How Can Lower-Income Countries Collect More Taxes? The Role of Technology, Tax Agents, and Politics

Online Appendix

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Appendix I: Cross Country Evidence on Use of Technology for Identification, Detection and Collection

As discussed under "Cross Country Evidence on Use of Technology for Identification, Detection and Collection", we construct indices of taxation technology computed from individual measures drawn from the OECD Inventory of Tax Technology Initiatives (ITTI) (2023) Global Survey on Digitalisation, which collects measures of uses of technology and data for tax purposes. More information about the tax technology measures can be found at https://www.oecd.org/tax/forum-on-tax-administration/tax-technology-tools-and-digital-solutions/.

We construct indices from indicators for variables included in each set, described in detail below. To build each index we first sum the indicators and then standardize the resulting sum so that it has a mean of zero and standard deviation equal to 1. Appendix Table 1 below summarizes the estimates of the relationships between indices and tax-to-GDP in 2018.

a. The taxpayer identification index is calculated from the indicators listed below. The unstandardized index (sum) has mean 3.51 and standard deviation 0.74.
    1. whether the tax authority requires taxpayers to have a digital ID
    2. the digital ID is built on an existing system
    3. a digital ID can be established using a unique identity number, government issued documents, or biometric information
    4. whether there are online services for registration for any tax type (PIT, CIT, VAT)

b. The detection index is calculated from the indicators listed below. The unstandardized index (sum) has mean 4.41 and standard deviation 1.81.
    1. whether the tax authority receives data on taxpayers
    2. whether the tax authority receives data from third parties
    3. whether some taxpayers are required to submit e-invoices
    4. some taxpayers are required to maintain online cash registers
    5. the tax authority receives data from other government bodies
    6. there exists a common database across government bodies
    7. whether the tax authority uses AI to conduct risk assessments for any tax type
    8. whether the tax authority uses AI to detect evasion.

c. The collection capacity index is calculated from the indicators listed below. The unstandardized index (sum) has mean 2.56 and standard deviation 1.16.
    1. taxpayers can file online for any tax type
    2. taxpayers can pay online for any tax type
    3. taxpayers can request an extension online for any tax type
    4. taxpayers can ask for a payment arrangement online for any tax type

d. The "taxation technology" index used in Figure 2 is a summary index that includes all of the variables listed above. The unstandardized index (sum) has mean 10.49 and standard deviation 2.58.

Appendix Table 1: Taxation Technology and Tax-to-GDP

	Tax Revenues as a Share of GDP (2018)			
Index of Tax Technology	2.155*			
	(1.133)			
Index of Identification		1.679*		
		(0.858)		
Index of Detection			2.136**	
			(1.008)	
Index of Collection				0.033
				(1.031)
Country income group fixed effects	Yes	Yes	Yes	Yes
Countries	75	75	75	75

Notes: This tables displays the estimates of the relationship between tax revenues as a share of GDP and an indices of taxation technology for 74 individual countries. The tax revenues as a share of GDP measure is drawn from the International Survey on Revenue Administration (CIAT, IMF, IOTA, OECD 2022) using values for 2018. We fill in missing values for 7 out of 74 countries using UNU-WIDER (2022) data in 2018. The indices of taxation technology is computed from individual measures drawn from the OECD Inventory of Tax Technology Initiatives (ITTI) (2023) Global Survey on Digitalisation. The identification index is calculated from indicators for whether the tax authority requires taxpayers to have a digital ID, the digital ID is built on an existing system, a digital ID can be established using a unique identity number, using government issued documents, using biometric information, and whether there are online services for registration for any tax type (PIT, CIT, VAT. The detection index is calculated from indicators for whether the tax authority receives data on taxpayers, receives data from third parties, some taxpayers are required to submit e-invoices, some taxpayers are required to maintain online cash registers, the tax authority receives data from other government bodies, there exists a common database across government bodies, whether the tax authority uses AI to conduct risk assessments for any tax type, and whether the tax authority uses AI to detect evasion. The collection index is calculated from indicators for whether taxpayers can file online for any tax type, taxpayers can pay online for any tax type, taxpayers can request an extension online for any tax type, and whether taxpayers can ask for a payment arrangement online for any tax type. More information about the tax technology measures can be found at https://www.oecd.org/tax/forum-on-tax-administration/tax-technology-tools-and-digital-solutions/. All regressions include fixed effects for country income group. Standard errors in parentheses are robust.

Appendix II: Impacts of Tax Interventions

Below is the list of papers included in Figure 5. Details on the results included are provided in the online replication dataset.

Tax officials: incentives/deployment

Amodio, Francesco, Jieun Choi, Giacomo De Giorgi, and Aminur Rahman. "Bribes vs. taxes: Market structure and incentives." *Journal of Comparative Economics* 50, no. 2 (2022): 435-453.

Balan, Pablo, Augustin Bergeron, Gabriel Tourek, and Jonathan L. Weigel. "Local elites as state capacity: How city chiefs use local information to increase tax compliance in the democratic republic of the Congo." *American Economic Review* 112, no. 3 (2022): 762-797.

Basri, M. Chatib, Mayara Felix, Rema Hanna, and Benjamin A. Olken. "Tax administration versus tax rates: evidence from corporate taxation in Indonesia." *American Economic Review* 111, no. 12 (2021): 3827-3871.

Bergeron, Augustin, Pedro Bessone, John Kabeya Kabeya, Gabriel Z. Tourek, and Jonathan L. Weigel. "Optimal assignment of bureaucrats: Evidence from randomly assigned tax collectors in the DRC." No. w30413. *National Bureau of Economic Research*, 2022.

Dzansi, James, Anders Jensen, David Lagakos, and Henry Telli. "Technology and local state capacity: Evidence from Ghana." *National Bureau of Economic Research*, Working Paper 29923, (2022).

Khan, Adnan Q., Asim I. Khwaja, and Benjamin A. Olken. "Tax farming redux: Experimental evidence on performance pay for tax collectors." *The Quarterly Journal of Economics* 131, no. 1 (2016): 219-271.

Ortega, Daniel, and Carlos Scartascini. "Don't blame the messenger. The Delivery method of a message matters." *Journal of Economic Behavior & Organization* 170 (2020): 286-300.

Weigel, Jonathan L. "The participation dividend of taxation: How citizens in Congo engage more with the state when it tries to tax them." *The Quarterly Journal of Economics* 135, no. 4 (2020): 1849-1903.

Identification

Jouste, Maria, Milly I. Nalukwago, and Ronald Waiswa. "Do tax administrative interventions targeted at small businesses improve tax compliance and revenue collection?." *Evidence from Ugandan Administrative Tax Data."* (2021).

Okunogbe, Oyebola. "Becoming Legible to the State : The Role of Identification and Collection Capacity in Taxation." *World Bank Policy Research Working Paper 9852*, (2021)

Detection/third-party info

Ali, Merima, Abdulaziz B. Shifa, Abebe Shimeles, and Firew Woldeyes. "Building fiscal capacity in developing countries: Evidence on the role of information technology." *National Tax Journal* 74, no. 3 (2021): 591-620.

Bellon, Matthieu, Era Dabla-Norris, Salma Khalid, and Frederico Lima. "Digitalization to improve tax compliance: Evidence from VAT e-Invoicing in Peru." *Journal of Public Economics* 210 (2022): 104661.

Brockmeyer, Anne, Spencer Smith, Marco Hernandez, and Stewart Kettle. "Casting a wider tax net: Experimental evidence from Costa Rica." *American Economic Journal: Economic Policy* 11, no. 3 (2019): 55-87.

Carrillo, Paul, Dina Pomeranz, and Monica Singhal. "Dodging the taxman: Firm misreporting and limits to tax enforcement." *American Economic Journal: Applied Economics* 9, no. 2 (2017): 144-164.

Eissa, Nada, Andrew Zeitlin, Saahil Karpe, and Sally Murray. "Incidence and impact of electronic billing machines for VAT in Rwanda." *International Growth Centre Report* (2014).

Fan, Haichao, Yu Liu, Nancy Qian, and Jaya Wen. "Computerizing VAT invoices in China." *No. w24414. National Bureau of Economic Research*, 2018.

Londoño-Vélez, Juliana, and Javier Ávila-Mahecha. "Can wealth taxation work in developing countries? Quasi-experimental evidence from Colombia." In *Annual Congress of the IIPF*. 2018.

Mascagni, Giulia, Andualem T. Mengistu, and Firew B. Woldeyes. "Can ICTs increase tax compliance? Evidence on taxpayer responses to technological innovation in Ethiopia." *Journal of Economic Behavior & Organization* 189 (2021): 172-193.

Mittal, Shekhar, and Aprajit Mahajan. "VAT in Emerging Economies: Does Third Party Verification Matter?." *Available at SSRN 3029963* (2017).

Naritomi, Joana. "Consumers as tax auditors." *American Economic Review* 109, no. 9 (2019): 3031-3072.

Shah, Jawad. "Using Computerized Information to Enforce VAT: Evidence from Pakistan." *Available at SSRN 4569607* (2020).

Collection: facilitation

Das, Satadru, Lucie Gadenne, Tushar Nandi, and Ross Warwick. "Does going cashless make you tax-rich? Evidence from India's demonetization experiment." *Journal of Public Economics* 224 (2023): 104907. https://doi.org/10.1016/j.jpubeco.2023.104907

Jouste, Maria, Milly I. Nalukwago, and Ronald Waiswa. "Do tax administrative interventions targeted at small businesses improve tax compliance and revenue collection?." *Evidence from Ugandan Administrative Tax Data."* (2021).

Mascagni, Giulia, Fabrizio Santoro, and Denis Mukama. "Teach to Comply? Evidence from a Taxpayer Education Programme in Rwanda." (2019).

Okunogbe, Oyebola, and Victor Pouliquen. "Technology, taxation, and corruption: evidence from the introduction of electronic tax filing." *American Economic Journal: Economic Policy* 14, no. 1 (2022): 341-372.

Collection: enforcement/sanctions

Aparicio, Gabriela, Paul E. Carrillo, and M. Shahe Emran. "Taxes, prisons, and CFOs: The effects of increased punishment on corporate tax compliance in Ecuador." *Available at SSRN 1808945* (2011).

Brockmeyer, Anne, Spencer Smith, Marco Hernandez, and Stewart Kettle. "Casting a wider tax net: Experimental evidence from Costa Rica." *American Economic Journal: Economic Policy* 11, no. 3 (2019): 55-87.

Castro, Lucio, and Carlos Scartascini. "Tax compliance and enforcement in the pampas evidence from a field experiment." *Journal of Economic Behavior & Organization* 116 (2015): 65-82.

Holz, Justin E., John A. List, Alejandro Zentner, Marvin Cardoza, and Joaquin E. Zentner. "The $100 million nudge: Increasing tax compliance of firms using a natural field experiment." *Journal of Public Economics* 218 (2023): 104779.

López-Luzuriaga, Andrea, and Carlos Scartascini. "Compliance spillovers across taxes: The role of penalties and detection." *Journal of Economic Behavior & Organization* 164 (2019): 518-534.

Mascagni, Giulia, and Christopher Nell. "Tax compliance in Rwanda: Evidence from a message field experiment." *Economic Development and Cultural Change* 70, no. 2 (2022): 587-623.

Okunogbe, Oyebola. "Becoming Legible to the State : The Role of Identification and Collection Capacity in Taxation." *World Bank Policy Research Working Paper 9852*, (2021)

Ortega, Daniel, and Pablo Sanguinetti. "Deterrence and reciprocity effects on tax compliance: experimental evidence from Venezuela." (2013).

Ortega, Daniel, and Carlos Scartascini. "Don't blame the messenger. The Delivery method of a message matters." *Journal of Economic Behavior & Organization* 170 (2020): 286-300.