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NOTES

Exploring the Adoption of Selected Digital Technologies in Tax Administration

A Cross-Country Perspective

Manabu Nose and Andualem Mengistu

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Abbreviations

AE	advanced economy
CIAT	Inter-American Center of Tax Administration
CIT	corporate income tax
EDAI	Enhanced Digital Accessibility Index
EFD	electronic fiscal device
EME	emerging market economy
ICT	information and communication technology
IOTA	Intra-European Organisation of Tax Administration
ISORA	International Survey on Revenue Administration
LIDC	low-income developing country
PIT	personal income tax
TADAT	Tax Administration Diagnostic Assessment Tool
RA	revenue administration
RA-GAP	Revenue Administration-Gap Analysis Program
VAT	value-added tax

Exploring the Adoption of Selected Digital Technologies in Tax Administration: A Cross-Country Perspective

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Using cross-country data, we explore the potential impact of selected digital technologies on tax collection and compliance. Our analysis makes use of multidimensional International Survey on Revenue Administration (ISORA), Tax Administration Diagnostic Assessment Tool (TADAT), and Revenue Administration-Gap Analysis Program (RA-GAP) data, with results indicating that digital technologies could enhance tax collection, but effects vary by the type of specific digital service or tools introduced. Although our results demonstrate a strong association between digital tax administration operations and improved performance outcomes, the realization of revenue gains is heavily contingent on accompanying policy, legislative and administrative reforms, and the availability of adequate digital connectivity and capable tax administration staff. The cross-country approach provides reasonable upper-bound estimates on revenue gains, which nonetheless need to be carefully validated with country-specific case studies. The note reviews single-country case studies from selected microeconomic literature that complement our cross-country results and reveal key enabling factors necessary to reap and sustain the benefits of new digital investments.

I. Motivation

Digital technologies have the potential to strengthen tax administration and enhance domestic revenue mobilization; such mobilization has been a long-standing challenge (particularly in developing countries) for scaling up priority social and infrastructure spending. Over the past few decades, tax administrations have adopted new technologies to enhance the effectiveness of tax collection, yet they have also introduced new challenges (Gupta and others 2017; Amaglobeli and others 2023). Recent literature offers rich empirical evidence that quantifies the revenue yields from the adoption of digital technologies in tax administration while pointing to the importance of developing enabling fundamentals (Okunogbe and Santoro 2023). From three data sets that assess the strength of revenue administration, we use granular indicators that specifically measure countries' adoption of selected digital technologies and services (such as e-registration, e-filing, e-payment, e-invoicing, and electronic fiscal devices [EFDs]) to describe the global trends in the use of technologies in tax administration and the impact of these technologies on tax revenue and compliance.[1] Drawing on micro-level evidence from the literature (see Appendix 1), this note also presents cross-country estimates on the revenue

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[1] We use the International Survey on Revenue Administration (ISORA) administered jointly by the Inter-American Center of Tax Administration (CIAT), Intra-European Organisation of Tax Administration (IOTA), IMF, and the Organisation for Economic Co-operation and Development (see http://data.rafit.org) and the Tax Administration Diagnostic Assessment Tool (TADAT), which provide a multidimensional index to measure the level of digitalization in tax administration practices in electronically registering taxpayer information; electronic filing of tax returns and electronic payments; automatic billing and transaction in the postfiling stage; and digital audits, monitoring, and compliance management. The ISORA and TADAT data are increasingly being used in the related empirical literature (Dabla-Norris and others 2020; Adan and others 2023). We also use data from the RA-GAP database to measure compliance.

gains of digital technology adoption in tax administration and discusses critical enabling factors needed to unleash the potential of technology adoption in tax administration.

II. Trends in Selected Digital Technologies and Services of Tax Administration

Digital technologies and services are foundational to tax administration; their adoption varies based on levels of development and the types of taxes administered. Modern tax administrations rely heavily on digital support for nearly all aspects of their core operations, both service and enforcement, ranging from registration, filing, and payment to audit, appeals, enforced collection, and an array of other important functions. Digital taxpayer services that facilitate taxpayer compliance, such as online filing, have become almost ubiquitous in advanced economies (AEs) and are more frequently employed for value-added tax (VAT) and corporate income tax (CIT) than for personal income tax (PIT). For example, across the globe, the proportion of VAT and CIT filings[2] completed online is 95 percent, whereas only 85 percent of PIT filings were submitted online in 2019 (Figure 1, panel 2). In addition, there is a significant difference in online filing rates between low-income developing countries (LIDCs) and AEs across all types of taxes. For example, only 47.2 percent of VAT was filed online in LIDCs, whereas 92.7 percent of VAT was filed online in AEs.

Tax administrations are adopting digital technologies in many other areas, beyond core operations, including e-invoicing and in the use of EFDs (Figure 1, panel 4).[3] These options improve services and provide taxpayers and tax administrations with higher levels of certainty, which is often important for their planning purposes. As one example, the availability of the information that digital technologies generate can create "paper trails" that improve the administration of VAT and CIT (Pomeranz 2015). In terms of prevalence, e-invoicing is more commonly used in emerging market economies (EMEs),[4] while EFDs are used more uniformly across income groups. This is due to the structure of the economy (informality), limited overall development of digitalization (public and private sector, including among taxpayers), and limited development of financial markets in EMEs and LIDCs, prompting them to resort to using these technologies as alternative tools of revenue administration (RA).[5] Other digital technologies being deployed to boost RA's efficiency include digital identification, mobile applications, artificial intelligence, and other related tools.

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[2] Of the countries included in the ISORA survey since 2014.

[3] EFDs are largely similar in operation to electronic cash registers. The main difference is that the EFDs contain a fiscal memory that captures core tax information. This fiscal memory can be accessed only by authorized personnel from the tax administration. In many countries, EFDs are linked to the databases of the tax authority and directly transmit either detailed or summary transaction data from businesses.

[4] E-invoicing helps RA by eliminating unintended errors, enhancing risk management capabilities, and detecting fraud schemes early. It also lowers taxpayers' compliance costs.

[5] A well-developed financial market enhances the availability of third-party information, which in turn improves the efficiency of tax administration. In contrast, low-income countries with underdeveloped financial systems often face a scarcity of third-party information. Similarly, a more formal nonagriculture sector enables governments to employ more efficient tax administration techniques, such as the withholding of personal income taxes. As a result, these countries tend to implement tools such as EFDs to help bridge the gap in the availability of third-party information and to compensate for the limited opportunity to implement efficient revenue administration techniques, such as withholding.

Figure 1. Adoption of E-Filing, E-Invoices, and EFDs, in Percent

1. Share of Countries with Online Registration for Taxpayers
(Percent)
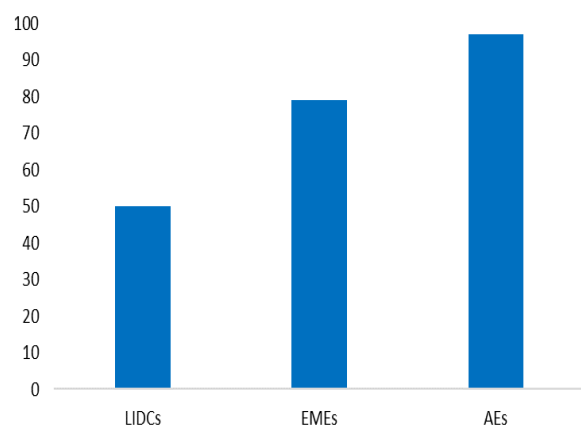
2. Share of Taxes Filed Online, by Tax Type, 2014–19
(Percent)
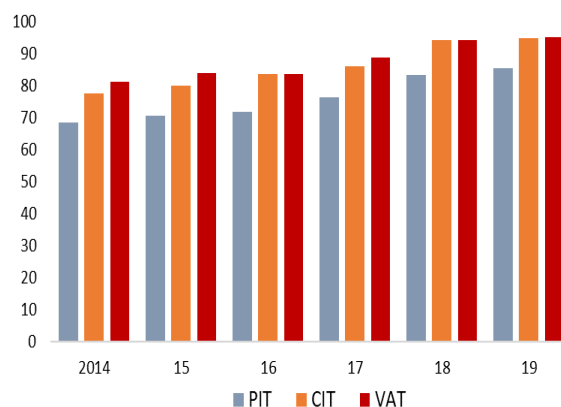
3. Share of Taxes Filed Online, by Tax Type, in 2019
(Percent)
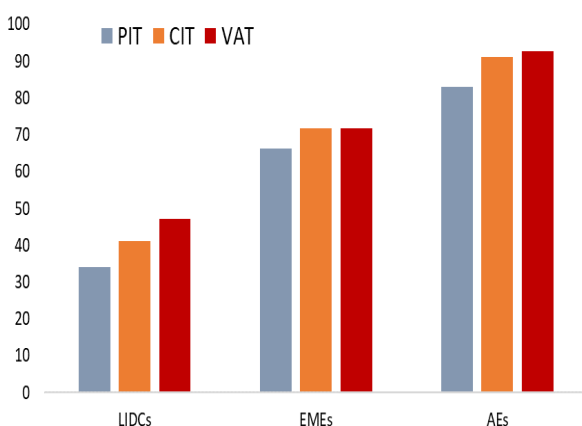
4. E-invoicing and EFDs across countries
(Percent)
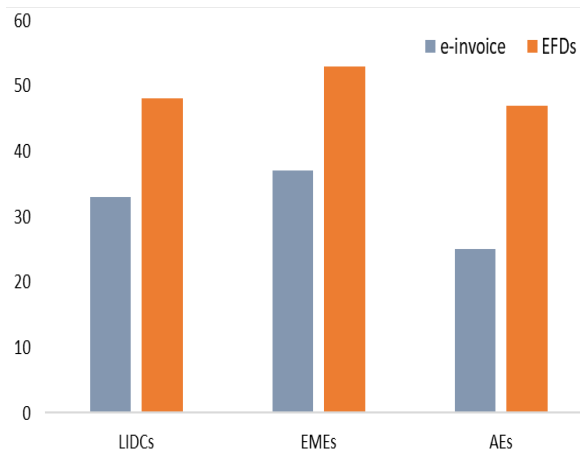
Sources: ISORA survey; and authors' estimates.

Note: The share of taxes filed online is calculated by dividing the number of tax returns filed online by the total number of taxes filed annually. The share of countries using e-invoicing and EFDs represents the proportion of countries that had implemented these tools in their revenue administration as of 2019. Panel 2 shows the share of online tax filing for an overlap sample of countries that have been surveyed in all rounds since 2014. AEs = advanced economies; CIT = corporate income tax; EFDs = electronic fiscal devices; EMEs = emerging market economies; LIDCs = low-income developing countries; PIT = personal income tax; VAT = value-added tax. In panels 1, 3, and 4, the sample includes 40 LIDCs, 70 EMEs, and 36 AEs.

LIDCs have more to gain from adopting emerging technologies that enhance the effective use of information that they collect (Figure 2). The taxpayer information gathered through e-filing, e-invoices, and/or EFDs can help to improve a tax administration's efficiency and performance outcomes when skilled analysts have the ability and tools required to work with the respective data (for example, database querying, use of machine learning algorithms). In fact, a substantial gap between AEs and LIDCs exists in the use of data to inform compliance activities. Conversely, as Figure 2 shows, there are some indications that EMEs and LIDCs are catching up, or even leapfrogging, in their use of certain emerging technologies such as digital identification and blockchain.

Figure 2. Adoption of Emerging Technologies in RA across Countries in 2019, in Percent
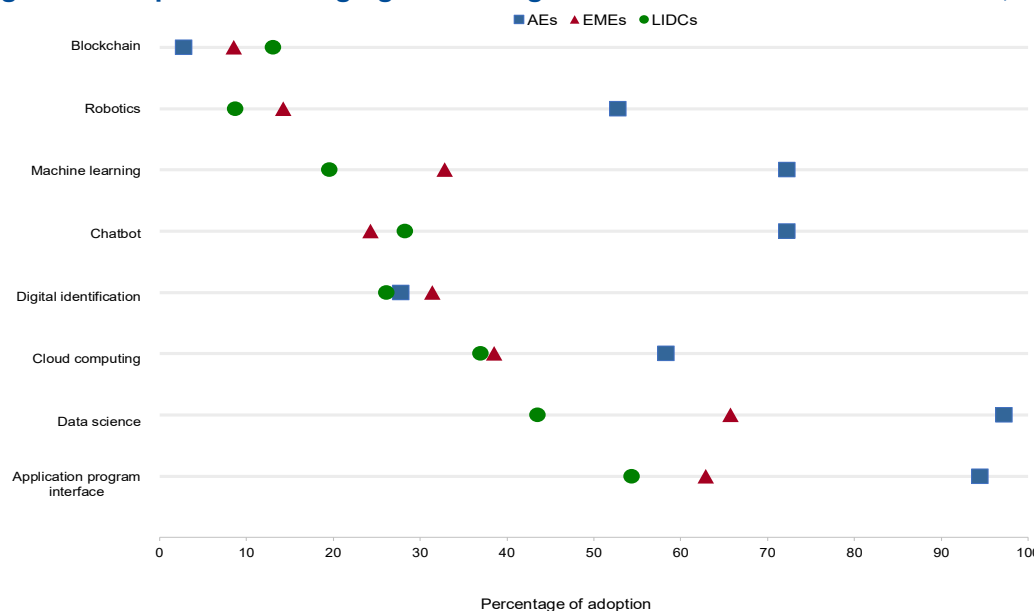
Sources: ISORA survey; and authors' estimates.

Note: The *x*-axis represents the percentage of countries that had adopted these data analytics techniques in their revenue administration as of 2019. AEs = advanced economies; EMEs = emerging market economies; LIDCs = low-income developing countries.

III. Tax Revenue Gains from Digital Technologies and Services

In specific contexts, digital technologies and services have had a positive impact on tax administration, improving tax collection. Several causal estimates in the literature reveal the effect of digital services and technologies (such as e-registration, e-filing, e-payment, e-invoicing, and EFDs) on revenue mobilization; however, as almost all existing studies use microdata from specific countries, their external validity is limited.[6] The following are highlights of a few of these causal studies before we discuss the cross-country results.

- The introduction of e-filing and e-payment increases the share of on-time tax payments, reduces compliance costs, and results in higher reported net tax liability for taxpayers with a higher risk of evasion. However, the result based on data from Tajikistan suggests that the overall impact on reported net tax payment is uncertain, as previously compliant businesses tend to underreport their tax liability after the introduction of e-filing (Okunogbe and Pouliquen 2022). In contrast, Santoro, Amine, and Magongo (2022), using data from Eswatini, showed that e-filing can lead to a significant increase in reported taxable income—up to 4 percent of GDP.[7] They also showed that the impact of e-filing is higher on CIT than on PIT; however, they also demonstrated that the increase in reported taxable income does not translate into more tax revenue, due to lack of enforcement capacity.

- The introduction of mandatory e-invoicing and/or EFD leads to increases in declared revenue and costs, with an increase in net tax liability. In particular, mandatory use of e-invoicing and EFDs can boost revenue by almost 1 percent of GDP (Mascagni, Mengistu, and Woldeyes 2021; Bellon and others 2022). The improvement in tax compliance from introducing EFD is significantly larger for VAT than for CIT (Mascagni,

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[6] Appendix 1 includes a detailed discussion based on case studies in the microeconomic literature. For a more comprehensive review of the microeconomic literature, refer to Okunogbe and Santoro (2023).

[7] Appendix 1 contains details of the back-of-the-envelope calculation. It is important to note that this estimate assumes a 100 percent e-filing adoption rate; however, even after mandating the e-tax system for all taxpayers, only 41 percent of them filed their taxes through the e-tax system.

Mengistu, and Woldeyes 2021). The self-enforcing mechanism inherent in VAT may be the reason for the higher impact.

- E-registration reduces both taxpayers' and tax administrations' costs. Empirical results also show that it is effective in mobilizing revenue from property taxes.[8]

The positive relationship is also present in analysis from cross-country data, confirming that digital technologies and services are often associated with improvements in tax revenue collection (Table 1).[9] The adoption of digital technologies and services in tax administration (as measured by ISORA and TADAT) is slow moving and correlated with country-level characteristics. With this caveat, Chatelain and Ralf (2021)'s Hausman-Taylor instrumental variable method, which allows an endogenous non-time-varying regressor, is applied to estimate revenue yields of digital technologies and services in tax administration. Results consistently show that greater digital adoption in tax administration is associated with larger tax revenue collection and the reduction in the VAT compliance gap.[10] Increasing e-filing adoption by half could boost tax revenues by 1.6 percent of GDP.[11] This points to sizable revenue gains for LIDCs, where online filing in tax administration significantly lags. We get the comparable size of revenue yield when ISORA online filing index (the first component of the share of PIT, CIT, VAT filed online) is used.[12] In Table 1, column 4, we also found a significant impact of e-audits and data analytics on revenues, which is presumably due to outcomes from enhanced capabilities for compliance risk management.

Table 1. The Potential Impact of Digital Technologies and Services on Tax Collection

Dependent variable	Non-trade tax revenues/GDP				VAT compliance gap			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ISORA: Online filing of PIT/CIT/VAT (principal component index)	0.0118*** (0.0039)				-0.0270** (0.0131)			
TADAT: Use of electronic filing facilities		0.0331** (0.0165)				-0.0277 (0.0638)		
TADAT: Use of electronic payment methods			0.0333** (0.0167)				-0.1074* (0.0636)	
TADAT: Use of large-scale data-matching systems to detect inaccurate reporting				0.0562** (0.0238)				-0.1393 (0.1137)
Constant	-0.3161 (0.2868)	0.0940 (0.3188)	0.0777 (0.3158)	0.0837 (0.3238)	1.2678 (0.9978)	2.7630*** (1.0404)	2.8656*** (1.0432)	2.7957*** (1.0705)
Observations	763	574	574	564	676	459	459	449
Number of countries	96	64	64	63	88	54	54	53
Macro factors controlled	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region & Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Sources: IMF, World Bank, ISORA, TADAT, Global Tax Expenditure Database; and authors' estimates.

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[8] The evidence is limited to property taxation (Knebelmann 2019; Prichard, Kamara, and Meriggi 2020).

[9] Although digital adoption progressed fast during the COVID-19 pandemic, this empirical analysis focuses on the pre-COVID period, mainly due to data availability.

[10] In Adan and others (2023), the VAT compliance gap is predicted based on the estimated coefficient of the compliance gap available in the RA-GAP, which expands coverage to 143 countries and is highly correlated with the implied VAT compliance; the implied VAT compliance is based on VAT efficiency and tax expenditure data from the Global Tax Expenditure Database.

[11] The coefficient of TADAT e-filing score (values from 0 [zero adoption] to 1 [full adoption]) in column 2 is used to calibrate the realistic size of revenue yield. We consider the situation where low-income countries raise the adoption of e-filing by 50 percent of total tax filing (that is, a 0.5 increase in the TADAT score). The yield can be computed as 3.3 x 0.5 = 1.6 percent of GDP. Note that revenue gains of RA reforms (including digitalization) typically materialize over the medium term (Adan and others 2023). In the case of e-filing, the timing of revenue impact depends on the establishment of an e-filing system (with all required IT systems) and when its use becomes mandatory.

[12] When a country moves from the 40th to 60th percentile of the ISORA online filing rate, the index improves by about 1.1. Using the coefficient of the ISORA index in column 1, we get the revenue yield of 1.3 percent of GDP (1.2 x 1.1).

Mandatory implementation of key digital technologies and services amplifies their impact on revenue mobilization. The impact of e-filing on revenue is larger (close to 5 percent of GDP) when e-filing is mandatory. The coefficient quantifies the potential increase in revenue when a country transitions from a system without mandatory e-filing to one where e-filing is obligatory for all taxpayers. In a realistic scenario of an improvement from no e-filing to 25 percent of all taxes being filed online, the improvement is close to 1.2 percent of GDP. And the impact is stronger on VAT and CIT compared with PIT (Table 2). Conversely, although e-registration, electronic invoices, and EFDs have positive and economically significant coefficients, they themselves are not statistically significant; one possibility for this statistical insignificance is that they are not mandatory.

Table 2. Impact of Digital Technologies and Services on Tax Collection

Dependent Variable: Nontrade Tax/GDP	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Online registration	0.0234 (0.0181)								
Mandatory online filing: CIT		0.0537** (0.0230)							
Mandatory online filing: PIT			0.0417** (0.0166)						
Mandatory online filing: VAT				0.0510** (0.0248)					
Mandatory online payment: CIT					0.0408** (0.0186)				
Mandatory online payment: PIT						0.0408** (0.0186)			
Mandatory online payment: VAT							0.0448** (0.0191)		
Electronic invoice in place								0.0056 (0.0096)	
Electronic fiscal device in place									0.0076 (0.0117)
Constant	0.1162 (0.3199)	0.1029 (0.3163)	0.0984 (0.3213)	0.0969 (0.3164)	0.0947 (0.3206)	0.0947 (0.3206)	0.1011 (0.3195)	0.1021 (0.3227)	0.1016 (0.3285)
Observations	521	521	521	521	521	521	521	521	521
Number of countries	97	97	97	97	97	97	97	97	97
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Sources: IMF, ISORA, TADAT; and authors' estimates.

The estimated revenue yields, which are broadly consistent with the findings from the literature for specific country cases, must be interpreted with caution.[13] Given the high correlation between tax administration digital technology and service measures, we report only single-variate regression results. However, when countries introduce multiple digital tools simultaneously in a package, the estimated effect reflects the joint impact of all digital tools rather than the individual effects of e-filing or e-payment alone. This dynamic extends into the context of reform and modernization, in which new investments in digital operations often occur alongside changes in policy, legislation, organizational design, governance, business processes, staffing, and training. The cross-country result provides a reasonable upper-bound estimate on average; its size must be carefully validated with a single-country case study (summarized in Table 3).

Table 3. Calibrated Tax Revenue Gains from Specific Digital Tools in the Literature

Case Study	Digital Tool	Country	Estimated Coefficient (on taxable income)	Impact on Tax Revenue (in percent of GDP)
Santoro, Amine, and Magongo (2022)	e-filing	Eswatini	40% for PIT 80% for CIT	4.00[1]
Bellon and others (2022)	e-invoice	Peru	8.2%	0.93
Fan and others (2020)	e-invoice	China	12.9%	1.56
Mascagni, Mengistu, and Woldeyes (2021)	EFDs	Ethiopia	12.0%	0.88
Eissa and Zeitlin (2014)	EFDs	Rwanda	6.3%	0.68

Note: Impact on tax revenue is computed based on the estimated elasticity on taxable income and each country's level of tax revenues (in percent of GDP). CIT = corporate incomes tax; EFDs = electronic fiscal devices; PIT = personal income tax.

[1]The impact is on taxable income. Santoro, Amine, and Magongo (2022) also estimated the impact on actual tax payment, which finds insignificant impact on tax payments due to the country's low enforcement capacity. The mixed result on actual tax payments suggests that the size of revenue gains from RA digital tools hinges on the complementary factors (for example, the capacity of the tax authority), as shown in Figure 3.

IV. Enabling Factors for Enhancing Revenue Yields

The literature based on microdata of specific countries emphasizes the importance of complementary factors for domestic revenue mobilization. In practice, the enabling factors for successfully operationalizing digital tools in tax administration include broader reforms in policy, legislation, organizational and procedural designs, and technological upgrades. The key enabling factors include reliable internet connections (Sifile and others 2018), sufficient staffing as well as digital literacy of taxpayers (Mascagni and others 2023), greater information and communication technology (ICT) expenditure by tax administrations, accountability, and implementation of appropriate anticorruption measures (Chalendard and others 2020). To assess the importance of such enabling factors, we use available proxies of digital enabling variables, including the Enhanced Digital Accessibility Index (EDAI; Alper and Miktus 2019);[14] the level of tax officials' staffing, experience, and skills; ICT expenditure; and the World Bank government effectiveness index (which serves as a proxy for governance quality). Based on the same cross-country panel regression as that used in Table 1, we also estimate coefficients of interaction terms between ISORA online filing index and the digital enabling variables.

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[13] For instance, research on e-filing by Santoro, Amine, and Magongo (2022) illustrated that although reported taxable income shows an increase, actual payment does not correspondingly rise. Similarly, a study by Bellon and others (2019) shows that e-invoicing results in an increase in tax payable; however, rather than responding with an increase in their payments, firms opt to use the tax credits they hold with the tax authority.

[14] The EDAI is a composite index that measures a country's strength and weakness in digital connectivity from both demand and supply sides, regarding: (1) access to digital infrastructure; (2) quality of internet access; (3) affordability of internet and mobile services; (4) citizens' literacy level in and knowledge of digital services; and (5) actual internet usage rate.

The success of the government digital ("GovTech") strategies in revenue mobilization depends on the availability of complementary human resources and physical infrastructure (for example, electricity, internet). Figure 3 reports the total revenue impact (that is, the direct impact of the adoption of online filing as well as its interactive effect with each digital enabler). In computing the total effect, we consider the increase in the adoption rate from the 25th to 75th percentiles of the ISORA online filing index. As the literature suggests, the effect of digital adoption is expected to differ according to the strength of a complementary digital enabling environment. In this regard, Figure 3 separately reports the estimates for countries with "low" versus "high" digital enabling environment scores (that is, countries at the bottom 10th or 75th percentile rank of each enabling variable).[15]

The results underscore large heterogeneity in the revenue yields, with a significantly larger effect for countries with higher scores in the enabling variable. The point estimate suggests that the adoption of online filing could contribute more strongly to domestic tax mobilization in countries with sufficient digital connectivity (higher EDAI scores), enough staffing of tax officials, higher quality of tax administration staffs in terms of their work experiences in revenue agencies (with length of services more than five years) and of their skill level (with a graduate-level degree), larger ICT investments, and higher governance quality.

Figure 3. Impact of Online Filing on Nontrade Tax Revenues: Heterogeneous Effect, by Enablers (in Percent of GDP)
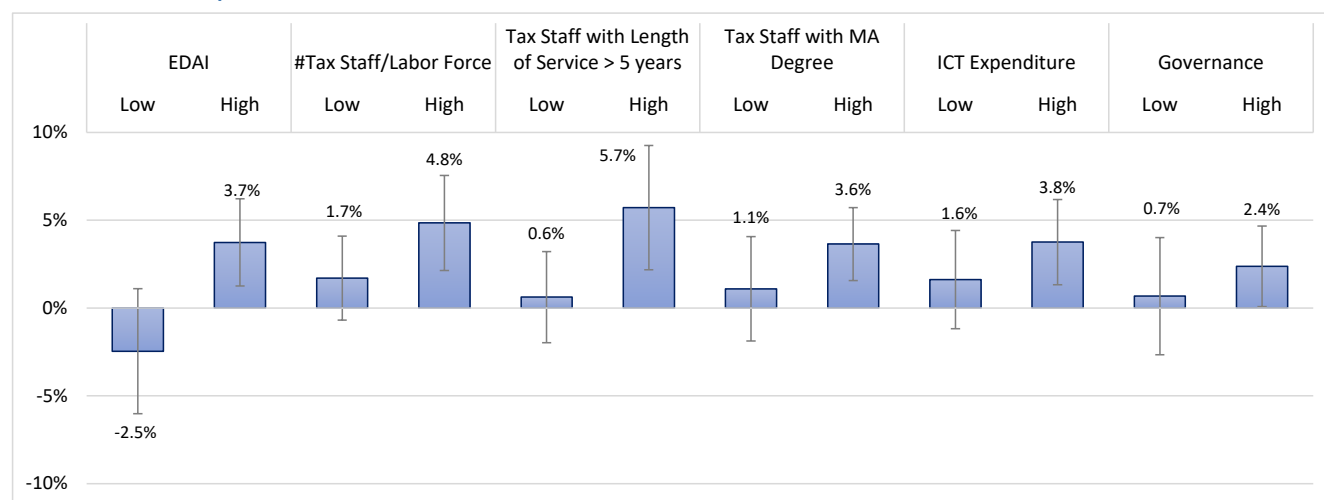
Sources: IMF, World Bank, United Nations, ISORA, Alper and Miktus (2019); and authors' estimates.

Note: Hausman-Taylor instrumental variable regression is applied. The *y*-axis indicates total effect of online filing (the sum of a single term of ISORA online filing index and the interaction term with each enabling variable). The subcategory ("low" versus "high") indicates the group of countries at the bottom 10th versus 75th percentile rank of five enabling variables. Error bars indicate 95 percent confidence intervals. EDAI = Enhanced Digital Accessibility Index; ICT = information and communications technology; ISORA = International Survey on Revenue Administration; MA = master of arts.

V. Conclusion

Evidence from the cross-country analysis suggests a positive association between digital technologies and improved tax revenues through higher tax compliance. Digital tools are increasingly used to support tax filing and payment, transaction monitoring, and compliance risk management. EMEs and LIDCs are still lagging behind AEs in digitalizing tax administration, but they are increasingly adopting digital tools (for example, EFDs)

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[15] For example, for the result of tax staff-to-labor force ratio, compared with countries with low tax staffing (at the 10th percentile), countries with high tax staffing (at the 75th percentile) are found to benefit larger revenue gains (by 3.1 percentage point (p.p.) of GDP) by mainstreaming the adoption of online filing.

to address information gaps. Our cross-country regression consistently shows that greater adoption in online filing, payments, and the use of data analytics to inform compliance activities that have the potential to create sizable revenue gains for EMEs and LIDCs when the digital enabling environment and complementary tools (for example, data analytics) are developed to reap the full benefits of the digital technologies and services.

However, the positive effect of digital tools in tax administration is associated with large uncertainty depending on the taxpayer's preexisting compliance behavior. Although the use of digital tools helps accumulate crucial information on the tax base (for example, third-party information) to detect noncompliance, the government's enforcement capacity should be strengthened in parallel. When adoption is voluntary, taxpayers may strategically choose not to use digital tools. Our results show that the impact of electronic filing and payment is significantly greater when adoption is mandatory, which underscores the need for stronger enforcement.

Digital solutions are also not a silver bullet for domestic revenue mobilization. Our cross-country results confirm that establishing adequate ICT infrastructure and enhancing internet access and reliability are essential steps for many LIDCs. In addition to investing in these enabling factors, governments should also advance complementary capabilities, such as data analysis, to make efficient use of the information that digital technologies provide. Moreover, enhanced information and analytics should be employed to improve compliance risk management.

Although mandatory digital adoption is one way to strengthen tax compliance, the success of such a strategy depends on the availability of complementary factors. The full integration of digital tools into tax administration requires that both taxpayers and tax officials have adequate digital skills, which should be supported with a strong commitment to educating taxpayers.[16] Our cross-country results confirm the importance of attracting tax officials with experiences in tax administration as well as advanced skills including digital literacy. Governments in emerging and low-income countries could enhance digital tax administration capacity, such as by establishing a modern tax administration (for example, launching an integrated tax administration system and recruitment and training tax officials with technical assistance from the international community).[17] Furthermore, the findings point to the importance of adopting technologies and services that align with the specific context of each country. For instance, in regions where digital literacy levels are limited, alternative technologies like mobile applications, unstructured supplementary service data, and similar solutions can serve as viable alternatives or complementary options to online services. The introduction of digital tools in tax administration should certainly entail broader institutional reforms (including policy, legislative, procedural, and organizational designs), which should be elaborated further in future research.

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[16] The case study from Tajikistan underscores that mandating tax filing online is not sufficient to change taxpayers' compliance behavior, whereas those taxpayers who receive training in e-filing increased their compliance (see Appendix 1).

[17] For example, refer to OECD (2016) and various technical assistance provided under the Revenue Mobilization Thematic Fund (RMTF; https://www.imf.org/external/np/ins/english/rmtf.htm).

Appendix 1. Case Studies

Mobilizing domestic revenue, sufficient to finance the required public spending, has been a recurrent challenge for governments in LIDCs. Tax revenue collection frequently faces obstacles due to structural economic factors. These include a large informal economy, a higher share of the agriculture sector, high compliance cost, asymmetric information, and pervasive bribes (Besley and Persson 2014). Further exacerbating the issue is the underdeveloped state of the financial sector, which restricts the availability of third-party information— subsequently resulting in decreased tax compliance. To overcome these challenges, many LDICs have recently deployed digital tools as part of their tax administration. The following paragraphs summarize key findings from recent microeconomic literature on the impact of digital tax administration tools on tax revenues and tax compliance.

E-Filing: Experience of Tajikistan and Eswatini[1]

Tajikistan

The tax system in Tajikistan has been characterized by significant compliance costs. For instance, firms spend 33 hours each month on filing taxes (including about three hours for visiting a tax office). The frequent in-person interaction creates an opportunity for soliciting bribes and decreases tax compliance.

To reduce the compliance cost for taxpayers, opportunity for bribes, and tax evasion, e-filing was introduced in Tajikistan in 2012. However, adoption of this technology progressed very slowly. Among the reasons behind this slow adoption include lack of taxpayers' awareness of the new system, lack of trust in the system's reliability, information security, difficulties in navigating the registration process, and lack of access to computers and internet. These factors demonstrate that the success of digital services in tax administration depends on the development (or availability) of complementary institutions and infrastructure.

In 2014, randomly selected firms received intensive training and information to increase awareness and trust in the e-filing system.[2] The treatment led to a significant reduction in compliance costs and an increase in tax payment, but the impact on aggregate government revenues was ambiguous. A study examining the effect of this intervention finds that e-filing contributed to a decrease in the cost of compliance by 40 percent and an increase in net tax liability for taxpayers with a higher risk of evasion. However, e-filing does not lead to any meaningful increase in overall tax payment, due to the decrease in the tax liability of low-risk taxpayers. The ambiguous result emanates from two contrasting incentives faced by tax agents in LIDCs: On one hand, frequent and in-person interactions with taxpayers create an incentive to accept in bribes and reduce tax liability. On the other hand, tax agents are customarily assigned a revenue target. This assignment creates an incentive to impose significant tax liability on some segments of taxpayers. E-filing removes the in-person interaction and leads to more tax liability on the taxpayers who tend to engage in bribes (high-risk taxpayers) and decreased liability on low-risk taxpayers.

Eswatini

Eswatini's economy is marked by a substantial informal sector, which, according to Medina and Schneider (2018), contributed approximately 40 percent of the national income between 2005 and 2015. Consequently, the level of tax compliance has been relatively low.

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[1] The discussion on Tajikistan and Eswatini is based on Okunogbe and Pouliquen (2022) and Santoro, Amine, and Magongo (2022).

[2] In the training session of the randomized control trial, firms received instruction about the availability and benefit of e-filing. In addition, the treated group participated in an interactive demonstration of the e-filing system, in which information on tax registration procedure was provided. Furthermore, firms received logistical support in registering for e-filing.

To improve tax compliance and reduce compliance costs, the Eswatini Revenue Authority introduced e-tax in 2014. The system was rolled out in a staggered manner. First, large taxpayers and businesses registered for VAT were required to register and use e-tax. High net-worth individuals were brought to the fold in 2018.

E-filing was mandated for all taxpayers in 2020, and paper-based filing was discontinued. The motivation for mandating e-filing was to reduce any physical interaction between taxpayers and tax officials to comply with COVID-19 social-distancing restrictions and reap the benefits that e-filing is thought to bring—including better accuracy and compliance and reduced corruption and unfairness in the tax system. The tax authority encouraged e-tax registration and helped taxpayers navigate the system. Internet kiosks were set up at tax centers across the country to provide e-filers with assistance and a stable connection. Despite such an effort, only 41 percent of registered taxpayers started to use the e-tax system.

The study in Eswatini finds low take-up of e-filing of CIT, especially by smaller firms before the mandatory e-filing was introduced. It also finds that the mandatory adoption of e-filing promoted on-time payment and increased actual tax payment (that is, fewer tax arrears). Furthermore, the impact of e-filing is found to be larger for CIT than for PIT, as there is more compliance in the latter due to withholding at source. Given that the taxable income of PIT and CIT increases by 42 percent and 80 percent, respectively, a back-of-the-envelope calculation indicates that the tax-to-GDP ratio is expected to increase by 4 percent of GDP.[3] Note that this calculation assumes full adoption of e-filing by taxpayers (rather than the 41 percent adoption observed in practice).

E-invoicing: Experience of Peru[4]

E-invoicing has been one of the tools at the disposal of Peru's tax administration since the early 2000s. However, the use of e-invoices was voluntary and not broadly embraced. Rather, paper-based filing was the norm.

In 2013, the Peruvian revenue authorities introduced a mandatory shift from paper-based to electronic invoicing. The reform was introduced gradually, with the first wave of reforms focusing on larger firms and priority sectors; smaller firms were given more time to adopt the new electronic system.

The introduction of mandatory e-invoicing led to a significant improvement in tax compliance. As a result of e-invoicing, firms declared higher sales (by 6.6 percent) as well as higher deductions on the VAT paid for inputs (by 4.5 percent), which resulted in higher net VAT liability by 7.2 percent. The impact of e-invoicing on net VAT liability was larger among small firms (by 9.7percent). Bellon and others (2019) also shed light on heterogeneity in e-invoicing's impact across sectors, with the highest impact on the transportation sector (net VAT liability increased by 16 percent). Despite the increase in net VAT liability, tax revenue gain was limited, given that firms can simply draw down existing stock of VAT credits to pay additional taxes rather than pay in cash. In an economy where the tax-to-GDP ratio is 14.5 percent of GDP, a 7.2 percent increase in tax revenue translates to about 1 percent of GDP increase in tax revenue.[5] In subsequent work, Bellon and others (2019) demonstrated that beyond the direct influence of e-invoicing on adopting firms, a company's decision to adopt also spurs its trading partners to voluntarily embrace e-invoicing. This impact is more pronounced on upstream trading partners.

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[3]   As of FY2019/20, PIT and CIT revenues were 5.3 and 2.6 percent of GDP in Eswatini. Using the estimated elasticity on taxable income, total revenue impact is calculated as 5.3 x 0.42 + 2.6 x 0.8 = 4.3.

[4]   The discussion on e-invoicing is based on Bellon and others (2019). See Fan and others (2020) for additional examples.

[5]   The calculation assumes that the mandatory e-invoicing has the same impact on all taxes (CIT, PIT, etc.) as it has on VAT.

Electronic Fiscal Devices: Experience of Ethiopia[6]

The Ethiopian tax system has been plagued by significant tax evasion. Tax revenue collection has been weak, with the tax revenue-to-GDP ratio falling from 11.8 percent in 2002 to 8.6 percent in 2009. In 2015, Shimeles, Gurara, and Woldeyes (2017) conducted a randomized control trial that demonstrated that a simple letter from the revenue administration, which reminds taxpayers of their duty to contribute taxes, boosted tax payments by 32 percent.

In the context of the declining trend in tax revenues and significant tax evasion, tax authorities in Ethiopia introduced electronic billing machines in 2008. The machines were introduced in a staggered manner; bigger firms and firms in the hospitality sector were mandated to adopt in the first stage (in the 2009 fiscal year). In subsequent years, firms are mandated to adopt the machines based on their size, industry, and location. Although the data transmitted by the machines are not directly used in the tax declaration process, such as through pre-populating tax returns, the information is of value to the tax authority and increases its ability to conduct ad hoc risk assessments or audits. That said, there are indications that the tax authorities do not use the data effectively.

Mandatory adoption of EFDs has improved tax compliance significantly, but the sustainability of the revenue gain requires continuous investment on maintenance and data analytics. This Mascagni and others (2021) finds that the introduction of EFDs led to a decrease in the discrepancy of the sales value firms declare in their VAT declaration vis-à-vis the sales value they declare in their profit tax declaration. Similarly, once EFDs were introduced, there was a decrease in the discrepancy of the value of input costs firms declare in their VAT declaration vis-à-vis the cost value they declare in their profit tax declaration. The digitization of information made it easier for tax authorities to cross-check across tax declarations for the same taxpayer, which urged taxpayers to declare consistent information. The overall impact on tax revenues was significantly positive, with the impact on net VAT revenue significantly greater than the impact on income tax (47 percent versus 12 percent). The impact on income tax gets larger (36 percent) when the sample is restricted to VAT registered firms. The mechanism behind this positive impact is through enhanced tax compliance by firms that were not compliant before the introduction. In an economy where the tax-to-GDP ratio is 7.3 percent, a 12 percent increase in tax revenue translates to about 0.88 percent of GDP increase in tax revenue. However, anecdotal evidence that the tax authority does not make use of the data efficiently exists, and taxpayers have become less compliant over time.

Two primary caveats should be considered concerning the revenue gains from EFDs. First, a survey (Casey and Castro 2015) highlighted that the introduction of EFDs brought about significant compliance costs for small and medium taxpayers. Second, the realized revenue boost is also contingent on the efficacy of the tax administration and the execution of complementary risk management strategies. However, it is also noted that other rigorous studies examining the impact of EFDs on revenue have found positive effects that align closely with the findings discussed in this section. Cardoza (2012), using data from the Dominican Republic, found that tax payments by companies using EFDs increased by 18.6 percent compared with those that did not use EFDs. Likewise, Eissa and Zeitlin (2014) found a 6.3 percent rise in VAT revenue in Rwanda due to EFDs.

E-registration: Experience of Sierra Leone and Senegal

Evidence shows that e-registration is particularly effective in revenue mobilization from property taxes. Preliminary results from a few studies show that e-registration enables significant revenue mobilization, but the evidence is

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[6] The discussion on electronic fiscal devices is based on Mascagni, Mengistu, and Woldeyes (2021). For a related work, see Ali and others (2021).

limited to property taxation (Prichard, Kamara, and Meriggi 2020 for Sierra Leone; Knebelmann 2019 for Senegal). The impact on other taxes is unknown.

Preconditions for Digital Tools' Success in Revenue Mobilization

Complementary infrastructures are critical for the efficiency of RA digital technologies and services in revenue mobilization. Frequent power interruptions and congested networks during peak hours have reduced the effectiveness of EFDs in Kenya and Tanzania (Eilu 2018). Sifile and others (2018) reported that limited internet connectivity, power cuts, and taxpayers' limited knowledge have also hindered the use of e-filing in Zimbabwe. Furthermore, Ouedraogo and Sy (2020) emphasized the importance of better digital connectivity to enhance access to information and combat corruption.

Institutional quality and human capital are also important factors that affect the revenue mobilization efficiency of RA digital tools. For instance, in Madagascar, customs inspectors do not effectively use information provided by third parties when it comes to goods, particularly in cases where the potential for rent-seeking is high (Chalendard and others 2020). A survey conducted in Rwanda shows that operating EFDs poses difficulties for taxpayers, especially smaller ones. One of the specific issues they encounter is resolving mistaken entries, which results in sales reported from EFDs differing from actual sales (Mascagni, Mengistu, and Woldeyes 2021). Moreover, tax administrators have limited capacity to effectively use the information generated from EFDs, including inconsistent claims.

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