about 14 percent. In contrast, the Europe and Central Asia region has the highest rate of 32 percent (UNU-WIDER Government Revenue Dataset, 2021). Across all countries, on average, higher income countries collect a higher share of GDP as taxes.

The composition of taxes in Africa is also roughly similar to that of countries at similar income levels. Figure 2 presents evidence on the reliance of countries on different tax instruments: taxes on consumption, personal income, corporations, payroll, trade and property. As in almost all regions, the greatest component of taxes in Sub-Saharan Africa is consumption taxes (49 percent), which consist of sales tax, value added taxes and excise taxes. Some striking differences of African countries, even compared to countries at a similar income level, are that African countries collect a minimal amount in payroll taxes, possibly a reflection of the low share of the economy employed in the formal sector.¹ In contrast, African countries collect more trade taxes than countries at a similar income level.

With regards to tax rates, the tax rate on income, profits and capital gains in African countries range from 3 percent to 48 percent. On average, African countries have a higher

¹According to Medina and Schneider (2018), the shadow economy amounted to about 40 percent of Sub-Saharan Africa's GDP in 1991-2015, compared to 17 percent of OECD countries' GDP.

tax rate on income, profits and capital gains, compared to other countries, even those at similar income levels (Figure 3a). However, Value Added Tax (VAT) rates, which range from 5 percent to 20 percent across the continent, are comparable to other countries with an average rate of 15 percent (Figure 3b).

Taxpayers in Africa face higher tax compliance costs, even compared to countries at similar income levels. Figure 4 presents how much time, measured in hours per year, firms spend preparing and paying three major types of taxes: the corporate income tax, the value added or sales tax, and labor taxes, including payroll taxes and social security contributions. African countries spend on average 273 hours per year on taxes, a greater burden than the average of 220 hours in other regions (World Development Indicators, 2018).²

Tax administration patterns in African countries feature lower reliance on technology and greater reliance on manual systems and in-person interactions between taxpayers and tax collectors. In African countries, 72 percent of firms report being required to meet with tax officials, and for those affected, 3.2 meetings are held on average each year (World Bank Enterprise Surveys, 2010-2020). In contrast, 37 percent of firms in Europe and Central Asia are required to meet with tax officials and of those affected, 2.1 meetings are held on average. The high frequency of meetings is also correlated with corruption indicators in taxation. On average, 17 percent of firms in Sub-Saharan Africa report that they are expected to give gifts in meetings with tax officials. However only 7 percent report the same in Europe and Central Asia. Similarly, 28 percent of firms in Sub-Saharan Africa cite tax administration as a major constraint, compared to 16 percent in Europe and Central Asia (World Bank Enterprise Surveys, 2010-2020).

Along the same lines, the use of information technology in tax administration, such as e-filing, increases with national income. For example, as of 2016, 85 percent of high-income countries, 65 percent of middle-income countries and 32 percent of low-income countries had adopted e-filing (World Bank, 2016). Its prevalence has since continued to grow rapidly.

²Data from the most recent year available between 2010 and 2020 is used to calculate the regional averages.

1.2 Information Technology Adoption in Africa

The use of information technology continues to rise substantially across the continent. In 2008, less than 5 percent of Africans were using the internet. That fraction had increased fivefold to 25 percent by 2018 (World Development Indicators, 2018) and continues to grow (Figure 5a). Mobile cellular access, in particular, has large penetration across the continent with about 90 subscriptions per 100 people across the continent, more than double the prevalence rate a decade earlier (Figure 5b).

Africa has achieved striking successes in some aspects of technology innovation, particularly in the adoption of mobile money with services like M-Pesa being able to leapfrog the technology frontier, with users bypassing traditional financial service providers. Kenya has been a leader with more than half of the adult population having a mobile money account. Other countries like Uganda, Zimbabwe, Gabon, Namibia and Ghana also have high levels of mobile transactions (Figure 6a). While the most common use of mobile money is for sending remittances, commercial uses such as paying utility bills and receiving wages are starting to emerge (Figure 6b). This holds promise for Africans using technology services for tax purposes as well.³

The use of information technology is also growing across different sectors of government in Africa. In many countries, tax administrations often lead technology adoption and digitalization, compared to other government bodies (World Bank, 2016).

1.3 Role of Information Technology in Increasing Tax Mobilization in Africa

Robust adoption of technology is designed to move tax administration from manual systems characterized by tax official discretion across taxpayers, tedious and error-prone data entry,

³In recent times, a number of countries such as Uganda, Ghana, Malawi, Tanzania, Cameroon, and Republic of Congo have introduced or implemented legislation to impose taxes on mobile money transactions. These taxes may have negative economic and financial inclusion impacts, especially on disadvantaged individuals with limited access to the formal banking system.

and case-by case detection of evasion to a reliance on electronic systems, where there is a more consistent and predictable experience across taxpayers, timely data for decision making and automated detection of suspicious activity. Using the framework developed in Okunogbe and Santoro (forthcoming), this paper examines how technology may help to improve core tax administration functions for the main tax types: consumption taxes, property (real estate) taxes, trade taxes, and income taxes (personal income, corporate income and payroll taxes).

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

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

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

Besides these three core functions, technology may also improve the ability of tax admin-

istrations to make timely and data-based decisions such as forecasting revenues, measuring progress, and monitoring staff performance. However, these internal functions have limited empirical evidence in the literature, and we do not include them in the scope of this paper. Instead, we focus on technology applications that directly affect interactions between taxpayers and the tax administration. The rest of this paper proceeds as follows. Sections 2, 3, 4 and 5 provide an overview of consumption taxes, real estate taxes, taxes on trade and income taxes, respectively, in Africa and discuss the possible role of technology in improving the administration of these taxes. Section 6 provides insights from interviews with revenue administrators in Africa on their practical experiences and challenges in implementing technology solutions. Section 7 concludes.

2 Technology and Consumption Taxes

Consumption taxes include sales tax, value added tax (VAT) and excise taxes. VAT is becoming increasingly common in Africa, as in the rest of the world, accounting for about 40 percent of total tax revenue (ATAF, 2019). Albeit quite sophisticated and complex to administer (Slemrod and Velayudhan, 2022), the VAT holds great potential to improve compliance, mostly due to its in-built self-enforcing mechanism as buyers must report their input purchases to be able to deduct the VAT they paid from their own VAT liability from their sales. This generates opposite incentives for buyers and sellers in reporting the same transaction: buyers have an incentive to maximize the amount paid, whereas sellers have an incentive to minimize the amount received, thereby creating less room for evasion. Importantly, the VAT generates a paper trail or a record of transactions from the different trading partners in the value chain. Especially when digitized, such a trail provides a wealth of information to tax administration which they can use in their monitoring function.⁴

Technology can significantly help in the correct administration of such a complex tax

⁴Another crucial use of VAT data is that it can be very informative about the state of the economy and help government measure trends and shocks, as done in Mascagni and Lees (2022) for Rwanda.

as the VAT. In most African countries, the introduction of VAT has been accompanied by the launch of electronic fiscal devices (EFDs), such as electronic billing machines (Mascagni, Dom and Santoro, 2022). EFDs are machines that automatically record transactions as they are performed and communicate this information electronically to the tax administration. Such machines hold potential to boost tax compliance in different ways. First, they help in defining compliance, in the sense that they provide information about the amount of sales made in a given period, that may then be cross-checked with self-reported sales amounts from both VAT and income tax returns.

Second and quite interrelated, this information may then be used for monitoring compliance by having data-based, automatic flags of irregularities and discrepancies, on which the authority can build its audit strategy to ensure proper enforcement.

Third, EFDs are also thought to facilitate compliance, helping tax-paying firms with their record-keeping. Especially in its more sophisticated version (see the case of Rwanda in Mascagni, Dom and Santoro, 2022), EFDs can store valuable information on sales, purchases and inventory which taxpayers can access when filing their returns. Likewise, more sophisticated, software-based EFDs, especially when integrated with e-filing platforms (as in Rwanda), can provide additional information to taxpayers around deadlines, VAT rates and the like. Ongoing research is evaluating whether these benefits then translate into higher VAT compliance in Rwanda (Hakizimana and Santoro, forthcoming).

Against these important theoretical benefits from EFDs, the existing evidence on their impacts in Africa is rather mixed. On the one hand, it is true that such technology improved VAT revenue collection as also shown in other contexts beyond Africa (e.g. Fan et al., 2018). Some positive evidence comes from Ethiopia, where two studies evaluate the impact of the electronic sales register machines (ESRMs) – as EFDs were named there – on VAT compliance. Box 1 summarizes the key lessons learned from these evaluations.

BOX 1: Electronic Sales Registration Machines in Ethiopia (Ali et al., 2021; Mascagni, Mengistu and Woldeyes, 2021)

Problem: Despite its in-built self-enforcing mechanism that creates opposite incentives for buyers and sellers, the collection of VAT is thought to be largely underperforming in low and middle - income countries (Keen and Simone, 2004; Gordon and Li, 2009; Besley and Persson, 2013; Pomeranz, 2015). One of the main reasons, apart from the administrative complexity, is widespread evasion as the lack of information on sales severely undermines the enforcement capacity of revenue authorities.

Technology intervention: The Ethiopian Revenue and Customs Authority (ERCA) started the rollout of electronic sales register machines (ESRMs) in 2008 with the goal of moving from paper-based receipts, which make monitoring business transactions on a daily basis extremely expensive and unfeasible, to a digital solution. ESRMs, on top of printing out receipts, automatically report transactions via a network to an ERCA server – with the agency being able to monitor sales and eventually use that information to enforce compliance.

Research design: The studies of Ali et al. (2021) and Mascagni, Mengistu and Woldeyes (2021) heavily rely on administrative tax data provided by the revenue authority. The authors have access to tax returns and payments data over a large span of years, as well as to the date of machine adoption. Both studies employ a difference-in-difference design. In Ali et al. (2021), the design is reinforced by a matching technique making adopters and non-adopters more comparable. In Mascagni, Mengistu and Woldeyes (2021), several restrictions are imposed on the sample (for instance, never adopters are excluded), and a triple difference-in-difference is performed to reduce imbalance between treatment and control groups.

Impact: Impacts from ESRM adoption are largely positive. On the one hand, Ali et al. (2021) find that the adoption leads to increase in reported sales and VAT liability. They also show that this improvement happened without the erosion of the tax base, as there was also an increase in employment rates. On the other, Mascagni, Mengistu and Woldeyes (2021) find a positive impact on tax revenue, increasing by 48 percent for VAT. Considering also income taxes, they rise by 12 percent after adoption, indicating spillover effects. Further, they measure positive impacts on the accuracy of reporting. However, such positive effect is partially muted by strategic taxpayer response, which will be discussed in more detail in Section 6. In Ethiopia, taxpayers respond by simultaneously adjusting both reported sales and costs, thus yielding net revenue gains that are proportionally lower than the increase in sales.

The key lesson from the two studies is that technology can improve compliance, but perverse responses from taxpayers can partially mute its impact.

In a different context, Rwanda, Eissa and Zeitlin (2014) find that the first version of electronic billing machines (EBM v1) that automatically records a firm’s sales leads to an

increase in VAT payments by an average of 8 percent – an effect highly variable by sector and firm size, with smaller firms as well as firms in computing/printing, construction, and restaurant sectors experiencing larger impacts.

On the other hand, increasing qualitative evidence indicates how taxpayers struggle to optimally use the technology, often with concerning repercussions on equity. For instance, and again in Rwanda, Mascagni, Dom and Santoro (2022) show that the expected benefits of EBM do not always materialize, especially for small taxpayers. The authors first show that the incidence of poor record keeping (as proxied by inconsistencies between VAT returns they submit and data automatically recorded in the EBM) is larger for smaller firms. They then use focus group discussions to demonstrate that taxpayer confusion, complexity and technical problems with the EBM, for example, issues with topping up SIM cards, and with the necessary equipment such as computers and internet connection are particularly severe for smaller taxpayers. The more advanced version EBM2 seems still expensive – especially in terms of the necessary equipment (computers, connection, etc.) - for smaller taxpayers who already face budget constraints in using the traditional EBM.⁵

This disproportionate effect brought about by more and more sophisticated technologies (as the ever-evolving versions of EBMs) could exacerbate existing inequalities in the taxpayer population. Similar impediments are witnessed in the deployment process of EBMs in Kenya and Tanzania. Eilu (2018) reviews the evidence from seven studies based on the adoption experiences of these two countries, to conclude that the most-cited challenge with the use of EBMs was the lack of training of VAT-collecting enterprises, mentioned as a hindrance in six of the studies. The second most-cited challenge was the high sunk costs associated with technology adoption.

With regards to the potential of in-built mechanisms of the VAT to help identify the tax base and monitor compliance, it is still unclear whether African revenue authorities

⁵At least in Rwanda, EBMs need airtime as they transmit information through the mobile network. Taxpayers, especially the smallest ones, easily forget (or are unaware they have) to top up airtime, thereby impeding the EBM from communicating with the authority. In addition, businesses have to buy the machine themselves without any subsidy (Mascagni, Dom and Santoro, 2022).

are fully exploiting the potential of the VAT-generated paper trail which has proved to be essential in other contexts (Pomeranz, 2015; Carrillo, Pomeranz and Singhal, 2017). Recent evidence indicates that, despite the adoption of EBMs, there are widespread discrepancies in data reported by buyers and sellers for the same transactions, both in Rwanda (Mascagni, Mukama and Santoro, 2019) and Uganda (Almunia et al., 2022). Such studies suggest that tax administrations are not fully equipped to unlock the potential of VAT cross-checks, mostly due to structural challenges with software and skills (see Section 6). More broadly, such challenge suggests that much more can be done in investing in automated data-based monitoring systems, which have shown to be impactful in more developed contexts – such as India (Mittal and Mahajan, 2017), Pakistan (Shah, 2020) and Türkiye (Dogan, 2011).

3 Technology and Real Estate Taxes

Although real estate taxes make up only about 3 percent of taxes in African countries (Figure 3b), they are often the primary source of revenue available to local governments. Increases in property taxes have also been shown to be more closely linked to increases in spending on public services, compared to other revenue sources such as transfers from the central government (Gadenne, 2017; Hoffman and Gibson, 2005). As many countries adopt fiscal decentralization programs, it will be important to have the appropriate information technology systems in place to support the implementation of real estate taxes.

At first glance, given the visibility and immobility of the tax base, real estate taxes would seemingly not suffer from the core information problem in taxation: the ability of authorities to identify the tax base and determine tax liabilities. Yet, in practice, many tax authorities in Africa struggle to keep accurate and comprehensive cadasters and other databases for real estate taxation purposes. Cadasters, when they exist, are often outdated, and property valuations often do not reflect existing market prices. Further, administrative processes to collect tax revenues and identify defaulters may be inefficient and open to manipulation.

Technology may help with these issues.

First, technology can help to identify and value properties. In cases where there is no cadaster, satellite images may be used to produce a map of buildings, with additional ground-truthing to populate information on property characteristics. Traditional valuation approaches such as those based on construction costs are costly and time consuming. In other settings, property owners are asked to self-declare their property value but this is subject to manipulation. Alternatively, a fixed fee may be imposed on each dwelling, but this approach is likely to be regressive. Computer assisted mass appraisal methods that use statistical models to assign an estimated market value to property using data on property characteristics (location, size, amenities etc.) and sale price from recent transactions are widely used in middle- and high-income countries, but in many African contexts with weak property markets, the required data on recent purchase prices are often not available.

An alternative approach aided by technology is a simplified “points-based” system recently adopted by the Freetown City Council in Sierra Leone (Fish, 2018), with support from the International Growth Center, the International Centre for Tax and Development and the UK government (Grieco et al., 2019). The project involved the city’s authorities using satellite imagery to identify and measure properties in Freetown. They then deployed teams to collect data on easily observable characteristics such as the quality of walls, roofs and windows. Following this, they used existing data on rental values to build a simple model for calculating the taxable value of each property. This approach almost doubled the number of properties on the tax register from 57,000 to about 110,000. Crucially, the new system produced much higher tax bills for the most valuable properties, owned by the wealthiest taxpayers, which have been historically under-taxed, thereby increasing the progressivity of the tax system (Kamara, Meriggi and Prichard, 2020).

A similar example comes from Senegal where Knebelmann, Pouliquen and Sarr (2021) report that, at most, a third of cadastral plots in Dakar are on the valuation roll. In addition, rental values listed on the roll are on average lower than values obtained through other sources

such as surveying owners and real estate experts, likely due to poor and biased valuation practices. Furthermore, cadastral information on plots in the tax database is not linked to address information that is visible and known by taxpayers. This lack of data harmonization makes it impossible to send tax notifications to most property owners. As a final challenge, manual practices in collecting new information on properties imply a cumbersome, time-consuming and error-prone data collection process by tax agents. Ongoing research examines the impact of a new mobile application that helps to determine property values and process billing and collection on tax collection. Box 2 presents a case study from Liberia on how using information from a newly developed electronic tax database increased tax collection.

Second, technology is important for facilitating and monitoring compliance with real estate taxes. The ideal technology system will not only support property identification using a geospatial database and valuation, but will also integrate billing, payments, appeals and enforcement. Dzansi et al. (2022) report from a census of local governments in Ghana that only 17 percent of them have a digital database of properties or a revenue software of any kind to assist with billing, and find that use of technology is associated with higher revenue collection. In addition, using a randomized experiment in a large municipal government, they find that revenue collectors using electronic tablets with geospatial data and navigational directions to more easily locate properties collected twice as much revenue as control group collectors.

Technology solutions can also be used to reduce compliance costs and revenue leakage. Weigel (2020) and Balán et al. (2022) describe the use of a payment technology in door-to-door property tax campaigns in Kananga, Democratic Republic of Congo. Taxpayers made cash payments to tax collectors instead of traveling to the tax office, thereby reducing their compliance costs. The tax collectors used handheld printers to issue receipts to taxpayers and each transaction was recorded in the device's memory and downloaded to the government database on a regular basis. To monitor leakages, supervisors confirmed that the revenues deposited were equal to the amounts on the receipts that were issued.

BOX 2: Real Estate Tax in Liberia (Okunogbe, 2021)

Problem: Real estate taxes in Liberia, like many low-income countries, is characterized by high non-compliance rates. One significant hurdle in administering the real estate tax is the lack of a property cadastral. In the absence of comprehensive information on property location, ownership and values, tax enforcement cannot be conducted in a systematic way and many properties remain out of the tax net. Only about 5 percent of residential property owners were estimated to be on the tax roll (Olabisi, 2013).

Technology intervention: The Liberia Revenue Authority (LRA) initiated a low-cost technology investment to create a new property database. The tax authority recruited and trained young people to use open-source software on tablets to capture the location, ownership, photo and GPS of properties. The “foot soldiers,” as they were called, went door-to-door, conducting a brief survey with the resident of each property to collect ownership information and record property characteristics, including a photograph of the property. This resulted in the creation of a new property database that the tax authority could then use for property tax administration.

Research design: The tax authority used the information from this new database to send notices to taxpayers to request payment of real estate taxes. Four types of notices were sent out, with property owners randomly assigned to the different notices (Okunogbe, 2021). The first group received a “Plain Notice” that provided information on the property tax requirement and the procedures to pay. The second group received a “Detection Notice” that used information from the new tax database to personalize the notice: it was addressed to the property owner by name and included a photograph of the property. The third group received a “Penalty Notice” that provided information on the legal consequences of not complying. The fourth group received a “Detection and Penalty Notice” that combined the features of those two notices.

Impact: The Detection and Penalty notice tripled the property registration and tax payment rate among recipients, relative to the baseline registration rate of 4 percent and payment rate of 2 percent among those who received the Plain notice. The Detection notice and the Penalty notice alone did not have a statistically significant impact on registration or payment.

This intervention shows the effect of using technology to organize the publicly visible information on property tax liabilities to boost tax compliance. It highlights the complementary roles of communicating government detection capacity to taxpayers and alerting them of consequences for non-compliance. Nevertheless, it highlights the fact that additional factors, such as enforcement, may play an important role because even with perfect detection and information on penalties, less than 15 percent of those who received notices registered or paid.

Given the rapid increases in open-source software for geospatial database creation and

simple record keeping, many of the technologies described in this section can be adopted at reasonable costs by local governments.⁶ It is important to pilot and test software to be sure it meets the specific needs in a given context. Knebelmann (2022) provides detailed illustrations from the experiences from over 15 property tax digitalization projects in different countries to show how satellite imagery tools and georeferenced data systems can help in detecting, registering, characterizing and valuing properties.

4 Technology and Trade Taxes

Trade and customs taxes account for a notable share of total tax revenues in Africa where they account for 14 percent of tax revenues, relative to 4 percent in other regions (Figure 3b). Also, the majority of VAT revenues are collected at the border in many countries (World Customs Organization, 2017). For this reason, national customs departments play a crucial role in revenue mobilization, in addition to being instrumental in facilitating trade and exchange with foreign investors. At the same time, customs departments are often characterized by high levels of corruption – mostly due to the fact that tax officials enjoy strong discretionary powers in their profession, and risk-based systems of control and accountability are often missing or easily manipulated.

Technological innovations can significantly improve the administration of trade taxes. Similar to VAT, automated customs systems produce high frequency transaction level data that can be used for tax monitoring. It is not surprising that, particularly in developing countries, the initial, experimental attempts to digitalize and automate tax administration took off from customs offices, usually in parallel with broader reorganization reforms of customs bureaucracies. According to the World Bank Global e-Government Systems database, by 2014 low-income countries have invested much more in automating customs (97%), than tax management (57%), filing of taxes (32%), or online service portals (11%). For instance,

⁶Relatedly, geolocalized address information and a more accurate taxpayer register can improve enforcement on other tax types as well, such as income taxes.

the first “pilot” examples of integration and automation of data management systems are given by the Asycuda platform for trade taxes, which then laid out the foundations for introducing automated systems at the level of domestic tax administration as well.

Technology can significantly boost all core functions of custom tax administration – especially if through an integrated custom management system as Asycuda that processes all necessary customs documentation such as cargo manifests, customs declaration, payments, and other regulatory requirements in a timely fashion (UNCTAD, 2020). First, technology could help to more clearly identify the taxable base, such as the value and quantity of imported goods – for instance, cargo information can be captured by scanning barcodes on shipments at the port of departure and communicating the information in real time to Asycuda. Likewise, integrated systems requiring a unique taxpayer identification number from traders would significantly help the tax administration identify the tax base and seamlessly connect traders with other tax databases (World Customs Organization, 2014).

Second, in relation to the above, technology could greatly improve the enforcement of tax collection and monitoring of performance. Using the information on tax liabilities and taxable entities, a sophisticated IT system could embed independent valuation reports from third parties and introduce explicit monitoring tags informing inspectors of high-risk declarations. In the most advanced versions of Asycuda, statistical tools and algorithms are included to detect fraud. Artificial Intelligence systems such as pattern recognition can be of great help in supporting risk assessment and profiling policy (World Customs Organization, 2014).

Lastly, technology could, more broadly, speed up the customs processes of importing and exporting of goods, incentivizing foreign traders through a smoother and less burdensome cross-country trading experience. In this sense, Single Windows are one-stop-shop electronic systems, usually integrated with Asycuda, that allows traders to submit information at a single-entry point to fulfill all import and export regulatory requirements. By reducing interactions with inspectors, Single Windows streamline and standardize traders’

experience, significantly curbing application processing times and increasing transparency and predictability (UNCTAD, 2020). In addition, e-payment modules embedded in Asycuda dramatically decrease customs clearance time and traders' compliance costs, improving their experience and at the same time speeding-up the transfer of funds to government accounts (UNCTAD, 2020).

However, existing evidence on the impacts of technology on customs in Africa is rather scarce. A first set of qualitative studies indicate that integration between customs and domestic departments is still partial, when it comes to data sharing and automatic cross-checks. In Uganda, as described in Mayega et al. (2021), the URA e-tax still needs improvements towards integration. For instance, the system is not able to validate some of the submitted information with information that is already available within different sub databases in e-tax and, more importantly, with the custom platform, Asycuda World. A similar challenge is documented in Malawi (Ligomeka, 2019). Some promising suggestive evidence comes from Zambia, where, in 2018, the tax administration implemented a successful data matching exercise cross-checking information from domestic tax returns and data from the customs information management platform (ATAF, 2019).

A second strand of research indicates how technology in customs departments could easily backfire due to conscious sabotaging responses from customs officials. A particular case study from Madagascar well illustrates this point and provides novel evidence on the impacts of IT-based information on customs performance in an African country, and is summarized in Box 3.

BOX 3: Technology and Corruption in Madagascar Customs (Chalendard et al., 2020)

Problem: Madagascar is characterized by a very low tax-to-GDP ratio (below 10 percent) and almost half of tax revenues in 2019 came from customs. Corruption by customs officials, particularly undervaluation of imports, was an important concern especially given the concentration of revenue monitoring among a small number of officials. In Toamasina, the main seaport in the country, only 16 inspectors clear declarations for about two-thirds of non-oil imports and three-quarters of non-oil tax revenue. Across the country, each inspector on average oversees the collection of approximately 10 million USD in terms of import revenues each year.

Technology intervention: The customs department in Toamasina worked together with an information service provider specialized in assisting customs with information technology (IT), equipment and risk analysis, including the provision of valuation advice on traded goods. Such advice comprises a detailed, high-quality report on the price and quality of declared goods. The advice is produced only for high-risk declarations more likely to evade tariffs. Chalendard et al. (2020) evaluated the impacts of such intervention on customs outcomes and inspectors' behavior.

Research design: The methodology consists of two steps. First, the authors estimate the impact of the provision of third-party valuation advice information on inspector actions and customs outcomes, through a regression framework. Second, in a pioneering randomized controlled trial in customs, the study randomly assigns high-risk customs declarations to improved information provision by the customs risk management unit and also randomly tags declarations for increased monitoring.

Impact: First, the authors show that third-party valuation advice significantly increased the probability of goods being scanned by 10 percentage points and the probability of a declaration being deemed fraudulent by 22 percentage points. Third-party data availability also increased tax revenue by 5.2 percentage points on average. However, third-party valuation advice is least effective in improving customs outcomes for declarations for which opportunities for corruption are largest. Such evidence is confirmed in the RCT - where stakes are higher, improved information remains less effective. Likewise, increased monitoring did not improve most customs outcomes.

A key lesson from this study is that customs officials may not react optimally to new IT-based information if their incentives for graft are largely unaltered. Also, higher monitoring is largely ineffective in a context of low fear of enforcement and an enduring culture of impunity.

5 Technology and Income Taxes

Income taxes paid by individuals, companies as well as employees are an important revenue source for African economies, representing about 33 percent of total revenues (UNU-WIDER Government Revenue Dataset, 2021). Unlike Pay-As-You-Earn (PAYE) taxes that are deducted at source on wages and salary, corporate income and other personal income taxes are typically self-declared, providing more opportunity for evasion (Kleven et al., 2011). This makes them particularly vulnerable to broader structural issues like high informality and low tax morale that to an extent also affect other tax categories.

One key obstacle to optimizing income taxes is informality: many individuals and companies operate completely outside the purview of the tax authority. The existence of an informal economy generates horizontal inequities and economic distortions that potentially undermine tax perceptions and the moral fiber of a society (Joshi, Prichard and Heady, 2012). Within the informal sector, most harm to revenue is produced not by micro-enterprises such as street vendors, but by hard-to-tax professionals such doctors, lawyers, architects, etc. (Ogembo, 2020). Even among those formally registered, tax minimizing schemes by professionals and high net worth individuals determine large revenue losses and damage to the fairness of the tax system (Keen, 2012; Kangave et al., 2016; Santoro and Waiswa, 2022).

A second major challenge for income taxes is that even among taxpayers that are formally registered, there is a high level of non-compliance: the vast majority of registered taxpayers in Africa either do not file their returns or zero-file (Santoro, 2021; Mascagni, Dom and Santoro, 2022; Almunia et al., 2022). In addition, African taxpayers' morale and willingness to pay are remarkably low. Different factors associated with low willingness to pay include: distrust of the state (Bratton and Gyimah-Boadi, 2016; Isbell, 2017), dissatisfaction with public services (Blimpo et al., 2018), perceived unfairness of the tax system (D'Arcy, 2011; Okunogbe and Edjigu, 2022) and the complexity of navigating obscure tax regulations (Aiko and Logan, 2014; Mascagni and Santoro, 2018).

A third constraint is that African tax administrations experience important limitations in

their traditional enforcement strategies and find it difficult to optimally monitor compliance with self-reported income taxes.

In this context, technology may be instrumental in boosting the performance of income tax collection in many ways. On the taxpayer side, technology can be used to simplify tax registration processes, such as the creation of one-stop shops for firms. In addition, taxpayer e-services such as e-filing and e-payment facilities, as well as web tax portals, can significantly ease the burden to comply, increase transparency and predictability of taxes, and reduce scope for corruption, factors which may increase willingness to comply. On the tax administration side, IT solutions such as Electronic Fiscal Devices, can provide crucial data on sales which can then be cross-checked automatically with self-reported income tax declarations. Similarly, the tax administration can obtain and crosscheck data from third-party reporting such as VAT data from clients and vendors and rental income withholding with self-reported income. Against these promises, the existing evidence is, once again, rather mixed, and we summarize it below.

5.1 Pay As You Earn

In theory, given the at-source deduction of PAYE tax by the employer, there is less scope for evasion with PAYE compared to self-declared income (Kleven et al., 2011), however, there is very limited empirical evidence from Africa on this. Rather, the existing descriptive evidence suggests that large gaps persist in the quality of PAYE returns data, thus undermining the capacity of revenue authorities to make best use of it and opening loopholes for tax evasion.

One issue is lack of proper tax identification of individuals. Descriptive evidence from both Uganda (Mayega et al., 2021) and Ethiopia (Mascagni and Mengistu, 2019) reveals that tax identification numbers (TINs) for employees are largely missing or incorrect in employers' PAYE returns. This means that the tax authority is unable to track payments by individuals over time and match individuals' records with other databases. Reporting aggregated PAYE taxes at the employer level and not linking to individuals also creates an opportunity for

inaccuracy in the amount of taxes remitted. Relatedly, the inability to match taxpayer-level data from PAYE to other data sets (such as income tax returns) makes it difficult to add up individuals' total income and enforce progressive income tax rates.

A second concern revealed in the Ethiopian context, but common in many others, is that PAYE data is not fully digitized. Many returns are kept in paper form, prone to loss or deterioration with time and making it very unlikely that this data will be analyzed (Mascagni and Mengistu, 2019).⁷

5.2 Corporate and Personal Income Taxes

Different technological interventions, such as EFDs and e-filing/e-payment services, have been introduced in Africa with the goal of facilitating compliance of self-declaring business income earners who are remitting corporate or personal income taxes. In Section 2, we discussed the potential benefits and key challenges for VAT compliance brought by the introduction of EFDs, which apply to compliance with income taxes as well. Furthermore, it is still unclear whether the revenue gains on VAT attributable to EFDs would then produce a parallel increase in income taxes. If anything, in Ethiopia, EFD users only partially improve their filing of income taxes, despite significant rises in VAT reporting (Mascagni, Mengistu and Woldeyes, 2021). Such gaps in compliance also depend on the sophistication of the IT system within the tax administration, which would limit discrepancies. In Rwanda, as discussed in more depth in Section 6, EFD data is used to benchmark self-reports from income tax returns.

Regarding the potential role of IT to facilitate compliance of income taxpayers, a first strand of the literature considers factors associated with taxpayers' adoption of and practical experiences with tax e-services. Box 4 summarizes this evidence.

⁷Statistical analyses would be a rather frustrating task if based on analog filings, which make impossible to precisely trace and identify employees across periods and firms.

BOX 4: Adoption of Tax E-services in Africa

Problem: Traditional tax processes involve paper-based filing and extensive in-person interactions between taxpayers and tax officials. This system creates several challenges such as large compliance costs, collusion with tax officials or extortion by them, and poor tax records that limit the potential of tax agencies to conduct analyses for compliance monitoring and forecasting. Whereas new technology to digitize taxpayer services may hold a lot of promise, important barriers to adoption of these technologies may severely curb the potential for revenue mobilization.

Technology intervention: Many African governments have been heavily investing in e-services as a way to move from paper-based systems to fully digital platforms. As an example of such e-services, e-filing and e-payment facilities enable digital filing of returns and digital payment of tax liabilities. These e-services often live within integrated and automated tax administration systems. The associated web portals also provide a range of benefits in terms of clear information on deadlines, access to assistance, and better record-keeping.

Research design: A number of studies from Africa attempt to understand the barriers to access of such e-services. These studies are typically based on surveys of representative samples of taxpayers, collecting detailed information around taxpayer experiences with e-services. In the case of Rwanda, Santoro et al. (2022) originally link survey data with tax administration data, in order to gain more information around taxpayers and their filing behavior.

Results: Lack of awareness and lack of training are key factors that have been identified in both Nigeria (Mas'ud, 2019) and Zimbabwe (Obert et al., 2018) as barriers to adoption of e-services by taxpayers. In Nigeria, Efobi et al. (2019) conclude that internal firm characteristics like owner's education, age of the company, and use of an external auditor and computerized accounting system, are most strongly correlated with the use of e-filing and e-payment by firms.

Partial take-up can persist even when e-services are mandatory, like in Rwanda. Santoro et al. (2022) uncover important digital divides among users and non-users. First, they show that female, less educated taxpayers, with less sophisticated businesses, are significantly less aware of e-services and less likely to use them.

In sum, for broad adoption of e-services to occur, tax administrators must ensure that the introduction of new technology is accompanied with extensive sensitization, training, and assistance, especially for disadvantaged taxpayers that are more likely to be excluded.

A second strand of the literature considers the impacts from technology adoption. While the impact of e-services like e-filing on tax payments, compliance costs and corruption have been rigorously studied in other similar contexts, such as Tajikistan (Okunogbe and

Pouliquen, 2022), there is some emerging evidence from Africa as well. Santoro, Amine and Magongo (2022) evaluate the effect of the Eswatini government mandate to adopt e-filing and e-payment services for all income taxpayers as a response to the pandemic, introduced in September 2020. Using extensive administrative data from the tax agency, the authors examine the impact of IT adoption by exploiting the partial take-up of the mandate. A first key finding is that, indeed, more than 8 months after the mandate came into force, only a minority (41 percent) of taxpayers moved to filing through the e-Tax system. In line with other research from Africa described in Box 4, qualitative evidence from interviews with the tax agency reveals that most small taxpayers lack the equipment, an adequate connection, and the knowledge to navigate e-Tax. These taxpayers, mostly from rural areas where internet coverage is poor, then resort to imperfect solutions such as bringing their manual returns to the revenue office or emailing them and asking staff to help enter them in e-Tax.

In terms of impacts, the evidence from Eswatini is rather positive, as e-Tax uptake significantly improved filing behavior, as e-Tax registered taxpayers are almost 60 percent less likely to file nil, and they declare 32 percent more turnover and 50 percent more taxable income. However, surprisingly, final tax liability remains unchanged due to corresponding increases in expenses and deductions. For payment behavior, the authors find a strong impact of e-Tax registration on the probability to pay conditional on filing, as well as on the final tax amount paid (70 percent and 64 percent increases, respectively).⁸ In terms of mechanisms, the study suggests that technology is facilitating compliance through a salience or reminder effect and helping taxpayers to track their records and fully report their expenses and deductions.

As a cautionary note to these positive impacts of technology on income taxes, in Rwanda, Santoro et al. (2022) do not find a positive relationship between adoption of E-tax or M-declaration solution and self-reported taxpayer outcomes such as tax compliance, perceived

⁸The divergent impact on tax declared and tax paid is not surprising in a context where filing and payment behavior are often disconnected, and where revenue authorities often prioritize payment over filing (Santoro and Waiswa, 2022).

fairness, or the intrinsic motivation to comply with taxes. From the qualitative information gathered from focus group discussions, the concrete benefits from e-services such as time savings and more transparent access to information are balanced out by a multitude of practical challenges in usage, such as connectivity problems and a slow IT system in the tax agency, on top of inadequate assistance from RRA when technical issues arise. Such issues seem to exacerbate the frustration and perceived unfairness in usage, and call for sustained investments in strengthening the e-services.

6 Insights from Interviews with Tax Administrators

In this section, we complement the evidence gathered from the desk review with qualitative insights from eleven in-depth interviews with tax officials from seven African revenue authorities, in a unique exercise carried out in 2021. These interviews tell us about the direct experience of practitioners, experts and implementers, which is particularly important to complement the limited information available in the literature. The countries included in this exercise are: Eswatini, Ethiopia, Malawi, Nigeria, Sierra Leone, Rwanda, and Uganda.⁹ In-depth interviews were mostly conducted remotely (due to COVID-related restrictions), lasted on average two hours and followed a specified protocol (see Appendix B for the interview form). First, we ask our respondents about practices and challenges with technology, focusing on those IT solutions more relevant to them. Then, we discuss general aspects on constraints to digitalization, ranging from infrastructure, funding and staff to the regulatory background and political will.

The sample of countries we cover is not representative of the African continent but rather selected out of convenience to introduce practical policy insights. Appendix Table A1 reports the details of the revenue authorities and officials we contacted in this study, as well as the date when the interview took place. The seven selected countries show varying degrees of technological maturity. We recur to the latest GovTech Maturity Index (GMTI) of the World

⁹In two cases (Uganda and Rwanda), we interviewed multiple tax officials in a revenue authority.

Bank (Dener et al., 2021), which assigns a 0-1 score and a grouping across four categories (A, B, C and D) to each country as an indicator for the state of its public sector digital transformation. The GMTI for our sample ranges from 0.28 to 0.62. In comparison, the average of low income countries is 0.27 and that of lower-middle income countries is 0.46. We summarize the novel evidence around practices and challenges with technology below, to reflect the direct experiences of tax officials from the continent.

6.1 Issues within the Tax Administration

The success of an IT intervention relies heavily on a range of considerations related to the tax administration itself. First, a very practical factor is funding. Governments need to secure enough funding for implementation, upgrading, and maintenance of any technology. From the interviews, budgetary constraints emerge consistently as a major challenge across the board. In Malawi, for instance, there is a dedicated budget for IT implementation which is, however, not sufficient. Nigeria’s revenue authority also heavily invested in the development of the new automated system TaxProMax. Often, the revenue authority is reaching out to the government and donors for help.

Second, the tax administration needs to have adequate equipment and enjoy a solid infrastructure to fully benefit from any technology. In Malawi, for instance, internet connectivity is a major issue within the tax administration. Sometimes, the very same MRA’s systems are down and there is often congestion. Traffic management of these systems continues to be an issue, especially with the integrated tax administration system (ITAS), as it often crashes. But the system has not been upgraded because it is quite expensive, consistent with the funding obstacle discussed above. In Sierra Leone, our respondent envisages that hard infrastructural barriers like poor internet connectivity and electricity disruptions could severely undermine the success of the ongoing ITAS project. The same risk is acknowledged by the FIRS respondent in Nigeria, who expects that TaxProMax and e-services for taxpayers are much likely to be impacted by infrastructural constraints. At the same time, in

Rwanda, interviewees point out that congestion in online systems at peak times is likely to increase, without adequate (and costly) investments in storage capacity and server upgrades, as more and more taxpayers are now brought into the tax net (also see Mascagni, Dom and Santoro, 2022).

On the bright side of availability of tax infrastructure and systems, the tax administration in Rwanda set up automatic cross-checks of different data sets, such as VAT, income taxes and EBMs, which imply that the self-reported turnover for income taxes is now benchmarked to the total of sales as transmitted by the EFD. Much more can be done in this direction, eventually enabling the abundant pre-filing of income tax returns now common in high income countries.

Third, another important precondition is the preparedness and incentives of revenue authority staff that interface with a new technology. In Sierra Leone, concerns exist around change management, which will determine whether the upcoming ITAS turns out to be optimal or not – since tax officials are used to one specific way of operating which could be difficult to change in a short time. A similar story comes from Malawi, where, as technology evolves, it closes loopholes previously used by some staff for illegal practices. As a result, there was significant resistance and delay in the launch of ITAS. Eventually, the top management provided clear directions of change and started imposing strict deadlines on the staff.

In the case of Uganda, in line with Mayega et al. (2019) and the challenges discussed in section 4, there seems to be weak incentives for staff to change. Since adapting to the new technology is inconvenient to them, they tend to resist it. Staff are very familiar with Excel, where they have more discretion on what to input, while ITAS modules are more complicated, with a variety of often-sophisticated checks and controls, and require more training and commitment. Similarly in Ethiopia, manual practices co-exist with digital ones and are difficult to erase. There are many returns which are not captured into SITGAS, but inputted manually by tax officials, especially outside the capital. This is mostly due to poor

understanding from staff, with the result that many declarations are lost. Against this issue, the revenue authority is providing sustained training to staff. Extensive training takes place at RRA in Rwanda as well, where even minute changes (for instance, small modifications in a single module) are discussed at length with the staff, which get fully trained to deal with these changes. The same pattern is confirmed in Nigeria, where technology is ubiquitous and staff seem to be embracing the change.

These conversations with tax administrators highlight the importance of ensuring that digitalization is accompanied by a broad shift in work culture and structural changes in how staff are organized. This means not having an isolated IT department in charge of digitalization. Instead, there need to be deep changes in how operational departments are organized: hiring, reallocating and retraining staff as needed to maximize the impact of newly acquired data and monitoring capacity on compliance, for example, shifting from case-by-case enforcement to large-scale, data-driven interventions. These structural changes are especially important when digitalization is accompanied by an expansion in the number of registered taxpayers. Relatedly, since digitalization programs are typically very expensive, it is crucial to ensure a right match between the needs of the tax authority and the IT solutions procured. The procurement process should involve extensive consultations with staff as well as maintenance contracts that allow for some flexibility and future adjustments in the software.¹⁰

6.2 Issues among Taxpayers

Our African tax administrator respondents' description of factors affecting effective adoption of technology by taxpayers echoes some of the findings from the desk review, such as reliable infrastructure and connectivity, adequate awareness and knowledge around tax e-services, and the deliberate misuse of an IT solution to avoid taxes.

¹⁰Occhiali, Akol and Kargbo (forthcoming) discuss procurement lessons from in-depth case studies of the adoption process of Integrated Tax Administration System (ITAS) in Uganda and Sierra Leone, based on a series of semi-structured interviews with revenue authority and ministry of finance officials.

First, the infrastructural limits and connectivity hiccups within a given tax administration inevitably affect the capacity of taxpayers to use a technology. As a recurring theme across the selected countries, when connectivity is poor, taxpayers are often forced to revert back to manual practices. For instance, when EFDs are not functioning, firms end up recording transactions manually, limiting the benefits coming from this technology. In Ethiopia, up to recent times, due to poor internet connectivity, taxpayers were forced to go to the local tax office to file electronically.

The same pattern emerges in Eswatini, where e-filing became mandatory in 2021, but taxpayers in remote, poorly connected areas still have to visit the local offices or internet kiosks to access the web portal and file their returns (see also Santoro, Amine and Magongo, 2022). In Rwanda, on the other hand, the RRA introduced the USSD-based M-declaration application that works on simple feature phones as a simpler tool for tax declaration and payment for presumptive taxpayers (Section 5) instead of the e-tax platform that requires internet connection, with the clear policy intent of reaching less connected taxpayers and facilitating their compliance. The app also easily enables tax payments through a direct link to mobile money platforms, which function smoothly on USSD phones. Second, IT literacy and high adoption costs must be factored in when implementing a new technology. In Uganda, for instance, we learned that lack of sufficient consultation with taxpayers on the new e-registration system, integrated with the national ID database, resulted in overwhelming feedback from taxpayers that URA's registration process was too cumbersome. As another example from Uganda, the biggest challenge with e-filing is that the average taxpayer does not have adequate knowledge of the tax system and familiarity with IT tools to fill in online forms. Also, language barriers play a role, as e-returns are only in English. This means that most taxpayers need a middleman or tax agent to register or file returns, a situation that the interviewees fear may lead to agents preying on ignorance of taxpayers and overcharging them.

In Malawi, taxpayer education is a key priority of the MRA. However, due to COVID-19,

MRA had to suspend all tax training and educational activities. There is a major concern that lack of awareness and training may result in low take-up of the upcoming e-filing system. Finally, in Rwanda, most taxpayers are familiar with basic IT solutions (such as the national e-government platform, Irembo) and that makes them less resistant to the use of technology for taxation. However, compliance costs remain high and disproportionately affect smaller taxpayers, as mentioned in Section 5. The authority is aware that it is common practice for less educated taxpayers to visit tax centers to get assistance in e-filing by staff, or use tax advisors, or visit designated internet cafés.¹¹ The launch of the M-declaration app, mentioned above, also shows the intent of the RRA to ease the burden of smaller taxpayers as the app solution effectively eliminated the need for small business to hire accountants and thereby reduced their compliance costs (Schreiber, 2018).

Lastly, our conversations with tax officials confirmed the desk review evidence that taxpayers may consciously misuse an IT solution with the aim of reducing their tax liabilities (see, for instance, Mascagni, Mengistu and Woldeyes, 2021). All interviewees are well aware of such risk, acknowledging that, especially for self-declared income taxes, the quality of incoming data from new IT options and their broader potential for improving compliance mostly depend on the taxpayer’s decision on what to declare and how to use the tools. All interviewees agree that traditional enforcement measures are essential to combat any potential strategic responses by taxpayers to the new reporting requirements associated with the use of new technologies.

6.3 Issues with Other Parts of the Government

A key lesson from the country experiences is that technology for taxation works best when it is embedded within a broad, coherent national transformational vision. In this sense, the case of Rwanda exemplifies how technology in tax administration belongs to a broader

¹¹A similar pattern is observed in Eswatini, where the ERS provided internet kiosks in all tax centers to assist less knowledgeable and less equipped taxpayers.

discourse at the national level.¹² The sustained investment in infrastructure described in Section 5 reflects this process. As confirmed by the interviewees, the revenue authority participates in the national-level reform strategy, which is affecting the digitalization of all public institutions and putting technology as one of the main priorities. A similar example of a long-term (2006-2021) digitalization journey is offered by the Mauritius Revenue Authority, which sequentially introduced more and more sophisticated technologies, from e-filing in 2007 to ITAS in 2010, mobile payments in 2014 and a digitally-enabled COVID-19 assistance scheme in 2020.¹³

Additional evidence on how the institutional vision can influence the success of an IT strategy comes from the in-depth interviews in Uganda. For the launch of the new taxpayer e-registration system and integration with the national ID system, interviewees state that public buy-in will be crucial for the initiative to be successful. They believe that it is not enough for only a few government players to be supportive, but whole administrative and institutional bodies need to be seen to embrace these initiatives, through a collaborative effort between public institutions and constant sensitization of the public. More specifically, they think the government should coherently incentivize citizens to register with the national identification systems and with URA. However, from the perspective of respondents, it is not clear that there is sufficient political will to embark on such an endeavor now.

Relatedly, the lack of a broad strategy for reform implies that often the tax administration, historically more IT-developed, coordinates with external public institutions which are at a lower IT development stage. This creates hiccups and delays in key functions. An example of this comes from Sierra Leone, where smooth integration, data sharing or communication between the NRA and the bureau responsible for registration of traders (OARG) is hampered by the lack of technical capacity of the latter (due to financial and HR constraints).

¹²Rwanda is undergoing a successful move towards fiber-optic network and the elimination of duties on the import of computers and other equipment. These policies, combined with the rapid surge of internet penetration country-wide, significantly facilitated the introduction of modern technologies (Schreiber, 2018).

¹³Presentation by Soobhash Sonah, Director of Information System Department at the Nigeria Governors' Forum Technology and Tax Event on April 19, 2021.

On top of structural differences in IT development across institutions, the persistence of a silo mentality which hampers inter-institutional data sharing, is another key consequence of the lack of a uniform, whole-government, IT strategy as reported in Ethiopia (also see Mascagni and Mengistu, 2019).

Another key element to consider refers to the legal background in which a given technology lands. For instance, it is unclear how the tax code adapts to an ever-evolving technological landscape. In Malawi, the revenue authority could not introduce e-filing solutions because of the existing tax code, which did not contain specific instructions around the technology. The authority experienced significant delays with e-filing rollout and is now playing a more prominent role in informing the tax amendment bills. As a similar challenge, the tax code is often unclear about the mandatory or voluntary nature of a technology, such as e-filing, an aspect which can be relevant for its effectiveness (Section 5).

In addition, regulatory confusion could arise when it comes to data sharing or co-using a given technology between institutions. Interviewees from Malawi and Uganda believe that the law stipulates that the tax administration may access any data required to perform its functions. However, this does not necessarily happen on the ground. In Uganda, private partners, especially banks, often refrain from sharing data due to confidentiality and political reasons (see also Santoro and Waiswa, 2022).¹⁴ Similar patterns arise in Ethiopia, where many banking institutions are reluctant to share customer data with the Ministry even when there are legal obligations on them to do so.

¹⁴In 2018, for instance, the URA lost an important battle to access financial transaction information from banks after vehement protests from the industry. In that case, the government quickly blocked this attempt, stressing the political element around inter-institutional data sharing. See Santoro and Waiswa (2022) and the article from Mumbere (2018) ‘Museveni blocks tax body from accessing Ugandans’ bank details’ on Africa News, (10 April) accessible at <https://www.africanews.com/2018/04/10/museveni-blocks-tax-body-from-accessing-ugandans-bank-details/>.

7 Conclusion

Increasing tax revenues is an urgent policy goal in many African countries. This paper examines the ways in which technology may be used to increase revenue mobilization by addressing tax administration challenges across four major tax categories: consumption taxes, real estate taxes, trade taxes, and income taxes. It focuses on the role of information technology to define compliance by helping the tax administration verify the extent of the tax base, to monitor compliance by leveraging multiple sources to uncover evasion, and to facilitate compliance by simplifying processes and reducing tax compliance costs. While this paper focuses on relatively established technologies being widely implemented in Africa, such as electronic fiscal devices, we believe that the same considerations and concerns apply to newer technologies, such as digital merchant payments and digital IDs, that are gaining momentum in Africa (World Bank, 2016).

The findings from the literature review as well as the interviews with senior tax administration officials highlight key lessons for African countries (and other countries at similar income level) to consider in the process of technology adoption, three of which we highlight here: equity concerns, taxpayer strategic responses and tax official training and incentives. New tax technology has the potential to exacerbate inequities among taxpayers. Smaller taxpayers, those with lower education or other disadvantages may find it more difficult to adopt new technologies and may bear disproportionate tax compliance costs. Not only should the introduction of new technology be accompanied by extensive awareness campaigns and trainings, but governments should also proactively consider the technical, infrastructure and financial limitations of less privileged taxpayers and develop programs and structures to support them.

A different concern with taxpayers is that they may respond strategically to undo the effects of the new technology on increasing their tax compliance. For example, if a technology application provides third-party information on one source of their revenues, they may compensate by misreporting on other aspects of their tax declaration. This implies that tech-

nology does not replace traditional tax enforcement strategies such as audits to expose tax evasion. Rather, technology can complement traditional enforcement by helping to analyze large amounts of data across firms to identify taxpayers at higher risk of non-compliance.

Tax officials are a crucial factor in the successful deployment of technology for taxation. If they lack adequate training or if their incentives are not well-aligned, they may avoid or circumvent the new technology. Tax authorities need to provide ongoing training to tax officials to be able to effectively use IT systems, as well as specialized training to use the electronic tax data generated for sophisticated analyses to help monitor compliance. Further, the highest levels of leadership need to establish and enforce standards of conduct and performance for tax officials to comply with the deployment of the new technology.

Whereas this paper has focused on the use of technology to administer existing taxes, an interesting area for further research is to consider how advancements in the use of technology may change the mix of tax instruments used across African countries. For example, with greater access to third-party information and employer withholding on individuals' incomes, countries may shift to a greater reliance on income and payroll taxes, and a lower reliance on trade taxes compared to higher income countries.

Lastly, an important concern with the deployment of technology systems in taxation is the need to protect citizens from unintended consequences in terms of privacy, confidentiality, data leakages and cybersecurity. This aspect is particularly important in Africa. On the one hand, weaknesses of the legal system and rule of law present a risk of government surveillance and violation of citizens' privacy. On the other hand, the nascent nature of data management systems within tax administration implies that such systems may be vulnerable to cyberattacks in which confidential data are accessed. As such, countries looking to expand the use of technology for taxation need to also focus on strengthening the regulatory framework to protect citizens' privacy rights and the cybersecurity capacity of all technology systems deployed.

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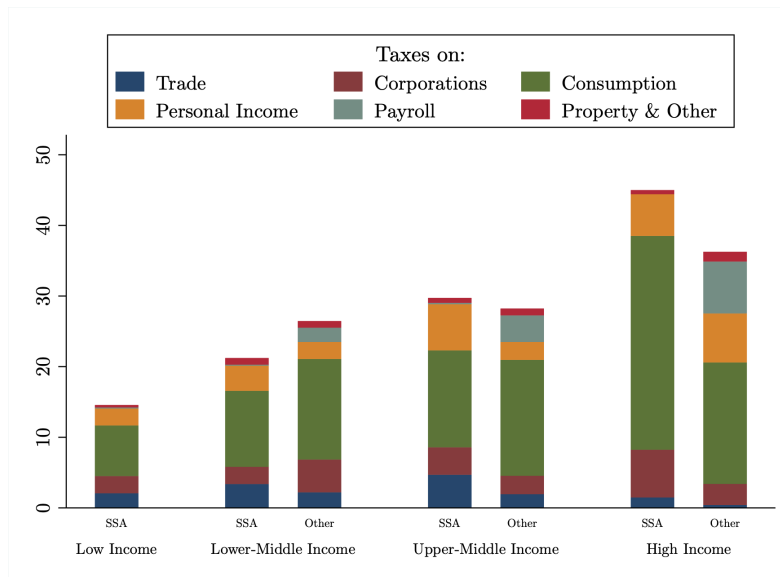
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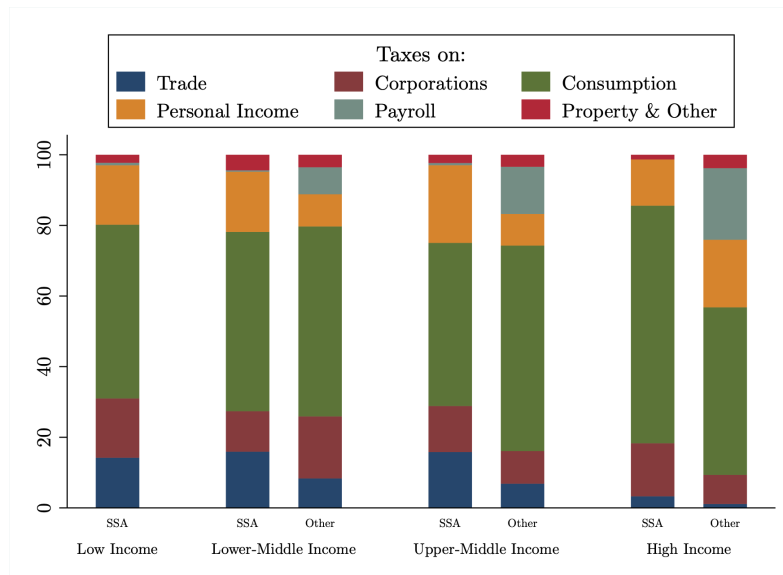
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Figure 2: Composition of Taxes by Country Income Level

Panel A: Taxes as Share of GDP



Panel B: Tax Types as Share of Total Taxes



Notes: Notes: Tax revenue data comes from UNU-WIDER Government Revenue Dataset (2021) for 2018, the most recent year with comprehensive tax data across a wide range of countries.

- Low income SSA: Rwanda, the Gambia, Togo, Sierra Leone, Somalia, Chad, Mali, Madagascar, Malawi, Sudan, Guinea-Bissau, Burkina Faso, Democratic Republic of the Congo, Niger, Liberia, Guinea, Uganda, Central African Republic, Mozambique.

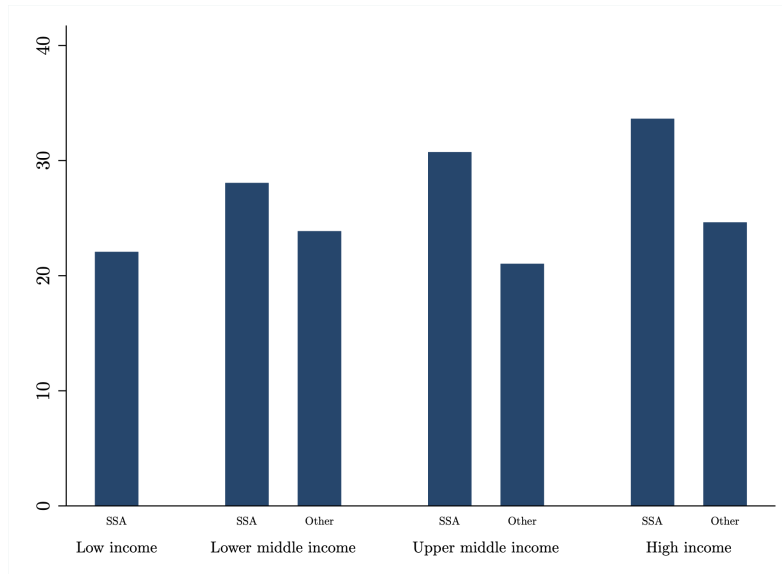
-Lower-Middle Income SSA: Cote d'Ivoire, Zambia, Eswatini, Comoros, Ghana, Lesotho, Sao Tome and Principe, Benin, Kenya, Senegal, Tanzania, Mauritania, Republic of the Congo, Angola, Cape Verde, Zimbabwe.

-Upper-Middle Income SSA: Botswana, South Africa, Equatorial Guinea, Mauritius, Namibia.

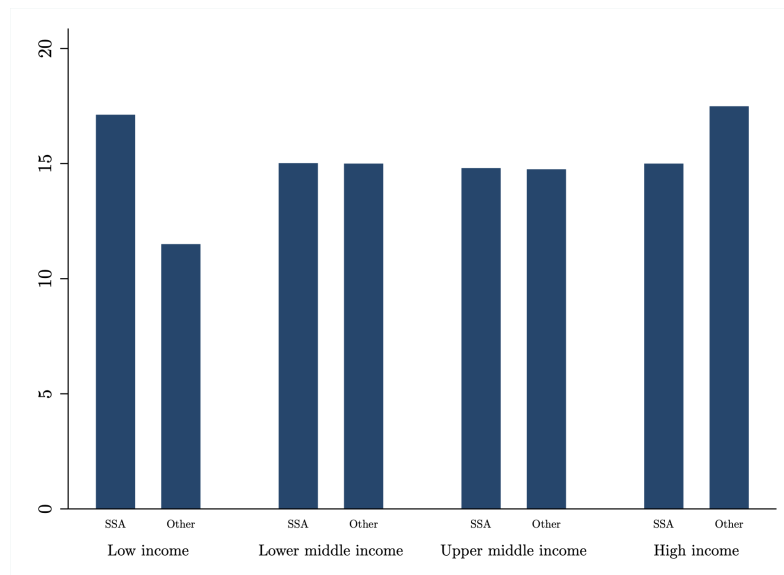
-High Income SSA: Seychelles

Figure 3: Tax Rates across Countries

Panel A: Taxes on income, profits and capital gains (% of revenue)



Panel B: VAT Tax Rates across Countries



Notes: Panel A: The data on tax rates is from World Development Indicators (2018). Panel B: The data is from International Monetary Fund (2022), Tax Policy Assessment Framework (TPAF) in 2018 over 214 countries. IMF country groups:

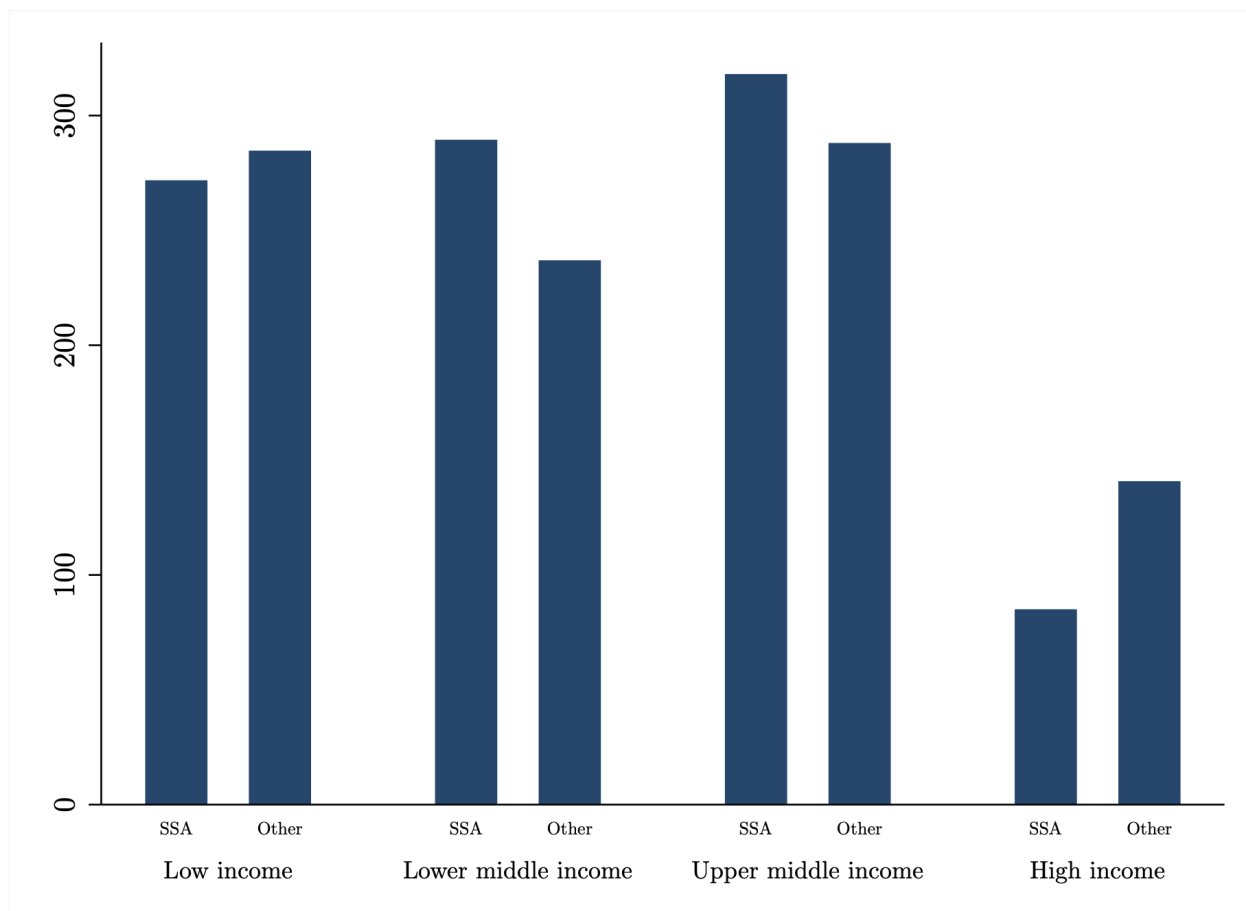
-Low income SSA: Burkina Faso, Burundi, Central African Republic, Chad, Comoros Islands, Democratic Republic of the Congo, Eritrea, Ethiopia, Gambia, Guinea, Guinea-Bissau, Liberia, Madagascar, Malawi, Mali, Mozambique, Niger, Rwanda, Sierra Leone, Somalia, South Sudan, Tanzania, Togo, Uganda, Zimbabwe

-Lower-Middle Income SSA: Cameroon, Cape Verde, Republic of the Congo, Cote d'Ivoire, Djibouti, Eswatini, Ghana, Kenya, Lesotho, Mauritania, Nigeria, Sao Tome and Principe, Senegal, Zambia

-Upper-middle Income SSA: Angola, Botswana, Gabon, Mauritius, Namibia, South Africa

-High Income SSA: Seychelles, Equatorial Guinea

Figure 4: Compliance Costs: Time to prepare and pay taxes (hours per year)



Note: The data is from World Development Indicators (2018). Figure 4 presents how much time, measured in hours per year, firms spend preparing and paying three major types of taxes: the corporate income tax, the value added or sales tax, and labor taxes, including payroll taxes and social security contributions.

-Low income SSA: Burkina Faso, Burundi, Central African Republic, Chad, Democratic Republic of the Congo, Eritrea, Ethiopia, The Gambia, Guinea, Guinea-Bissau, Liberia, Madagascar, Malawi, Mali, Mozambique, Niger, Rwanda, Sierra Leone, Somalia, South Sudan, Sudan, Togo, Uganda

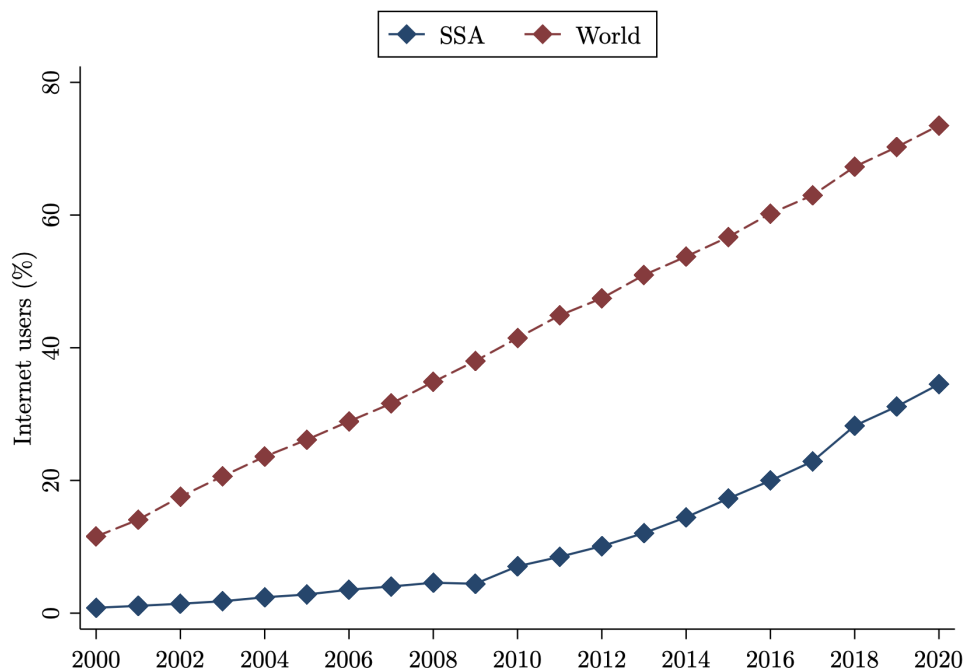
-Lower-Middle Income SSA: Benin, Cabo Verde, Cameroon, Comoros, Republic of the Congo, Côte d'Ivoire, Eswatini, Ghana, Kenya, Lesotho, Mauritania, Nigeria, Senegal, São Tomé and Príncipe, Tanzania, Zambia, Zimbabwe

-Upper-Middle Income SSA: Botswana, Equatorial Guinea, Gabon, Mauritius, Namibia, South Africa

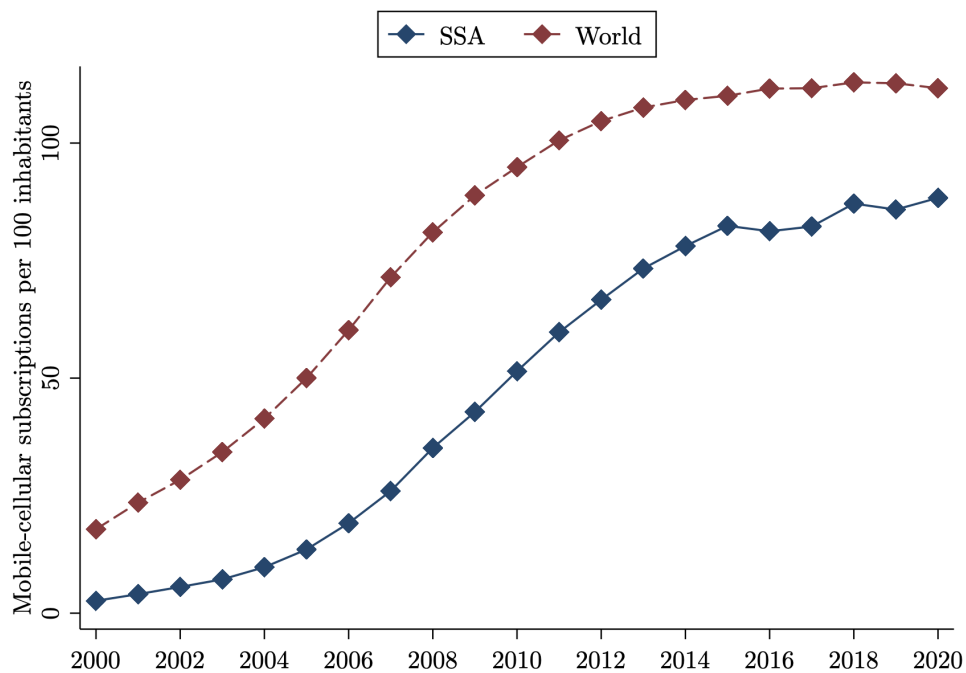
-High Income SSA: Seychelles

Figure 5: Use of Internet and Mobile Phones

Panel A: Percentage of Population using the Internet



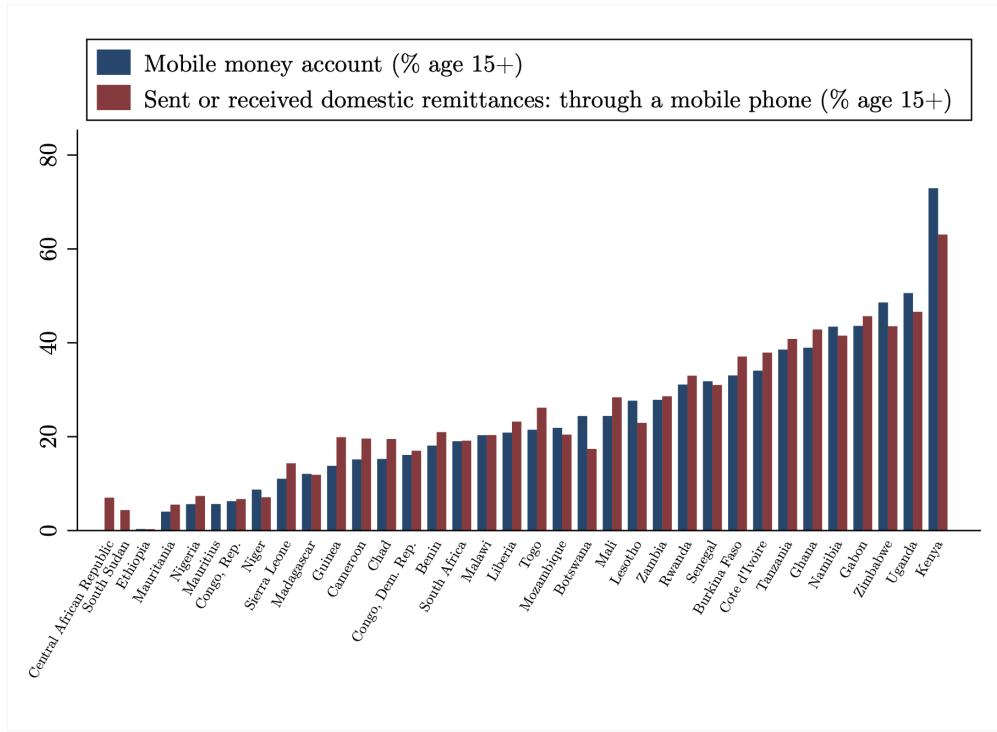
Panel B: Number of Mobile Phone Subscriptions



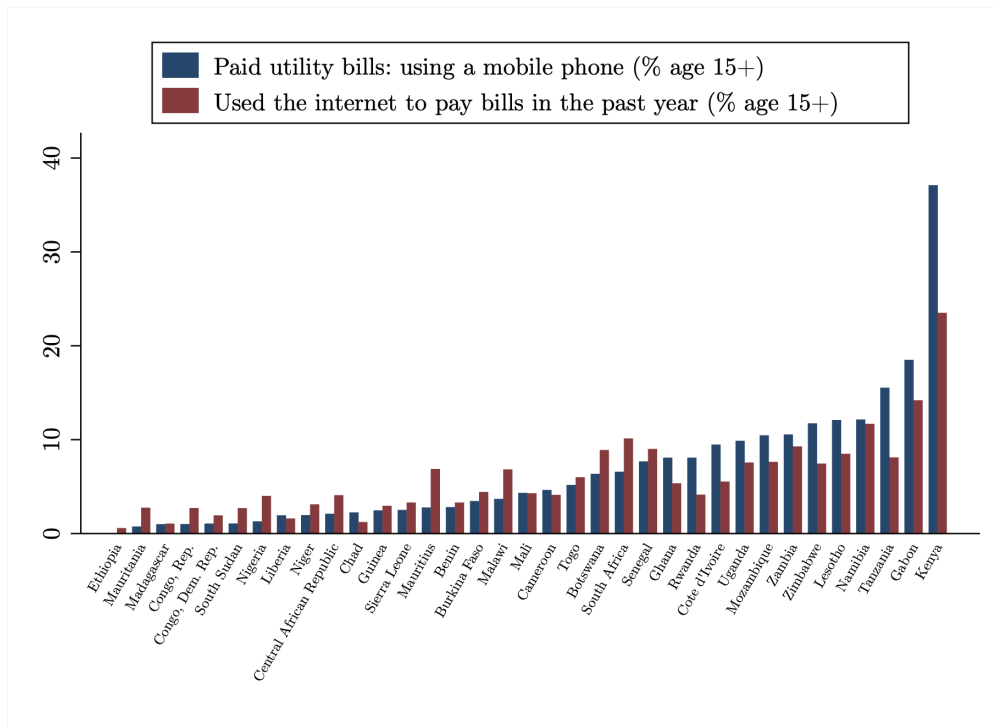
Note: Panels A and B: Data from the World Development Indicators (2018).

Figure 6: Use of Mobile Money

Panel A: Ownership and Usage of Mobile Money Accounts



Panel B: Usage of Mobile Money Accounts and the Internet for Bill Payments



Note: Panels A and B: Data from the World Bank Global Financial Inclusion data for 2017.

Appendix

Appendix A: In-depth interviews conducted for this study

N	Country	GovTech Index	Tech Maturity Group	Revenue Authority	Date
1					05/05/21
2	Uganda	0,62	B	URA	06/05/21
3					02/06/21
4	Malawi	0,47	C	MRA	17/05/21
5	Ethiopia	0,33	C	Ministry of Revenue	03/06/21
6					22/06/21
7	Rwanda	0,53	B	RRA	10/06/21
8					08/07/21
9	Sierra Leone	0,37	C	NRA	25/06/21
10	Nigeria	0,49	C	FIRS	22/07/21
11	Eswatini	0,28	C	ERS	04/11/21

Roles of interviewees: Manager of Data Warehouse, Head of Business Intelligence Computer Centre, Head of Software applications, Directors of ICT, ICT Support Experts, Data specialists and business analysts, Heads of research departments.

Appendix B: In-depth Interview Form

Section I – Technologies

1. CORE: Broad, introductory

- What do you think are the current key challenges with technology and priorities in technology development your RA has?

In this session, we want to discuss both more structural, inward-looking technologies, like the integrated tax management system, and more piece-meal, transactional technologies, like EFDs and e-filing/payment. Let's start with the first.

2. CORE: Integrated system

- Which IT system or systems does your RA currently use to manage its data and operations?
 - a. [if not an ITAS] Which are the biggest obstacles to adopt an ITAS?
 - b. [if not an ITAS] If you are planning to get an ITAS, when this will happen?
 - c. [with or without ITAS] Do departments managing different datasets and systems communicate with each other and share information?
- [if using an ITAS] What do you think are the most significant impacts from ITAS?
 - PROBE I: how does that affect data practices and data quality?
 - PROBE II: what are the impacts on tax administration efficiency?
- DIVE-IN, BACK-UP QUESTIONS: More broadly, how does the technology used influence the data quality? What issues in data quality are due to the technology used and/or could be solved with a different technology?

3. CORE: Technologies for taxpayers

For each of the following technologies (i) EBM/EFDs, (ii) e-filing and e-payments, if they are in place:

- What do you think are the impacts on Domestic Revenue Mobilization and taxpayer compliance?
- Was facilitating compliance a policy goal of this technology? How is it performing on that side? Are you noticing challenges, complaints, or technical difficulties with using the technology?
- Is the new technology improving the quality of data within the RA?
 - PROBE I: how is the new data used for enforcement?

Section II – Broader considerations

1. *Staff and IT*: Let's explore the linkages between RA staff and technology: How do you think the RA staff is coping with the increasing complexity produced by evolving data practices and technology?
 - a. PROBE I: What measures did you put in place to encouraging staff to accept new technologies and data practices?
 - b. PROBE II: Who is in charge of dealing with raw data, cleaning and managing data?
2. *Infrastructure*: are you facing connectivity or hard infrastructure issues in the implementation of technology?
3. *Funding*: do you have a sufficient budget allocated to technological improvement?
4. *Legal framework*: how do you think the regulatory/legal framework in your country helps the uptake of technology by taxpayers? Is the tax code adapting to evolving technology? Could you give an example?