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Working Paper 135

**The Promise and Limitations of
Information Technology for Tax
Mobilisation**

Oyebola Okunogbe and Fabrizio Santoro

January 2022

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Oyebola Okunogbe and Fabrizio Santoro

Summary

Tax revenue in many low-income countries is inadequate for funding investments in public goods and human capital. While tax systems have been adopting new technologies to improve tax collection for many years, limitations to in-person interactions due to COVID-19 have further highlighted the role of information technology in tax mobilisation. This paper examines the potential of technology to transform tax administration by helping to identify the tax base, facilitate compliance, and monitor compliance. It also identifies possible limitations to the use of technology arising from inadequate infrastructure and connectivity, lack of adoption (or resistance) by taxpayers and tax collectors, lack of institutional mainstreaming, and an unsupportive regulatory environment.

Keywords: Technology, taxation, tax administration, tax compliance.

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Acronyms

EBM	Electronic billing machine
EFD	Electronic fiscal device
ERCA	Ethiopian Revenue and Customs Authority
ESRM	Electronic sales register machine
ITAS	Integrated tax administration system
LMICs	Low- and middle-income countries
MRA	Malawi Revenue Authority
RRA	Rwanda Revenue Authority
TIN	Taxpayer identification number

Introduction

Over the last few decades, tax systems around the world have increasingly adopted new technologies to improve administrative processes, reduce taxpayer compliance costs, and enhance their overall effectiveness at collecting tax revenue. These developments come in the context of digital transformation across all facets of life: from government to business to interpersonal relationships and much more, an increasing number of interactions are conducted virtually given the rapid development and expansion of digital infrastructure.¹ While this transformation 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.²

Given the rapid expansion in the use of information technology by tax authorities, this paper discusses the potential and limitations of information technology for tax administration, especially in low- and middle-income countries (LMICs), with a focus on Africa. Currently, technology adoption in LMICs is generally lower than in high-income countries.

However, there may be significant opportunities to leapfrog to the technology frontier, as African countries were able to do with mobile phones and electronic payment technology such as m-PESA. Compared to high-income countries, low- and middle-income countries are characterised by a higher level of in-person interactions between taxpayers and tax officials. In African countries, 72 per cent of firms report being required to meet with tax officials, and for those affected, 3.2 meetings are held on average each year. In contrast, 37 per cent 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 (World Bank Enterprise Surveys). Robust adoption of technology will move taxpayers from in-person interactions where they are susceptible to the discretion of individual tax officials to interfacing with electronic systems where there is a more consistent experience across taxpayers. However, it is still unclear whether taxpayers, once used to in-person interactions and manual practices, will be able to seamlessly embrace new technology.

Against this background, the key research question is, how can African countries (and other LMICs) improve tax mobilisation using recent technological advancements? We draw on a burgeoning literature on the role of technology in tax administration to highlight key lessons on maximising the potential of technology. We also discuss complementary reforms that must be undertaken to ensure that investments in technology yield the desired results for tax mobilisation. Our approach is to provide a broad overview on the literature, combined with deep dives into a few country case studies from selected academic papers.

In the first part of the paper, we consider how technology can transform three core functions of tax administrations. First, technology could be used to *define compliance*, that is, to strengthen the capacity of tax administration to identify the tax base – or the pool of subjects liable to remit a given tax amount. This could happen, for instance, when IT enables the creation of a new database of taxable subjects (such as individuals or properties). In the same fashion, IT could help define the actual amount to be remitted more transparently by relying on the automatic capture of transactions as they occur, through electronic fiscal devices (EFDs), or by accessing different data sources and reports.

¹ In 2020, 51 per cent of the global population was connected to the internet. This figure was 7 per cent only 20 years earlier (source: Our World in Data/ World Bank indicators).

² For example, in the United States, the average number of telecommuting days for all workers more than doubled, from 2.4 per month to 5.8 before and after the onset of COVID-19 (Gallup 2021). <https://news.gallup.com/poll/355907/remote-work-persisting-trending-permanent.aspx>

Second, technology can be used to *facilitate compliance*, that is, to simplify processes and improve taxpayer experience. Technology could significantly reduce tax compliance costs, which are often disproportionately borne by smaller taxpayers. For example, e-filing (often accompanied by e-payment) of taxes can make the taxpaying experience less time-consuming and more consistent across taxpayers.

Third, technology can be used to *monitor compliance*. Technology could significantly boost the capacity of the tax administration to monitor and enforce compliance, through the automation of cross-checks of self-reported tax liability with other data sources – thus increasing the transparency of the audit experience – as well as through risk-based auditing practices which would result in more targeted and data-centric audit selection.³ As we will see, certain technologies can address more than one of these three potential uses.

In the second part of the paper, we consider factors that may prevent the realisation of the potential of technology to improve tax mobilisation. First, lack of appropriate infrastructure and internet connectivity will hinder effective deployment of the technologies. Second, users (taxpayers and tax officials) may avoid or actively resist the introduction of a new technology due to lack of training, high adoption costs or loss of opportunity for unofficial behaviours. Third, the absence of a clear organisational strategy that involves high-level change management and a proper sequencing of the digitisation of different functions and processes can hamper the effectiveness of technologies that are introduced. Fourth, without a functional legal system to enforce tax laws, the revenue authority may be unable to collect tax liabilities that have been uncovered with the use of technology. Relatedly, there needs to be an appropriate regulatory framework that allows a balance between data privacy and security and the use of new data and technology for tax purposes.

While there are many applications of technology in tax administration, this paper focuses on foundational technological innovations which are usually adopted at the core of the digital journey of a tax administration, such as e-filing (often coupled with e-payment), electronic fiscal devices (including electronic sales registers and electronic billing machines), IT solutions used for taxpayer registration and communication, as well as tax data cross-checks and third-party data analytics. We highlight these types of technology as they communicate with each other and are likely to perform best when included in the same technological transformation package – usually supported by an integrated (and automated) tax administration system (ITAS).⁴ Focusing on these foundational technologies also enables us to draw on an increasing, robust body of evidence that has been produced on them in the last few years. We expect that the lessons from reviewing the existing evidence on the effectiveness of technologies that are more widely used in LMICs will help in understanding the potential impact and constraints in the adoption of more sophisticated technologies that have been introduced in some other contexts, such as the automatic withholding of taxes from sales payments made via credit card,⁵ automatic pre-filing of tax returns using third-party information, and the use of blockchain to verify transactions and tax records.⁶

³ Other core functions are impacted as well. These include the capacity to perform more timely data-driven decision-making, as well as the capacity to run more elaborate statistical analysis and forecasting. We decided to leave these aspects outside the scope of the paper, as we focus on those aspects directly affecting taxpayers' interactions with the tax administration.

⁴ For instance, the huge amount of data produced by EFDs is unlikely to be fully tapped without an automated and integrated data management system on the receiving end. Likewise, e-filing without a flexible, adaptive, timely response from the authority (which is often enabled by ITAS) is likely to be unsuccessful (Santoro, Lees, Carreras and Mukamana (forthcoming)).

⁵ See Brockmeyer and Hernandez (2016).

⁶ Such technology would enable a variety of services (such as e-registration with government entities, e-filing of taxes, and sharing of data among government agencies) under a strong security model where all information is digitally signed and encrypted and all incoming data are authenticated and logged (Martinovic, Kello and Sluganovic 2017).

This paper contributes to both the academic literature as well as policy conversations in LMICs. It provides a review of the booming literature on the use of technology in tax administration (Bird and Zolt 2008; OECD 2015; World Bank 2016; Kochanova, Hasnain and Larson 2020; Bellon, Chang, Dabla-Norris, Khalid, Lima, Rojas and Villena 2019; Santoro et al. forthcoming) and identifies outstanding gaps in the literature for future research. It therefore complements other reviews on taxation in developing countries (e.g. Mascagni (2018), Slemrod, Collins, Hoopes, Reck and Sebastiani (2017), Pomeranz and VilaBelda (2019)).

More broadly, the paper adds to the literature on the use of technology in governance. The evidence on the effectiveness of investment in e-government on strengthening government capability to deliver services and expanding citizen participation is still rather mixed (World Bank 2016). On the one hand, there is evidence of effective deployment of digital public service provision in procurement (Lewis-Faupel, Neggers, Olken and Pande 2016), education (Aker and Ksoll 2019; Escueta, Quan, Nickow and Oreopoulos 2017), voting (Callen and Long 2015; Fujiwara 2015; Callen, Gibson, Jung and Long 2016; Aker, Collier and Vicente 2017) and social protection (Aker, Boumnijel, McClelland and Tierney 2016; Banerjee, Duflo, Imbert, Mathew and Pande 2020). On the other hand, better information technology does not necessarily translate into improved behaviours and welfare, especially in health (Nglazi, Bekker, Wood, Hussey and Wiysonge 2013 provide a review) and agriculture (Aker, Ghosh and Burrell 2016; Courtois and Subervie 2015; Hildebrandt, Nyarko, Romagnoli and Soldani 2014; Nakasone, Torero and Minten 2014; Mitra, Mookherjee, Torero and Visaria 2013; Camacho and Conover 2010; Fafchamps and Minten 2012; Casaburi, Kremer, Mullainathan and Ramrattan 2014). This paper examines several studies where technology has led to improvements in government service delivery but also describes conditions that may preclude successful outcomes. Relatedly, the paper also addresses basic questions of digital technology access and usability (Aker and Cariolle 2020; Santoro et al. forthcoming).

For policy, the paper provides guidance to policy makers as tax authorities increasingly adopt electronic systems in interacting with taxpayers in a post-COVID world where remote interactions are more prevalent. It distils lessons from the academic literature on the vast potential of technology as well as highlights the necessary technical, institutional and political factors for a successful shift to technology. In particular, it emphasises how technology adoption must be contextualised within the current administrative capacity of the country. Lastly, by highlighting the potential policy impact of rigorous and timely policy research, in many cases made possible by the rich data produced from the use of technology, this paper also seeks to encourage further collaboration between policy makers and researchers.

1 Potential of technology in taxation

1.1 Define compliance

Information technology is crucial for addressing the ‘information problem’, a core challenge for tax administration (Alm 2021). In order to tax, the government must be able to identify the tax base. Prior research has shown that for taxes that are subject to third-party reporting, such as wages paid to employees and capital income paid to clients, tax evasion is negligible. However, evasion is substantially higher for taxes not subject to third-party reporting, where taxpayers self-declare their tax liability (Kleven, Knudsen, Kreiner, Pedersen and Saez 2011).

Tax authorities can deploy appropriate technology systems to obtain information on taxpayer liabilities that may otherwise be hidden or manipulated by taxpayers. For third-party information, technology can enable the efficient submission of large amounts of data from a reporting entity (such as an employer or financial company). Technology may also facilitate linking databases that provide information on the different sources of taxable income/property of a taxpayer. The examples below will highlight the use of technology in defining the tax base in two different settings. First, in addressing the challenge of information on transactions that may otherwise go unreported, we examine the use of electronic fiscal devices that report information on sales as they occur. Second, we examine the use of technology in improving taxpayer registration, with a specific focus on how IT is used in real estate tax administration to systematically capture information on tax liabilities that are observable but not codified.

1.1.1 Obtaining real-time transaction information with electronic fiscal devices

An interesting example of how electronic fiscal devices could help define compliance comes from Ethiopia. The main premise of EFDs is that such machines, in their different versions, are able to automatically record transactions as they are performed and smoothly communicate with the tax administration through either a mobile network or the internet. Such an unprecedented flow of information holds the potential of assisting the tax administration in knowing more about their taxpayer population. The Ethiopian Revenue and Customs Authority (ERCA) started the rollout of electronic sales register machines (ESRMs) – as EFDs were named there – 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. Ali, Shifa, Shimeles and Woldeyes (2017) evaluate the impact of such technology on both tax payments and proxies of the tax base. They show that ESRMs statistically significantly increase reported sales and tax payments, while also leading to positive impacts on actual output – proxied by employment rates. Importantly, the tax base is not negatively affected by ESRMs as firms do not shun ESRM adoption – the authors do not find any significant relationship between ESRM adoption and net entry rate. By and large, the evidence from Ali et al. (2017) points to positive impacts on ERCA’s fiscal capacity, by which the authority benefits from ESRMs in terms of more informative data flows, accompanied by increases in tax remitted.

The study of Mascagni, Mengistu and Woldeyes (2021), also set in Ethiopia, provides another interesting angle to the narrative. In addition to Ali et al. (2017), the authors consider the fact that ESRMs may well have compliance effects across other tax types beyond VAT, following the recent shift towards studying compliance spillovers across taxes for a complete evaluation of any policy intervention (López-Luzuriaga and Scartascini 2019). The authors document that the ESRMs significantly improve the accuracy of firms’ reporting, measured by the discrepancies in reported sales between VAT and income tax returns. The authors

first document a situation in which discrepancies are widespread: on average in 2010-2014, 60 per cent of firms reported discrepancies in turnover in their declarations. Such discrepancies more than halve after the introduction of ESRMs as a result of the combination of improved record-keeping practices and increased perception of detection of misreporting – given that the machines automatically communicate with ERCA and it is indeed a rational response for taxpayers to improve the accuracy of their own reports, even across taxes (Mascagni, Mengistu and Woldeyes 2021).

In addition to the positive evidence above, there are some more nuanced considerations. First, while technology could help better identify transaction volumes and tax payable, as shown in Ethiopia, behavioural and strategic responses from taxpayers could produce perverse effects. Mascagni, Mengistu and Woldeyes (2021) show how taxpayers react to the adoption of a technology on multiple margins. In the case of Ethiopia, the 87 per cent increase in VAT sales as a result of ESRM adoption is offset by a simultaneous – and proportionally larger, 150 per cent – increase in deductible costs thus substantially reducing the potential revenue gains (Mascagni Mengistu and Woldeyes 2021).⁷ Second, while technology could be an effective tool to identify the tax base and the tax due more accurately, it proves to be ineffective in those contexts lacking robust traditional enforcement, as also mentioned in section 1.3 below. While new technology could generate new data, it is only effective if it spurs adequate deterrence actions from the authority – which in turn depend on the resources available for traditional enforcement.

1.1.2 Using technology for taxpayer registration

Technology could also significantly assist tax administration in registering taxpayers and, more importantly, uniquely identifying them. In this sense, integrated tax administration systems (ITAS) are crucial in streamlining the registration process. Unsurprisingly, one of the first modules which is usually implemented when an ITAS is launched is the registration module, enabling e-registrations. Qualitative evidence shows that it is quite hard to keep proper registration data without a well-functioning, automated system. In its absence, revenue authorities often implement suboptimal practices which translate into the existence of parallel registries, often kept on Excel spreadsheets, and, ultimately, in administrative confusion, duplication of work and difficulty in monitoring the taxpayer base (Ligomeka 2019; Stewart-Wilson forthcoming). In light of the recent wave of automation in tax administration, more research is needed to explore impacts on internal efficiency.

A particular case study, for example, could refer to the new technology by which revenue authorities link their registration process with the national registration agencies – as is happening in Uganda and Malawi, among many other African countries – in order to automatically extract taxpayers' demographic details. This harmonisation of registries revolves around the national identification system, as taxpayers have to input their national ID number when registering with the authority, and presents an interesting example of cooperation between public institutions. It is not clear however whether data from digital IDs could fulfil all the informational needs of data-hungry tax administrations, or whether tax administrations are adequately equipped with skills and staff to make the best use of such new data.

Technology could also significantly assist local authorities in moving away from obsolete property valuation systems. Property tax is particularly placed for benefitting from simplified valuation systems as enabled by new technology. For instance, the Freetown City Council (Sierra Leone) introduced a new simplified 'points based' system (Fish 2018), with technical support from the International Growth Center, the International Centre for Tax and

⁷ Similar offsetting responses are found in the broader tax literature on firms (Ariel 2012; Carrillo, Pomeranz and Singhal 2017; Slemrod et al. 2017; Mascagni and Nell forthcoming).

Development and aid from the UK government (Grieco, Bakarr Kamara, Meriggi, Michel, Prichard, and Stewart-Wilson 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. And then they used existing data on rental values to build a simple model for calculating the taxable value of each property. Importantly, and highlighting again the need for complementary automation to strengthen tax administration internal functions, the city council also developed a new IT system to manage this entire process: from data collection to valuation, billing, payments, appeals and enforcement. This new system should significantly grow property tax revenues. First, it almost doubled the number on the tax register from 57,000 to about 110,000. Notably, the new system has produced much higher tax bills for the most valuable properties, owned by the wealthiest taxpayers, which have been historically under-taxed. This new IT solution is meant to correct societal inequalities as it will better reflect the enormous disparities in property values, wealth, and ability to pay across the city (Kamara, Meriggi and Prichard 2020).

A similar example comes from Senegal. According to Knebelmann (2019), key challenges impede the administration of a sound property tax in Dakar. Baseline data shows that, at most, a third of cadastral plots are on the valuation roll – hence their value is known to the tax administration. On top of that, rental values listed in the roll are on average lower than values obtained through other sources (surveying owners and real estate experts), likely due to poor and biased valuation practices. Furthermore, cadastral information on plots, as owned by the tax administration, is not linked to address information as declared by taxpayers, which is accepted as it is and not verified or double checked in the current declarative system. This lack of data harmonisation results in the impossibility of sending 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.

In an ongoing study led by the International Growth Center and the International Centre for Tax and Development, a new technology has been introduced, namely a specific property tax application digitising the different steps of the fiscal chain, thus limiting the loss of information and improving the quality of data (through linking of property information to GPS coordinates), strengthening the efficiency of the local tax administration, and allowing data sharing with the Treasury. Importantly, before introducing the app, the whole cadastral information was added to the new system. Research is currently ongoing evaluating the efficacy of the application in improving property tax collection and taxpayers' perceptions (Knebelmann 2019). Along the same lines, in Box 1 we examine the case of real estate taxes in Liberia and how the use of technology could systematically capture information on tax liabilities that are observable but not codified.

Despite these positive considerations that can be made in support of technology in registration, technology-enabled registrations could take place over-aggressively in developing countries, along with the increasing drive towards formalising as much as possible, often to reach given annual targets (Moore 2020). However, it is still unclear whether mass registration could translate into higher compliance. If anything, abundant evidence is being produced on the poor impacts on revenues due to widespread non- and nil-filing⁸ – as well as to high compliance costs (Mascagni, Santoro and Mukama 2019) – of new entrants.

⁸ In Guatemala, the share of non-filers of income tax in 2013 was 39 per cent (Kettle, Hernandez, Ruda and Sanders 2016); in Costa Rica, 50 per cent of registered firms failed to file in the period 2006-2014 (Brockmeyer, Smith, Hernandez and Kettle 2019); in the República Bolivariana de Venezuela, the non-filing rate for the municipal income tax is 20 per cent (Ortega and Scartascini 2015). In Eswatini, for CIT and PIT respectively, the six-year average of missing returns is 43 and 57 per cent, while nil-filers represent 29 and 17 per cent of the CIT and PIT filing population, respectively (Santoro and Mdluli 2019). In Rwanda, over half of all newly registered taxpayers completely fail to file a declaration in the first year (Mascagni, Santoro and Mukama 2019), while 53 per cent and 19 per cent of CIT and PIT

Box 1 Real estate tax in Liberia

Problem: Real estate tax in Liberia, like many low-income countries, is characterised 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 outside the tax net. Only about 5 per cent of residential property owners were estimated to be on the tax roll (Okunogbe 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 for paying. The second group received a 'Detection Notice' that 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 per cent and payment rate of 2 per cent 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 highlights the effect of using technology to organise the publicly visible information on property tax liabilities to boost tax compliance.

1.2 Facilitate compliance

An important application of technology in taxation is to improve taxpayers' experience by making it easy for them to obtain information and fulfil their tax obligations. Many tax authorities are increasingly adopting a customer service orientation towards taxpayers. One initial step taken by tax authorities is to provide detailed instructions, forms and guidance on their website on the compliance steps and requirements for each type of tax. A further step is to make it possible for taxpayers to complete transactions online, such as the ability to file and pay taxes online. Tax authorities may then also have individual taxpayer accounts that contain the taxpayer's transaction history with the tax authority. The tax authority may also

returns are nil in 2013-18 (Mascagni, Santoro, Mukama, Karangwa, and Hakizimana 2020). Also in Rwanda, Mascagni, Mukama and Santoro (2019) show that 35 per cent of VAT returns from July 2016 to June 2017 have both zero VAT on sales and zero VAT on purchases. In Ethiopia, about 23 per cent of CIT returns filed in 2006-2013 are from nil-filers (Mascagni and Mengistu 2016). Likewise, in Uganda 27 per cent of PIT returns are nil over the period 2013-2018 and, according to Almunia, Hjort, Knebelmann and Tian (2021), 15 per cent of VAT returns in 2012-2015 are nil.

use electronic means of communicating with taxpayers such as SMS and email reminders, payment confirmation and announcements.

A major consequence of these technology-driven tools is that they allow taxpayers to interact with the tax system in an impersonal way. In their absence, taxpayers would likely be subject to the discretion of tax officials responsible for providing information, conducting transactions and monitoring them in-person. We consider three specific technologies: (i) e-filing and e-payment services in section 1.2.1; (ii) electronic billing machines in section 1.2.2; and (iii) online communication in section 1.2.3.

1.2.1 E-filing and E-payment services

Electronic filing and payment refers to digital services that allow taxpayers to (i) file their taxes electronically – together with a range of other tax-related activities (attach annexures, claim for refunds, make appeals, update their personal details, get assistance online, check their filing history, etc.), usually through a web portal to which they have access or through similar phone applications, (ii) to perform payments of tax liabilities online, by means of digital platforms (mobile money, credit card or similar electronic transfers) which efficiently connect the revenue authority, private banks or digital financial service providers, and the central bank. The main promise that e-filing and e-payment hold refers to the capacity of taxpayers to perform such activities in a less burdensome and more transparent way – saving travel and queuing costs, error-prone manual inputting, and avoiding physical interactions with tax officials who may ask for bribes. Despite this potential, evidence on the impact of e-filing (and e-payment) is rather scarce, especially so from Africa. Despite focusing on a different context, Tajikistan, Okunogbe and Pouliquen (2022) provide important lessons for African countries as they turn to e-services in response to COVID-related social distancing measures.⁹ Box 2 below describes the study in detail.

Another meaningful example of the potential of e-filing to facilitate compliance comes from Uganda. Jouste, Nalukwago and Waiswa (2021) evaluate the impact of the introduction of a new e-filing system – an online tax form – for presumptive taxpayers in 2015. Before this technological innovation, taxpayers had to fill in more complex and less transparent offline Excel forms. These forms had to be submitted to the Uganda Revenue Authority's (URA) website, while, in order to get a payment receipt, taxpayers had to separately register the payment. With the new system, instead, taxpayers simply log in on the URA's website and fill in the form, which automatically calculates the tax due and provides receipts in one single venue. The most interesting aspect of this study is that the e-filing system, on top of doubling the number of presumptive taxpayers and increasing revenues thanks to its simpler nature, performed even better in conjunction with the parallel Taxpayer Register Expansion Project (TREP). With TREP, the URA provided a one-stop shop where tax officials offered assistance and further lowered taxpayers' compliance costs. The complementary impacts thus arising indicate that technology is likely to be more successful when coupled with taxpayer assistance and awareness campaigns (Jouste et al. 2021).¹⁰

The increasing evidence on the benefits arising from technology in terms of reduced compliance costs begs the question whether take-up could be incentivised and barriers to adoption could be more carefully considered. Some studies from Africa attempt to understand the nature of such barriers and document that more sophisticated taxpayers are

⁹ In more developed contexts, two evaluations of e-invoicing in Peru and China both reveal relatively large revenue increases (Bellon et al. 2019; Fan, Liu, Qian and Wen 2018). There are also reports on e-invoicing in Latin American countries, available in Spanish, such as Ramírez, Oliva and Andino (2018); Templado and Artana (2018); Bérngolo, Ceni and Sauval (2018).

¹⁰ According to World Bank (2016), in Belarus, e-filing was similarly part of a broader reform to lower compliance costs for citizens, including simplifying the tax code, setting up taxpayer facilitation services, and reaching out to the business community.

more likely to adopt the technology in the first place. In Nigeria, Efobi, Beecroft, Belmondo and Katan (2019) analyse the factors which drive small businesses to adopt and use e-filing and e-payment facilities. The study concludes that internal firm characteristics like owner's education, age of the company, and use of an external auditor and a computerised accounting system, are most strongly correlated with the use of these online tools. These results resonate with a more specific study on North-Western Nigeria by Mas'ud (2019).¹¹ In a different context, Obert, Rodgers, Tendai and Desderio (2018) identify the knowledge gap as a key challenge as taxpayers agree that a dearth of technical know-how and lack of training significantly impact their likelihood of adopting the e-filing system.

As a final consideration, evidence shows great heterogeneity in impacts which can be attributed to the specific design of the e-service. Important aspects in the design of IT solutions could have unintended consequences on taxpayers' compliance costs, especially when solutions are not customer-centric, reliable and trustworthy. In this regard, Yilmaz and Coolidge (2013) critically compare the different policy experiences of South Africa, Nepal and Ukraine and show how the potential of e-filing in reducing compliance costs depends on the policy design itself. E-filing is impactful in those cases, like South Africa, in which it completely replaces paper-based filing with no additional work required from firms.¹² In Nepal, where e-filing was mandatory and particularly cumbersome, it actually increased compliance costs. In Ukraine, where businesses kept filing on paper in parallel to e-filing due to lack of trust in the online system, compliance costs increased as well (Yilmaz and Coolidge 2013). Analogously in Africa, the Kenyan Revenue Authority (KRA) continued to maintain two concurrent tax filing systems – manual and i-tax – even after the introduction of the latter. As these two systems were not integrated with one another, they likely generated confusion among taxpayers and the KRA eventually detected discrepancies in the taxpayers' records (Maisiba and Atambo 2016).

Along the same lines, Kochanova et al. (2020) suggest that the policy implementation of complementary online tools such as e-payments plays a crucial role – whereas a simpler e-filing system that does not enable online payment of taxes has no effect on compliance costs and interactions with tax officials. Likewise, the existence of an ITAS on the tax administration side could considerably improve the e-filing experience – as taxpayers would be able to monitor their tax obligations on their web-profile, provide feedback and receive timely assistance. A highly policy-relevant message that can be derived from the literature is that the success of a given technology does not only depend on the effectiveness and design of that specific solution, but most importantly hinges on the comprehensive implementation of a coherent set of IT measures which together address interlinked taxpayer needs (such as filing and paying online), communicate smoothly and, thus, have an impact when combined.

¹¹ Mas'ud (2019) finds that, while microentrepreneurs hold positive views on the impact of e-filing usage, they lack awareness of its operating modalities and need assistance from intermediaries.

¹² It is also true that government mandates can produce unintended consequences. As a response to COVID-19, some low-income countries are making e-filing the only choice for taxpayers, regardless of their size. Anecdotal evidence from Eswatini, for example, shows how taxpayers in remote rural areas, where internet coverage is poor, have to travel to internet kiosks to be able to file online, assisted by tax officials. While this practice would probably enhance the quality of tax returns, it is unclear whether small taxpayers could see any benefit in terms of compliance costs, an aspect which in turn could deteriorate their willingness to comply and exacerbate socioeconomic inequality.

Box 2 E-filing in Tajikistan

Problem: Small business owners in Tajikistan faced high compliance costs as they had to submit monthly tax declarations in person at the tax office. These frequent meetings with tax officials also provided the opportunity for unofficial payments. Thirty-two per cent of taxpayers said they expect to give gifts in a meeting with tax officials (Enterprise Survey 2013).

Technology intervention: The Tax Committee introduced electronic tax filing to allow firms to file online. Initially, take-up was low due to lack of awareness, lack of trust in the system, and complicated e-filing registration procedures, among others.

Research design: E-filing was available to all firms, so the intervention was to encourage a randomly selected group of firms to e-file by removing some of the constraints through providing training on e-filing as well as logistical help to complete the e-filing registration process.

Impact: The treatment group e-filed at a higher rate than the comparison group. Firms that were more likely to be evading at baseline (measured by a risk score used by the tax authority) were less likely to adopt e-filing and also more likely to stop e-filing after a few months. Tax payments doubled among these high-risk score firms. While there was no average effect on bribes, e-filing led to a large reduction in bribes (18 percentage points) among firms less likely to have been evading. More broadly, e-filing resulted in a large reduction in compliance cost across firms with five hours saved each month (about 40 per cent of the time spent on fulfilling tax obligations).

This intervention highlights the role of technology in not only reducing compliance costs for taxpayers, but also affecting tax payments and unofficial payments by changing the interactions between taxpayers and tax officials. It also underscores the importance of thinking about distribution effects in the impact of technology as certain taxpayers may be more affected than others. Lastly, it provides lessons on the take-up of technology solutions as taxpayers may be strategic in deciding to take up and those for whom the technology may have greatest impact may be least likely to adopt.

1.2.2 Electronic billing machines

Electronic fiscal devices, already discussed in section 1.1 for their potential in better defining tax liabilities, could also play a major role in terms of reducing compliance costs. The evidence available is rather mixed. On the one hand, current research indicates that electronic billing machines (EBMs) are impactful in making the taxpayer experience less burdensome, more predictable and less frustrating. In a recent survey, Ethiopian firms highlighted the following benefits from ESRM adoption: 'less opportunity for theft' (mentioned by 20 per cent of respondents), 'updated and easily available sales information' (22 per cent), 'easy to comply with tax requirements' (17 per cent) and 'better sales and inventory control' (16 per cent) (World Bank 2015: 26). In Rwanda as well, electronic billing machines have been rolled out since 2013 with the aim of improving VAT compliance by transmitting transaction records directly to the Rwanda Revenue Authority in real time. In this context, Eissa and Zeitlin (2014) document that EBM impacts on tax declared have been larger for smaller firms, which, in a manual system, are those generally facing higher compliance costs (Yilmaz and Coolidge 2013).

At the same time, also in Rwanda, evidence from a mixed methods approach – based on administrative data, focus group discussions (FGDs) and a nationally representative survey – from Mascagni, Dom and Santoro (2021) shows that medium and large taxpayers considerably value EBMs as a tool for facilitating their compliance. A more sophisticated version, EBM2, which is software-based and works on computers, is also quite appreciated by this group as it improves record-keeping, monitoring of transactions on a daily basis and business reputation, thus attracting new IT-savvy costumers (Mascagni, Dom and Santoro, 2021).

On the other hand, Mascagni, Dom and Santoro (2021) show that technology-enabled facilitation should not always be taken for granted as small taxpayers in particular bear the largest burden of adopting EBMs. The authors first show that the incidence of poor record-keeping (as proxied by inconsistencies between VAT returns and EBM data) is larger for smaller firms. They then use FGDs to demonstrate that taxpayer confusion, complexity and practical difficulties with the machine are particularly severe for smaller taxpayers. Technical problems, for example, issues with topping up SIM cards, and with the necessary equipment (computers, connection, etc.) required to keep up with the new EBM version (EBM2) – seem to disproportionately affect smaller taxpayers. Mistakes with inputting the correct transaction amount are also commonplace – thus explaining the large discrepancies mentioned above. The more advanced version EBM2 seems still expensive for smaller taxpayers, who already face budget constraints in using the traditional EBM.¹³ This disproportionate effect brought about by more and more sophisticated technologies could however 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 electronic billing machines (EBMs) was the lack of training of VAT-collecting enterprises, mentioned as a hindrance in six of the studies. As identified in five of the studies, the second most-cited challenge was the high sunk costs associated with technology adoption.

It is also important to acknowledge that revenue authorities are attempting to reach less educated, often rural, taxpayers, through user-friendly technologies, to facilitate their

¹³ At least in Rwanda, EBMs need airtime as they transmit information through the mobile network. Taxpayers, especially the smallest ones, easily forget to top up airtime (or are unaware that they have to), thereby impeding the EBM from communicating with the authority. Also, they face higher costs in procuring the equipment needed in conjunction with EBMs, such as printers or computers (for the new, app-based, EBM2 version). Most importantly, businesses have to buy the machine themselves without any subsidy (Mascagni et al. 2020).

compliance. This is the case of the M-declaration tool in Rwanda, discussed more in detail in section 2. With M-declaration, presumptive taxpayers can easily declare their taxes and pay through mobile money by using a simple feature phone. The Malawi Revenue Authority (MRA) also introduced a similar M-mobile application with the intent of streamlining the payment process of less sophisticated taxpayers, building on the widespread nature of mobile money, which is accessible to the lower strata of the population. As these technologies are extremely new, no robust impact evaluation has yet been conducted and future research should examine whether they alleviate the compliance costs of smaller taxpayers.

A key takeaway from these case studies is that, while EFDs can bring positive impacts in terms of facilitating compliance – which often translates into higher revenues – their introduction should be accompanied by sustained taxpayer education and assistance, both at the stage of installing the device and of routine checks after adoption (also see section 2). Incentives schemes could also be applied, even if the evidence of their effectiveness is scant (Brockmeyer and Somarriba 2021). As they incrementally introduce new technology, often at a rapid pace,¹⁴ tax administrations should increasingly rely on timely communication and proactive feedback mechanisms for taxpayers, the ultimate users of such technology. Unintended inequitable repercussions should be considered, as smaller and less educated taxpayers can be those struggling the most in using any new technology.

1.2.3 Online communication

Linked to its role in facilitating compliance, technology also holds a great potential in terms of communicating information around the tax system and easing the burden of complying. By accessing e-portals, for instance, taxpayers could seek tax-related assistance online or browse through tax laws and similar official documents. In the literature of the so-called tax nudges, communication experiments manipulating the message content and testing different motivations behind compliance, most examples refer to traditional delivery methods, such as letters, while increasing attention is being devoted to more modern and cheaper solutions, such as SMSs and e-mails (Mascagni 2018). More scientific research is needed in this direction, given the huge potential that IT-based communication retains in potentially reshaping the way in which revenue authorities assist, educate, and train their taxpayers (World Bank 2016; OECD/FIIAPP 2015).

In this sense, an illustrative case study comes from Rwanda, where in early 2016 the revenue authority sent messages to 9,000 taxpayers, aimed to encourage compliance. Mascagni and Nell (forthcoming) compare the efficacy of different delivery methods, from more traditional (physical letters) to more digitised (SMS, email). They show that non-traditional delivery methods, specifically SMS, are highly effective and significantly increase the tax due of nudged taxpayers, in contrast to physical letters. This exercise is particularly relevant from a policy perspective, as governments in developing countries are constantly looking for cost-effective ways to achieve policy goals, in the context of very limited capacity (Mascagni and Nell, forthcoming). In this setting, it would be difficult to scale up the delivery of letters beyond a relatively small group – also considering the often poor quality of taxpayer contact information in tax registries (Ortega and Scartascini 2015; Mayega, Ssuuna, Mubajje, Nalukwago and Muwonge 2019).

1.3 Monitor compliance

Recent developments in the use of technology in taxation have generated troves of data that tax authorities can leverage to detect non-compliance. For example, many tax authorities

¹⁴ This is the case of Rwanda, which has already introduced an EBM2 version and is planning to launch a more sophisticated EBM3 version as well.

compile data from several dimensions of a taxpayer's behaviour to generate a risk profile that reflects the likelihood that a taxpayer is evading (Khwaja, Awasthi and Loeprick 2011). Selecting audit cases using this data-driven approach would lead to a more targeted and efficient audit. Beyond this, with the appropriate technology-based reporting systems, tax authorities can systematically cross-check information provided by a taxpayer with third-party information sources (Dogan 2011).¹⁵ The examples below highlight the potential compliance gains from reconciling firms' VAT declarations. Box 3 below presents a case study from Uganda on the potential compliance gains from reconciling firms' VAT declarations.

Using a similar approach to Almunia et al. (2021), Mascagni, Mukama and Santoro (2019) focus on Rwanda and study how data from VAT returns is used for monitoring and enforcement purposes. By analysing the universe of VAT returns in 2016-2017, the authors find that discrepancies are abundant. In terms of within-taxpayer discrepancies, 43 per cent of VAT payers either over- (18 per cent) or under-report (25 per cent) their VAT sales compared to what is automatically recorded in the EBMs. While practical difficulties in using the machines and inputting mistakes could be a reason behind this finding (see section 1.2.2), evasion could also explain underreporting of VAT sales compared to EBM data. This challenge is particularly alarming given that the Rwanda Revenue Authority is planning to increasingly rely on automated data from EBMs to cross-check VAT returns and curb evasion. If the information inputted by taxpayers on the machines is likely to be filled with mistakes, it will not be useful for enforcement. In any case, technology could help the tax administration with closing these gaps through automated cross-checks and data-driven enforcement. Addressing these discrepancies seems to be a low-hanging fruit, with considerable revenue implications, which is however left hanging due to administrative complexity and weak capacity (Steenbergen 2017).

The potential of data analytics and automatic cross-checks to identify non-compliance is likely to matter for most of Africa (Santoro, Mascagni, Munoz and Occhiali forthcoming^b). Recent evidence shows that a concerning pattern of extensive taxpayer misreporting also applies to Ethiopia (Mascagni, Mengistu and Woldeyes 2021). In Ethiopia, as mentioned already in section 1.1.1, in 60 per cent of cases total sales from VAT returns are different from the same figure from the profit tax returns (Mascagni, Dom and Santoro 2021). It is unclear why revenue authorities do not automatically identify such gaps, notify the taxpayers to correct them, and eventually boost revenues through accurate compliance. As in the case of Rwanda, a possible explanation could lie in the lack of adequate capacity to run automated cross-checks on a large scale. The inability to fully exploit the VAT data, which already sit within the tax administration system itself, inevitably impairs the potential of using data from external sources, such as third-party reports.

More positive examples come from Asia, whose technological trajectory could potentially be followed by Africa. In Pakistan, the revenue authority managed to curb fake VAT input claims by using a computerised VAT refund validation mechanism (Shah 2020). Success has been possible only after a decade-long period of transition towards a fully computerised infrastructure, funded by donors. Also, the reform received wide institutional and political support from both the government and the constitution, an aspect that is often seen to be missing in low-capacity countries. Similar promising evidence comes from India (Mittal and Mahajan 2017), where third-party reporting in New Delhi increased compliance by the top 1 per cent of firms, and China (Fan et al. 2018), where the digitisation of VAT annexes improved tax compliance with VAT.

¹⁵ A success story in this sense comes from Turkey, where a data warehouse system collects information from both private (including commercial banks) and public organisations to curb VAT fraud and misreporting. The impacts of extensive data-matching exercises and a conducive cross-agency administrative environment have been remarkable (Dogan 2011).

Box 3 VAT compliance in Uganda

Problem: VAT is supposed to be self-enforcing because government receives a report of a transaction from both buyer and seller (with opposite incentives). However, in practice, while many tax authorities may analyse this information for specific taxpayers, for example in the case of an audit, often they do not routinely use this information systematically in their tax enforcement.

Technology intervention: Since 2012, the Uganda Revenue Authority has required all VAT firms to electronically file their monthly VAT declarations, including detailed transaction-level records (sales and purchases with other VAT firms). Firms also electronically submit customs declarations, providing transaction level data on imports. These electronic submissions ensure that in recent years, for all VAT firms, the URA has detailed data in electronic format.

Research design: Researchers worked with the tax authority to match these data, comparing the amounts reported by buyer and seller for transactions done each month (Almunia et al. 2021).

Impact: Sellers and buyers report different amounts in 79 per cent of transactions. Importantly, in about a third of the cases, the discrepancy is due to 'disadvantageous reporting', that is reporting errors in VAT returns that increase the firm's overall liability and leave money on the table. The paper estimates that VAT misreporting cost Uganda USD 446 million in revenue from 2013-2016. Systematic cross-checks of these data from the tax authority could help recover, at least partially, the foregone revenues.

2 Limitations of technology

While the evidence discussed above highlights the unprecedented potential of technology in improving tax administration and revenue mobilisation, it is also true that technology alone is likely to be ineffective in a context in which pre-existing, complementary factors are not yet in place (Bird and Zolt 2008). This is also true in high-income countries as failure to get these preconditions right explains the poor take-up of e-government services there as well (Gauld, Goldfinch and Horsburgh 2010; Reddick and Turner 2012). The relevance of these preconditions, and the evidence produced on them, is summarised here below.

2.1 Hard infrastructure and connectivity

Even the most user-friendly technology will hardly function if basic infrastructure and, for those technologies based on the internet, stable connectivity are lacking. Immediate implications concern take-up and usage – neither taxpayers/users nor tax officials could smoothly take-up and use a technology that halts in peak periods or functions only intermittently. On top of that, inadequate infrastructure and connectivity could also pose important equity repercussions, as those taxpayers most likely to be disconnected from the internet are more likely to be smaller, rural, and less educated. In turn, their broad taxpaying experiences could be frustrating and their tax attitudes and perceptions could likely deteriorate. Particular attention should be devoted to these unintended consequences, especially in light of the current shift to e-filing and e-payment as a response to the pandemic – as in certain cases (for instance, in Eswatini and Cameroon) revenue authorities imposed the adoption of e-tools to avoid physical interactions. However, it is unclear whether making

adoption compulsory would prove to be effective for compliance if large portions of the taxpayer population are simply not covered by connectivity or stable electricity.

Some descriptive evidence describes the challenges taxpayers face in adopting technology in less IT-friendly contexts. In Zimbabwe, Obert et al. (2018) study the underutilisation of the e-filing tax system and conclude that connectivity is indeed a major challenge to most taxpayers, with around 33 per cent of respondents reporting absolutely no access to any form of network connection. For instance, one challenge unearthed by this study was that the server used to operate the e-filing system frequently faltered during peak periods, with negative repercussions on taxpayers' filing experience. Likewise, in Eilu's (2018) review of six studies on the adoption of EBMs in Kenya and Tanzania, poor internet connection is cited in three of the studies, while power outages come just next.

It is also true that tax administration can proactively roll out less sophisticated technologies with the clear policy intent of reaching less connected taxpayers and facilitating their compliance. This is the case in Rwanda, where the RRA launched the M-declaration tool as an offline declaration and payment solution for rural taxpayers, working on simple feature phones. M-declaration has been introduced as a simpler complement to the more IT-heavy E-tax platform, which instead works on computers and through the internet. Solutions like M-declaration could easily address connectivity issues and enable digital payments through the widespread mobile money system. The survey study of Santoro et al. (forthcominga) shows how the user profiles of M-declaration and E-Tax are different by policy design and how the two technologies get adopted by those who need them most.¹⁶

2.2 The human factor

Technology could rightfully be considered as a tool, which does not live by itself but is meant to be used by people. If people refrain from, resist, or manipulate technology, the latter is unlikely to produce any impact. This human factor is crucial to understanding the potential of technology more realistically. In this context, users of IT can be divided into two broad categories: taxpayers and tax officials.

2.2.1 Taxpayers

Taxpayers could fail to adopt a technology for a number of reasons. First, apart from the infrastructural limitations mentioned above, taxpayers may have little understanding and practical knowledge of sophisticated innovations. As mentioned in section 1.2, lack of awareness and training could be a key obstacle to the uptake of a given technology (Obert et al. 2018; Eilu 2018; Efobi et al. 2019; Mas' ud 2019). It would be beneficial for African tax administrations, which already devote a great deal of resources to taxpayer training and sensitisation programmes (Mascagni and Santoro 2018), to update and adapt their training modules in light of the ever-changing technological possibilities. When tax systems are overly complex, taxpayers may resort to using third-party service providers (such as cyber cafe workers and not tax professionals) who may exacerbate problems with inaccuracies with taxpayer data.

Second, users can fail to adopt a new technology if sunk costs for its implementation are too high. There could be resistance in adoption from taxpayers within certain categories having to cover significant costs for accessing the service (Yilmaz and Coolidge 2013). Qualitative evidence from Rwanda (Mascagni, Dom and Santoro 2021) documents high levels of frustration, as taxpayers have to buy the EBMs with their own funds,¹⁷ and also have to cover

¹⁶ They also document that the major issues with both E-tax and M-declaration is that the system is slow, with two-thirds of respondents reporting that.

¹⁷ Also, Ethiopian taxpayers had to buy the ESRMs themselves (Mascagni, Mengistu and Woldeyes 2021).

all ancillary costs on the equipment needed for using the machines (airtime, internet connection, computers, printers, etc.). In this sense, digital technologies can reinforce socioeconomic disparities already present in the taxpayer population. Limited evidence exists on the impacts of subsidies for technology uptake, with rather inconclusive results. A notable exception comes from Brockmeyer and Somarriba (2021) which, despite considering a different technology (point of sales (POS) terminals) provides mixed evidence on the impact of incentives, which could inform the design of incentive schemes for other technology, namely EFDs, as well.¹⁸

Third, more IT-sophisticated taxpayers could blatantly manipulate the technology in order to avoid paying taxes. A tax administration whose internal systems are not integrated and automated is open to manipulation attacks from taxpayers. In Malawi, among many other countries, the revenue authority makes use of several disconnected systems running in parallel, making registration, tracking and monitoring quite challenging. Being aware of these weaknesses, taxpayers seem to use multiple taxpayer identification numbers (TINs) for the same business to cut tax liabilities, while not being automatically detected (Ligomeka 2019).¹⁹ At the same time, even less sophisticated taxpayers could be reluctant to adopt a new technology due to mistrust towards the tax administration, especially for concerns about issues around data security and confidentiality.

2.2.2 Tax officials

Tax officials as well are adopters of technology and could sub-optimally use it due to a number of constraints. First, tax officials could resist change and prefer keeping up the usual, often manual-based, practices. Tax officials can have a disincentive to reorganise their work to take full advantage of digital technologies, often due to the possibility of losing the discretionary benefits they have been accumulating with a manual, discretionary system. However, very little causal evidence has been produced on how technology could shape the interactions between taxpayers and tax collectors – with the exception of Okunogbe and Pouliquen (2022) – or on incentive schemes for motivating tax officials in taking up a new technology.²⁰ Regarding the latter, Chalendar, Duhaut, Fernandes, Mattoo, Raballand and Rijkers (2020) argue that the effectiveness of third-party reporting in Madagascar is undermined by the limited incentives to tax officials to optimally make use of this new information. The authors find that even though better information on import values from a third-party significantly enhanced the performance of the customs department by enabling a more exact determination of tax liabilities, yet its impact on revenue appeared compromised by misaligned incentives of custom officials. Thus, the absence of strict sanctions against opportunistic behaviour and the prevalence of rampant corrupt practices in the Madagascar customs department – as in the customs departments of other low-income countries – could explain why the provision of information to inspectors has not yielded stronger impacts.

Mayega et al. (2019) provide some interesting qualitative evidence on staff resistance to technology in Uganda. They document the negligence of under-incentivised registration staff, who do not respond to the TIN duplicates warning triggered by the system, hence clogging up the registry with duplicates. In Sierra Leone, anecdotal evidence tells that tax officials may

¹⁸ In the broader context of Uruguay's Financial Inclusion Reform, Brockmeyer and Somarriba (2021) find that firms are largely unresponsive to the financial incentives for the rental fee of POS terminals. Surprisingly enough, 80 per cent of firms taking up the subsidy already have a POS while only a small fraction of firms without a POS take up the subsidy. In terms of impact on compliance, the latter group of firms actually increases reported VAT liabilities while effects are null on those firms already using a POS.

¹⁹ It is also true that this strategic behaviour is observed in Uganda as well, despite the URA maintaining a uniform registry (Mayega et al. 2019). This is to stress again that even a sound integrated system, which could in theory easily identify fraud, would prove inefficient if not used to its full potential by the tax administration.

²⁰ Outside technology, notable exceptions are Khan, Khwaja and Olken (2016) and Amodio, Choi, De Giorgi and Rahman (2021), who study the impact of performance pay for tax collectors on revenue and bribe payments.

record tax return information on separate Excel sheets instead of using the formal platform. This means that tax returns could be missing from the system because of issues with data entry (Stewart-Wilson forthcoming). In Malawi as well, preferences for manual practices imply that a specific, separate registry exists for large taxpayers, stored and managed on separate Excel files, not integrated on a uniform platform and controlled by the large taxpayer unit (LTU) staff (Ligomeka 2019). Anecdotal evidence suggests that these discretionary practices are commonplace in other countries as well.

A second major impediment for tax officials is a lack of adequate skills and training. It is true that revenue authorities in Africa routinely assign their staff to intense training periods, often incentivised, as well as making completion of certain learning modules compulsory for promotion.²¹ Notwithstanding, it seems that more could be done in terms of building more specific, tailored skills on how to use technology and, correspondingly, how to manage tax data. Observational evidence indicates that revenue authorities in low-income countries often do not cross-check their tax records, even if it would be relatively straightforward to do so (Kangave, Nakato, Waiswa and Zzimbe 2016; Almunia et al. 2021; Mascagni, Mukama and Santoro 2019). This, for instance, is documented in Rwanda, where easily identifiable discrepancies across VAT returns are not closed likely due to limited know-how from tax officials. Robust evidence is lacking on this aspect but most existing studies point to the lack of IT skills as one of the concurring causes for limited usage of different technologies, such as systematic cross-checks (Pirttilä 2017).

2.3 Institutional strategy and change management

The adoption and implementation of technology should not happen in a single step, motivated by a political frenzy or competitive imitation of peers, but rather within a clearly defined, long-term transformational journey.

As a first consideration, the sequencing of technology adoption, as delineated in a strategy of structural reform, is crucial. Digitisation of functions and processes is usually pioneered by customs departments, as they tend to use internationally standard information systems.

After piloting a new automated and integrated platform in customs (such as ASYCUDA +++ and ASYCUDA World), revenue authorities turn to digitising their internal functions, by automating all internal processes. In this phase, it is preferred that clear sequential actions are taken. For instance, a new integrated and automated tax administration system is unlikely to succeed if the existing data within the tax administration are not properly cleaned first, so as to be adequately analysed by the new system. A clear example of this is given by the experience of the local tax administration in Dakar (Knebelmann 2019), as mentioned in section 1.1.2. Likewise, retraining and reengineering tax officials should come before introducing the technology, as well as repeatedly over time. Also, there seems to be a clear sequencing in how the different functions get automated. After customs, usually e-registration modules are introduced next, to improve the quality of taxpayer registries. Then, the most relevant taxes are digitalised first, with VAT and income taxes being the priority. All the remaining taxes and fees usually get digitised at a later stage.

Once all internal functions are integrated successfully, the next step entails providing e-services to taxpayers. E-filing and e-payment systems could develop naturally and directly feed into a well-running automated tax administration system. Often, e-services are rolled out sequentially, first imposed as a pilot on large taxpayers, and only later to the taxpayer population at scale. More and more sophisticated modules could be added as the opportunity arises. For instance, the M-declaration phone application introduced by the RRA was meant to represent an additional service building on the already existing e-filing system. Similar

²¹ A successful example of staff training is provided by the case of Rwanda (Schreiber 2018).

mobile-based additional services have been introduced in Senegal and Malawi as well, among many other African countries. More generally, a brilliant example of a long-term (2006-2021) digitalisation journey is offered by the Mauritius Revenue Authority. The authority inaugurated its plan in 2006 by integrating three different legacy systems and introduced e-filing in 2007; it then launched a fully-integrated ITAS in 2010, which has then been upgraded routinely after; it introduced mobile payments and filing in 2013-2014 and eventually went ahead with more and more digitalised solutions, ranging from a digitally-enabled COVID assistance scheme in 2020 and, in 2021, a behavioural insight unit with the goal of predicting risky behaviours by building on machine learning techniques.²²

As a second related point, technology provides the opportunity for an unparalleled cultural change within the tax administration, where obsolete analogue practices are abandoned and a new mindset, based on efficiency and transparency, is embraced. Descriptive evidence from different contexts in Africa shows that it is difficult to change the silos mentality with which different departments within a revenue authority tend to operate. It is commonplace to see different IT systems operating in parallel to manage taxpayer data. This simultaneous use of distinct systems creates a host of structural challenges for the tax administration. One major challenge is the duplication of work. Given that different units manage the systems, another challenge pertains to the authorisation required by officials in a unit to access the data from a different unit within the same institution. As a result, officers often concentrate solely on recording information on the taxes under their mandate and ignore any other tax-relevant data (Ligomeka 2019). Ethiopia, among many other countries, is emblematic of a context in which administrative data, such as PAYE returns, is inadequate due to this silo mentality. In Ethiopia, as many as four institutions collect data on employment income.²³ Despite having common challenges and aligned interests, such institutions do not communicate for both political and technical reasons (Mascagni, Santoro and Mukama 2019). This challenge is strictly intertwined with the unclear regulatory framework surrounding the administration of PAYE, an aspect that is also discussed below. Systems working in parallel exist in Sierra Leone as well, and produce disconnected information, often inaccessible outside of a given department (Stewart-Wilson forthcoming). More broadly, customs and domestic tax departments still appear not to communicate systematically. To properly address this challenge when introducing new technology, it is acutely important to have a rigorous procurement process that carefully gathers system/business requirements, understands user needs, and reviews business processes to ensure that the procured technology systems are fit-for-purpose and avoid needless duplication.

At a higher level, the implementation of technology requires strong buy-in from key leaders and a long-term strategy at the national level. The Rwandan case is very much emblematic of how technological transformation has been enabled by the strong political support from the very top government through the Vision 2020 development plan (Schreiber 2018). A number of concurring strategic actions have been taken in order to unleash the full potential of technology in Rwanda. First, government and donors massively invested in a high-speed fibre-optic network, serving the whole country. This directly enabled the RRA to make use of more advanced online technologies and to eventually launch its automated data management system. Second, a target-oriented and performance-based staff management culture has been crucial to build higher professionalism within the authority – often coupled with intense trainings on IT tools. Third, the government eliminated import taxes on computers, cell phones, and telecommunications equipment, facilitating digital inclusion. Lastly, to facilitate compliance of micro-entrepreneurs through digital means, the finance ministry's policy committee moved quickly to create a simple, new presumptive tax for them,

²² Presentation by Soobhash Sonah, Director of the Information System Department at the Nigeria Governors' Forum Technology and Tax Event on 19 April 2021.

²³ The ERCA, the Ministry of Finance and two institutions for social security provision, both for the public and private sectors.

easily payable through mobile phones (Schreiber 2018). More research is needed to understand how the political vision of a country could spur successful technological transformation.²⁴

2.4 Regulatory framework

A broader key consideration refers to the regulatory and legal framework in which technology exists. As technological innovations develop at a faster and faster pace and tax administrations keep updating themselves, the same should be true for the legal system. However, the latter is typically much slower to respond and adapt to change.²⁵ On the one hand, revenue authorities could strengthen themselves through the use of technology. On the other, the ultimate ability to enforce, prosecute, impose sanctions and collect taxes often lies outside the authority itself. Hence, countries need a functional, modern legal system enabling the technology-enhanced tax administration to fully benefit from this transformation.

There are many ways in which the legal system could hamper the potential of technology in tax administration. For instance, technology could empower revenue authorities in their enforcement capacity, helping them with assessing the underlining true liability, tracking defaulters, identifying blatant evaders (see section 1.3). All these efforts are however likely to be unfruitful if actual prosecution does not materialise due to long delays in courts. Likewise, technology could spur mass registration and formalisation, which however would not deliver better compliance outcomes if the tax code is silent about the tax obligations of new entrants (Mascagni, Mengistu and Woldeyes 2021). Furthermore, confusion could arise about the legal requirements to use a given technology, such as e-filing. In a situation where e-filing is made compulsory by decision of the revenue authority but where the national laws are still ambiguous on whether the adoption of a digital practice is mandatory or voluntary, and for whom, navigating the regulations could lead to higher compliance costs for taxpayers, alongside greater mistrust and frustration.²⁶

On top of that, gaps in regulation could arise when it comes to co-using a given technology across different public institutions. As mentioned above, data sharing between revenue authorities and a range of public and private actors does not happen systematically, often due to privacy and confidentiality concerns. One possible approach is for policy makers in a country to work towards setting up a central automated platform which would be accessible from a variety of government institutions and banks for identification of taxpayers and cross-checking of information. Robust evidence on the effectiveness of such mechanisms is needed to determine how effective this approach may be. Along the same lines, in order to boost tax compliance, more developed countries have enacted specific legislation whereby processors of debit or credit cards and electronic payment systems are mandated to report to the tax authorities the gross receipts of the enterprises accepting these forms of payments. Legislation in lower income countries is still mostly undefined.

Lastly, a crucial consideration is that as technology evolves, adjustments in the regulatory framework are needed in order to protect citizens from unintended consequences in terms of privacy, confidentiality, data leakages and cybersecurity. Accessing third-party data from, say, digital financial services providers comes with risks of breaching a confidentiality agreement with the clients of those services. Likewise, the institution of national ID systems, as well as any technology at scale (see, for instance, mass media) in contexts which are not

²⁴ In a different context, take-up of e-procedures in Caribbean countries has been very low due to faulty strategic direction (Schlotterbeck 2017).

²⁵ Qualitative evidence from Malawi shows how the MRA is constrained from introducing e-filing services given that the tax code is still silent about how to regulate such services (Santoro et al. (forthcomingb)).

²⁶ In this sense, the recent move of some African countries (such as Cameroon and Eswatini) to make e-filing and e-payment mandatory to reduce physical interactions offers an interesting case study, and adequate quantitative research is needed to measure its impacts (Santoro, Amine and Magongo (forthcoming)).

fully democratic poses new risks in terms of the government's ability to surveil and restrict citizens' rights. In these cases, a conducive regulatory framework needs to be in place, allowing for keeping a balance between data protection and security and the use of new data and technology for tax purposes. In sum, technology needs to be thought of as a unique catalyst for broader regulatory reforms within public institutions and an opportunity to modernise tax codes, eventually promoting the country to a higher development trajectory.

3 Conclusion

This paper describes the potential that information technology provides for tax mobilisation, as well as the challenges that still exist in low- and middle-income countries in order to tap into it. First, technology could be a powerful tool for understanding 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, for example, through the use of electronic billing machines that record sales transactions, or from third-party sources like employers, vendors, customers or financial institutions.

Second, technology is also valuable for improving service delivery to taxpayers. Technology solutions like electronic filing and payment can reduce the time and other compliance costs borne by taxpayers. Electronic billing machines reduce the costs of compiling and submitting information. Electronic communication tools (such as email and SMS) provide a timely and cost-effective way of keeping taxpayers informed of their tax requirements and account status. These technologies also reduce the level of in-person interactions between taxpayers and tax officials, thus reducing opportunities for extortion and collusion.

Third, technology also contributes to strengthening the capacity for tax monitoring. It provides tools for collecting and analysing large amounts of data to detect inconsistencies, such as mismatches between sales reported for income tax to those recorded for VAT, or between VAT sales and purchases reported by sellers and buyers. By using different electronic sources of information on taxpayers' behaviour, tax authorities can systematically assign the risk of tax evasion to different firms to prioritise audits to maximise revenue recovery.

A common theme to these uses of technology is that they move the tax system towards becoming more standardised and delivering a consistent experience across taxpayers and away from the use of tax official discretion in the treatment of taxpayers.

At the same time, several country examples highlight a number of challenges associated with the adoption of technology in taxation. First, given the infrastructure deficit in many African countries, access to internet and electricity may hinder the effective adoption of technology by taxpayers, especially the disadvantaged, raising equity concerns. Some governments have responded by opening up spaces for people to conduct electronic tax transactions or by rolling out simpler tools accessible to mobile devices. Ongoing research is exploring the impacts of more and less sophisticated e-filing solutions (Santoro et al. forthcoming).

Second, no matter how sophisticated an IT system is, it is only effective as long as its users can employ it. On the one hand, taxpayers may be hesitant to use technology tools due to lack of information and trust, security concerns or high costs of adoption, such as with electronic billing machines. Taxpayers could also deliberately respond to technology in perverse ways, by adjusting multiple margins in their tax returns and thus muting the impacts on revenue mobilisation. Tax authorities have responded by conducting regular trainings for taxpayers and in some cases subsidising the costs of technology adoption or rolling out less sophisticated alternatives to serve disadvantaged taxpayers.

On the other hand, tax officials may not maximise the use of IT tools due to lack of skills and training, or may actively resist to avoid losing the private benefits they received from the influence they had under a manual system. Tax authorities must ensure that their IT agenda focuses on empowering staff members with the skills and training they need, while also being as manipulation-proof as possible. Related to that, tax administrations should be equipped with sufficient resources to conduct traditional strategies in enforcement and monitoring, to which IT-enabled audit solutions could contribute.

Third, technology reform must not be a stand-alone project but should be part of a broad institutional strategy, where complementary reforms are designed. It requires a clear sequencing of reforms to avoid redundancies and disorder. For example, it is important to coordinate human resource needs (recruitment and training) with hardware and infrastructure needs (e.g. internet, electricity, computers) alongside investment in different software and complementary e-solutions. Different tax modules should be sequenced so they build on one another. Importantly, adequate investments in traditional tools for monitoring and enforcement should be planned for as well.

Fourth, the success of technology reforms in taxation is dependent on the broader regulatory environment. In many countries, the legal authority to enforce, prosecute, and impose sanctions to recover delinquent taxes does not lie within the tax authority but with the judiciary, which may be slow and inefficient. Also, the regulatory framework needs to be updated on data sharing between institutions and private actors, and provisions to protect citizens' rights. As such, technology-based reforms in tax administration must be backed by a functional, modern legal system to realise the full revenue gains and ensure a fair and equitable tax system.

The recent upsurge in the literature on taxation in low- and middle-income countries is, in large part, due to the availability of administrative tax data in electronic format. As countries continue on their technology transformation journey, there are two key opportunities for collaborating with researchers. First, tax authorities can work with researchers in real time to understand the impact of the different technology interventions they adopt to guide expansion or modifications to the technology. Second, tax authorities can collaborate with researchers more broadly to understand the implications of different tax policy choices for efficiency and equity through the analysis of tax data in electronic format (Pomeranz and Vila-Belda 2019).

In conclusion, while technology has the potential to transform tax administration, its success depends on the presence of an enabling environment both within and outside the tax authority.

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