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Raising Tax Revenue: How to Get More from Tax Administrations?

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**Raising Tax Revenue: How to Get More from Tax Administrations?**

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### Abstract

Can we empirically show the benefits of improving the practices and characteristics of tax administration agencies for revenue collection? While many country experiences suggest a strong link, there is little systematic empirical evidence on the matter. This paper analyzes the association between tax collections and tax administrations, using the novel dataset (ISORA). We find that tax performance is positively and strongly associated with the operational strength of tax administrations. Among emerging and low-income economies, countries at the top 25 percent (in terms of the operational strength) collect substantially larger tax revenues (by 3¼ percent of GDP) than countries at the lowest 25 percent, assuming other conditions are equal. Our results also suggest that adopting key administrative practices such as compliance risk management and use of third-party data is associated with stronger tax collections. Furthermore, larger staffing of a tax agency improves tax revenue up to a point. These findings have important policy implications, particularly during the unprecedented global pandemic situation.

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# I. INTRODUCTION

1.      **Mobilizing tax revenue is essential for a country's development.** Achieving stable domestic tax revenue allows budget resources to finance their essential spending needs (e.g., healthcare, education, and critical infrastructure). As noted in Besley and Persson (2009) and Gaspar et al. (2016), increasing tax collection is important for economic growth and development. For many developing countries, enhancing tax revenues is critical for the attainment of the Sustainable Development Goals (IMF, 2018). In order to build up tax capacity, country experiences suggest the importance of tax policy and administration reforms.[2]

2.      **The recent Covid-19 pandemic also highlights the importance of establishing sound administrative features in tax administration.** With the pandemic, many countries are experiencing erosion of tax collection, reflecting the decline in economic activities and possible deterioration in tax compliance. Most tax administrations have had to shift to working remotely, with little or no face-to-face contact with taxpayers. Tax administrations' practices will have an impact on their ability to adapt and respond to changing circumstances. The situation underscores the importance of good tax administrative features. After the pandemic recedes, strengthening tax administration would be even more important because of the critical need to generate fiscal resources for addressing development needs and safeguarding debt sustainability through enhancing revenue mobilization.

3.      **Despite the importance of tax administration to revenue collection, empirical literature on this subject has been limited**. Many country experiences suggest the benefits of tax administration reforms, in terms of increased taxpayer compliance, increased transparency, and perceptions of fairness of the tax system, among other outcomes. Various reform efforts have been made in many developing countries (often assisted by IMF and other international partners), however, there has been limited empirical literature on this matter, largely owing to the lack of data on practices and features of tax administration. This poses some important questions. Can the beneficial outcomes of better tax administration be empirically supported? If so, what specific practices and characteristics of tax administration would be associated with better tax performance?

4.      **This paper empirically examines the benefits of specific tax administration practices and characteristics, using the novel dataset of the International Survey on Revenue Administration (ISORA), based on the two-step approach**. The ISORA dataset results from the completion of a standardized questionnaire designed jointly by the ISORA partners,[3] based on responses from 135 administrations in 2016, and 159 administrations in 2018. It covers a wide spectrum of data on institutional characteristics, practices, and characteristics of tax

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[2] Akitoby et al. (2018)—examining a dataset covering 55 episodes of large tax revenue increases in developing countries—find that multi-pronged tax administration reforms often go hand in hand with tax policy measures.

[3] Inter-American Center for Tax Administration (CIAT), Intra-European Organization of Tax Administrations (IOTA), the IMF, and the Organisation for Economic Co-operation and Development (OECD)  (see http://data.rafit.org).

administration. Given the limited availability of the historical data from the ISORA, the analysis in this paper is based on the two-step approach, as proposed by Hsiao (2003). This would allow us to focus on the effects of tax administration while controlling for other factors (e.g., macroeconomic developments and tax policy changes).

5.      **The paper confirms the importance of sound design of practices and characteristics of tax administration agencies to mobilize domestic tax revenue (Box 1).[4]** The empirical results reveal that the operational strength of the agency is positively and strongly associated with tax revenue. Among emerging market and low-income economies, countries at the top 25 percent (in terms of operational strength) collect more tax revenues (by 3.25 percent of GDP) than countries at the lowest 25 percent, assuming other conditions are equal. Our results also highlight the importance of adopting key tax administration practices and characteristics—such as compliance risk management (CRM), use of third-party data, degree of digitalization, service orientation, and public accountability.

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**Box 1. Key Findings of This Paper**

- *The practices and characteristics of tax administration agencies matter significantly for tax performance.* The operational strength of the agency, comprising compliance risk management (CRM) practices, the use of third-party data, degree of digitalization of services, service orientation, public accountability, and autonomy, is tightly associated with tax collections.

- *Amongst sound practices of tax administration, CRM and the use of third-party data are particularly important.* To enhance tax collection, tax administration reform efforts should prioritize: (i) strengthening CRM by adopting automated risk profiling and electronic audits; and (ii) utilizing third party data by adopting computer systems for processing the data and prefilling returns.

- *Many of the above factors are highly correlated.* This aligns with advice to countries that tax administrative reform benefits derive from the strategic integration of multiple components, rather the implementation of individual measures. For example, it is the effective operation of an office or program for large taxpayers that matters, rather than the establishment of such an office or program.

- *Furthermore, adequately staffing tax administration agencies is important.* Increased staffing of a tax administration agency improves revenue performance up to a threshold of 0.25 percent of the labor force. The staff complement of many LIDC tax administrations is below this level. Broadening the taxpayer base is important. The number of active taxpayers (in relation to the labor force) matters for tax collection.

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[4] These findings are also supported by country experiences of tax administration measures (Akitoby et al., 2018). Examining a dataset covering 55 episodes of large tax revenue increases in developing countries, they find that broadening the tax base for both direct and indirect taxes by means of revenue administration and tax policy, especially through improvements in compliance and by reducing exemptions and/or eliminating tax holidays, were frequently used measures. In more than half of the episodes, improvements in information technology (IT) systems provided support for core revenue administration processes, with enhanced tax collection following the implementation of an IT strategic plan, the enhancement of the IT system, the computerization of tax and customs administration to support tax payments, and the filing and use of third-party information.

6.     **The rest of the paper is organized as follows.** Section II presents a brief review on related literature. Section III describes the ISORA dataset and key stylized facts on tax collection and design of tax administration. Section IV describes the empirical methodology. Section V discusses empirical findings. Section VI concludes with policy implications.

## II.   LITERATURE REVIEW

7.     **A number of studies examine various determinants of tax revenue performance.** The impact of the structure of the economy, economic dynamics, socio-political factors, and tax policy have been examined through cross-sectional studies, the analysis of panel data, and case studies. Several studies point out the complex interrelationship of factors impacting revenue outcomes, and the difficulties in isolating relevant factors (Kidd, 2006; Dom, 2017).

- **A stream of literature investigates how the level of economic development and structure affect revenue collected.** There is broad consensus that per capita GDP is positively correlated with revenue (Gupta, 2007; IMF, 2018). The contribution of agriculture to the economy is generally found to be negatively correlated with central government revenue (Yohou, 2017), although not in all studies (Boukbech, 2018; IMF, 2018). Gupta (2007) notes that per capita GDP and agriculture's value add as a proportion of GDP are strongly correlated.  Revenue collections are also correlated with trade openness (Gupta, 2007).

- **Some studies explore the impact of changes in tax policy on revenue collection, though proxies for measuring the impact of tax policy are not well-established yet.** Akitoby et al. (2018) found that episodes of revenue growth in emerging markets and low-income countries were frequently associated with tax policy reforms such as the reduction of exemptions, and/or rate increases in indirect taxes. Dabla-Norris et al. (2017) investigated how the level of tax compliance burden faced by firms affects firms' performance in 21 countries and considered the corporate income tax (CIT) and value-added tax (VAT) rates to control for tax policy. The impact of the introduction of a VAT has been examined in various studies, with some finding a growth in revenue in Sub-Saharan Africa (Ebeke, 2014) and the Caribbean (Schlotterbeck, 2017), while in others no significant impact was identified (Ngoma, 2017). Ngoma finds that when controlling for other reforms on non-resource tax revenue, there is no evidence that the introduction of a VAT increased tax collection performance in Sub-Saharan Africa. Productivity of CIT and VAT is found to be lower in countries with a higher number of exemptions (IMF, 2018).

- **Recent literature also recognizes the role of socio-political factors in determining the level of revenue relative to GDP.** The Gini coefficient, a measure of income inequality, appears to be negatively correlated with revenue collection, while the spending on education within a country correlates positively with performance (Fenochietto, 2013). Amongst countries with similar incomes, those with the lowest levels of corruption collect four more percentage points of GDP in tax revenues, than those with the highest corruption levels (IMF, 2019).

8.      **There is, however, far less empirical literature on the effect of tax administration practices and characteristics on tax performance.** As one of these few pieces of literature, Crivelli (2018) conducted cross-sectional correlation analyses between 'tax administration strength,' comprising a range of tax administration characteristics and tax efficiencies (i.e., VAT, PIT, and CIT) in Europe using data collected by the OECD.[5] This study—while being novel in comprehensively exploring the effects of specific administration features—does not control for other factors (such as macroeconomic environments and tax policy).

- Other studies examine the effects of a Large Taxpayer Office (LTO) or program. Baum (2017) finds that LTOs enhance revenue collections through dampening the perception of corruption, while Ngoma (2017) does not identify any positive change in revenue associated with LTO establishment. Ebeke (2016) does not find the positive impact of a LTO but notes that the establishment thereof is often a precursor for the introduction of VAT or establishment of a semi-autonomous revenue authority (and thus its impacts).

- In addition to these empirical studies, there are some country case studies on tax administration: Pomeranz (2015), for instance, finds that the use of third-party data impacts VAT collections positively, while Almunia and Lopez-Rodriquez (2018) finds that the increased monitoring and auditing of large firms through an LTO enhanced CIT collected from large companies. Both studies suggest that a combination of factors—use of third-party data together with enforcement capacity is more effective than either factor alone.

9.      **A lack of comparable data on the practices and characteristics of tax administrations hindered comprehensive empirical studies.** While Crivelli (2018) conducted cross-country analyses on tax administration in Europe using data collected by the OECD, such data was not available for countries in other regions. Using the novel ISORA dataset, this paper fills the gap by comprehensively studying various practices and characteristics of tax administration across countries and their impacts on tax performance while controlling for other factors (such as macroeconomic environments, tax policy, and socio-political factors).

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[5] Some studies have examined selected tax administration practices and characteristics and revenue collection effectiveness in cross-sectional studies. CASE (2018) found that the larger scale of the tax administrations (measured as its total administrative cost to GDP) decreased the estimated VAT gap, and that the share of the administration's IT expenditure (measured by the share of the administration's IT expenditures to total administrative cost) reinforces this impact on VAT gap.

### III. DATA ON TAX ADMINISTRATION PRACTICES AND CHARACTERISTICS

10. **The ISORA dataset provides a source of comparable data on the characteristics and practices of revenue administrations across income groups in all regions.** The most recent data (for 2017) covers 37 Advanced Economies (AEs), 76 Emerging Markets (EMs), and 46 Low-Income Developing Countries (LIDCs). All regions are represented in the data collected. For the ISORA dataset, tax administrators of each country provide information on their operational practices and other characteristics based on questions and definitions agreed on by four partner international organizations. As the data is not in the public domain, inaccuracies may remain despite checking for inconsistencies in the data provided.[6]

11. **Based on the ISORA data, the operational strength index of tax administration is constructed with seven sub-indices on specific tax administration practices and characteristics.** The ISORA dataset consists of responses to both numerical and categorical questions, with 982 data points. We categorize these responses into seven different sub-indices and compile them into an overall operational strength index. While ISORA questions were not designed with the creation of indices in mind, the broad set of questions lends itself to thematic grouping.[7] Features associated with facets of the administration's operations and generally regarded as indicators of good practice are grouped to create each sub-index.[8] The seven sub-indices are: (i) degree of autonomy; (ii) establishment of LTO or large taxpayer program; (iii) public accountability; (iv) service orientation; (v) CRM approach; (vi) use of third party data; and (vii) digitalization of services (depicted in Figure 1, and further detailed in Appendix 1). CRM, the use of third party data and digitalization of services are advocated to enhance compliance (IMF, 2015) and all these features have been recommended to reduce corruption potential with the administration (World Bank, 2019).

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[6] From ISORA 2020 onwards, all data will be publicly available, which will further promote accuracy.

[7] For example, an autonomy index may be determined from the responses to 14 questions, that include whether the tax administration operates through a semi-autonomous body or not, the discretion it has to manage operational and capital budgets, the discretion it has in managing human resources, and whether it has authority to design its organization structure, set performance standards and provide tax policy advice. Thus, in contrast to previous studies that distinguish only between whether the tax administration operates through a semi-autonomous body or not, the relationship between the *degree* of autonomy and revenue performance can be examined.

[8] Respondents may have a tendency to give a 'good practice' response, in cases where the issue may not be clear cut.

**Figure 1. Indices Compiled to Reflect Facets of Tax Administration**

| *How the tax administration is organized* | *Broad operational practices* | *Detailed operations* |
|---|---|---|
| | | **Compliance Risk Management**<br><br>*Formal approach for identifying, assessing and prioritizing key compliance risks;*<br>*automated risk profiling;*<br>*electronic audit* |
| **Autonomy**<br><br>*Institutional form;*<br>*degree of autonomy in managing expenditure and human resources;*<br>*ability to set performance standards;*<br>*provision of tax policy advice* | **Public Accountability**<br><br>*The publishing of key documents such as plans and achievements against plans;*<br>*use of an external auditor* | |
| | | **Use of Third Party Data**<br><br>*Computer based information systems for processing various forms of third-party data;*<br>*Use of third-party data in prefilling returns* |
| **Large taxpayers office**<br>*An office or a program dedicated to large taxpayers is in operation* | **Service Orientation**<br><br>*Service offerings facilitating compliance;*<br>*Provisions to enhance taxpayer satisfaction with services offered* | |
| | | **Degree of Digitalization of Services**<br>*Provision of e-services, including e-filing, e-payment, and web-based information and communication services* |

**Operational Strength Index = average of seven sub-indices**

Source: ISORA (2017).

12.      **Closely looking at these indices, AEs tend to have higher values across them (Figure 2).** The radar diagram points the strength of tax administration in AEs (relative to EMs and LIDCs), for all but one index on the establishment of an LTO.[9] Almost all EMs and LIDCs have LTOs, while just under 80 percent of AEs indicate an LTO or program for large taxpayers.[10] The box and whiskers plots of the operational strength index show a spread in value within each country grouping, with the mean and median value for AEs greater than that of EMs and LIDCs.

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[9] The LTO indicator is binary (0=no LTO, 1=LTO), i.e., effectively a dummy indicator.

[10] Large taxpayers may be managed through dedicated offices, or programmatically. Many AEs manage large taxpayers through a program, rather than through separate offices.

**Figure 2. Indices for AEs, EMs, and LIDCs**
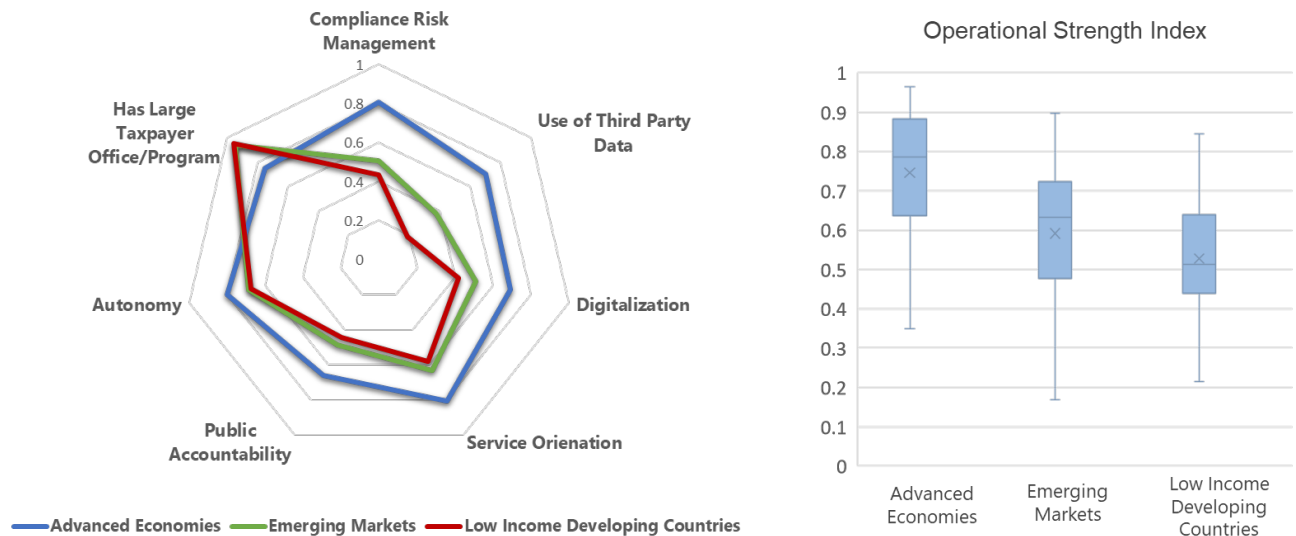


Sources: ISORA (2017) and authors' calculation.

13. **Two further descriptors of tax administrations have been derived from ISORA responses—the ratio of full-time-equivalents[11] to labor force, and the ratio of active taxpayers to the labor force.** The first provides an indication of the scale of the tax administration. For the second, active taxpayers are taxpayers that interact with the tax administration, providing a proxy for the tax administration's workload. It is worth noting that the number of active taxpayers is a product of tax policy, societal attitudes and norms, as well as efforts by the administration to ensure that all taxpayers comply with their tax obligations. The spread in these ratios by AE, EM, and LIDC groupings is illustrated in Figure 3 below.

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[11] Full Time Equivalent (FTE): An FTE of 1 means resources equal to one staff member available for one full year.

**Figure 3. Distribution of the Ratios of FTEs and Active Taxpayers to Labor Force**
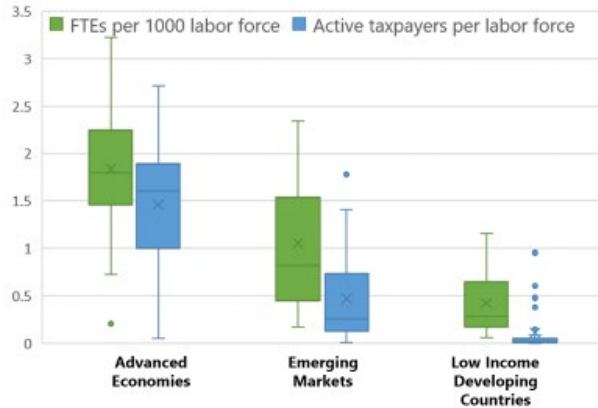


Source: ISORA (2017).

14.     **The tax-to-GDP ratio is positively correlated with the operational strength index, as well as the ratios of staff to labor force and active taxpayers to labor force**. As Figure 4 shows, the ratios of staff to labor force[12] and active taxpayers to labor force vary by one and two orders of magnitude respectively, exhibiting far smaller values in general for LIDCs than for AE or EM countries. In countries with a higher active taxpayer to labor force ratio, tax administrations are likely to have higher compliance risk management and third-party data indices.

**Figure 4. Operational Strength, Size of Tax Agency Staffing, and Size of Taxpayer Base**



Sources: ISORA (2017) and authors' calculation.

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[12] The staffing level of the tax administration is measured in terms of the number of FTEs.

15.      **There are high correlations between sub-indices of tax administrations.** Table 1 on the correlation between the sub-indices generally indicates that countries with a stronger index on one aspect tend to be stronger on other indices. The service orientation index, for instance, correlates strongly with all other indices (LTO establishment aside). Given common underlying information management capability prerequisites, the correlations between the use of third-party data and both compliance risk management and the degree of digitalization are also high. Tax administration reform experience demonstrates that the major benefits of administrative reform arise from the strategic integration of multiple components, rather than the implementation of individual measures (IMF, 2015). These correlations, while not unexpected, present challenges in isolating exactly which characteristics or practices are associated with enhanced revenue performance.

## Table 1. Correlations Among ISORA Sub-Indices

|  | Compliance risk management | Third party data | Digitalization | Service Orientation | Public Accountability | Autonomy | Staff/Labor Force | Active Taxpayers /Labor Force |
|---|---|---|---|---|---|---|---|---|
| Compliance Risk Management | 1 | | | | | | | |
| Third party data | 0.47 | 1 | | | | | | |
| Digitalization | 0.39 | 0.46 | 1 | | | | | |
| Service Orientation | 0.47 | 0.51 | 0.45 | 1 | | | | |
| Public Accountability | 0.41 | 0.49 | 0.39 | 0.62 | 1 | | | |
| Autonomy | 0.32 | 0.36 | 0.35 | 0.57 | 0.38 | 1 | | |
| Staff/Labor Force | 0.31 | 0.33 | 0.26 | 0.14 | 0.13 | 0.13 | 1 | |
| Active Taxpayer/Labor Force | 0.48 | 0.61 | 0.37 | 0.33 | 0.36 | 0.22 | 0.55 | 1 |

16.      **The recent Covid-19 pandemic is affecting tax administration (Box 2).** With the pandemic, many countries are experiencing erosion of tax collection, reflecting the decline in economic activities and likely deterioration in taxpayer compliance. Thus, securing revenue streams and bringing taxpayers' compliance behavior back to pre-crisis levels and beyond, will be a key priority for revenue administrations in the months and years ahead.

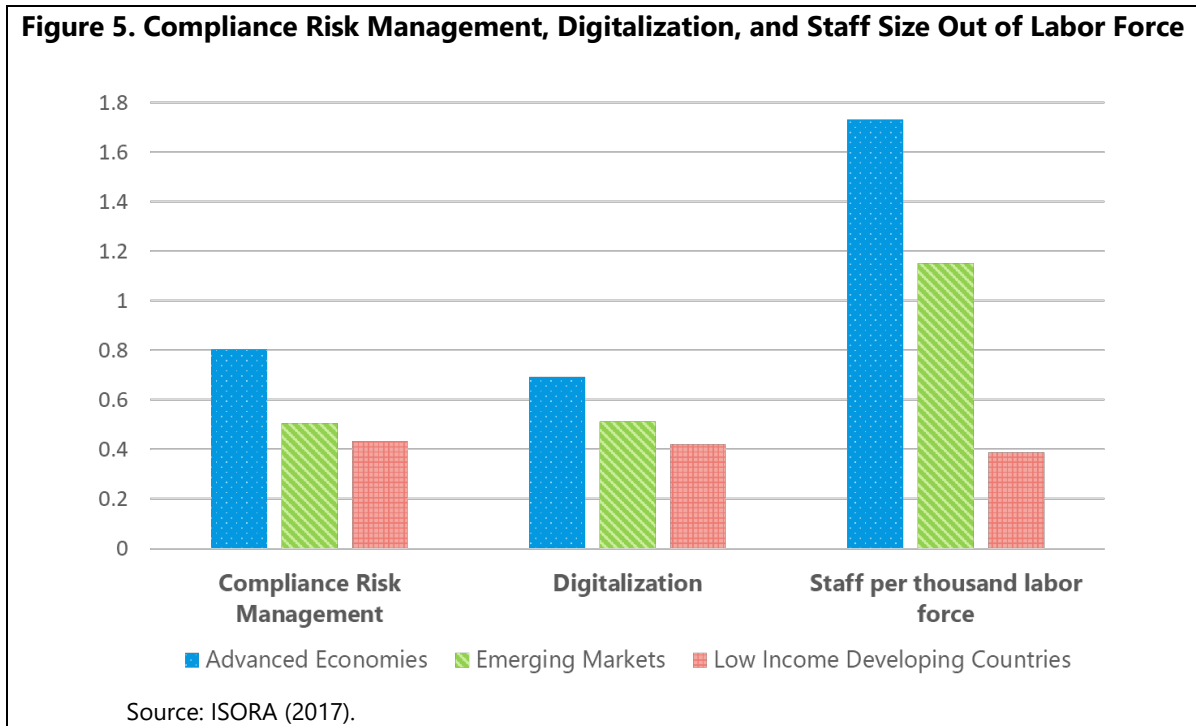**Box 2. Potential Impact of Covid-19 on Tax Administration**

**During the pandemic, tax administration is likely to be adversely impacted.** Containment efforts for Covid-19 can slow down economic activities, while the easing of taxpayer obligations, such as extensions to filing and payment deadlines, together with the administration of crisis relief measures, adds complexity to the tasks of compliance monitoring and non-compliance response. As discussed in IMF (2020), during the crisis, filing, declaration, and payment compliance may deteriorate due to extended deadlines, limited availability of staff and taxpayers weakened financial positions. Face-to-face interactions of tax administration officials and taxpayers are limited, in the realm of both services and enforcement (IMF, 2020).[1] Most tax administrations have had to shift from face-to-face audits to desk audits.[2] For administrations with limited digital service offerings and/or remote access to data, these challenges are more severe. Furthermore, for the tax administration agencies with lower levels of staffing, any further reduction due to illness in staff may further undermine tax collection.

**Strong tax administrative operations will be particularly important in the post Covid-19 recovery period**. After the pandemic recedes, strengthening tax administration will be even more important, because of the critical needs to generate fiscal resources for addressing development needs and safeguarding debt sustainability through enhancing revenue mobilization. Enhanced efforts for strengthening tax administration should be sought, accompanied by appropriate reform efforts for tax policy. In the case of staff shortages, the focus should turn to prioritizing staffing for "critical" areas, based on a risk management approach. The expansion of digital services should be explored, where possible.

**LIDCs may experience greater challenges in maintaining compliance and revenue collections during the pandemic and in the recovery period.** They may be less able to work remotely effectively, due to a lower degree of digitalization. As shown in Figure 5, LIDCs are in general less equipped with CRM and digitalization. The figure further illustrates LIDCs' lower level of tax administration staff that could pose challenges for business continuity during the pandemic.

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[1] FAD Notes on 'Tax and Customs Administration Responses' and 'Revenue Administration: Reinvigorating Operations to Safeguard Collection and Compliance,' available from https://www.imf.org/en/Publications/SPROLLs/covid19-special-notes#fiscal.

[2] In a survey of 89 tax and customs administrations (conducted by the IMF in April 2020), over 70 percent indicated that measures easing taxpayer obligations had been implemented and 64 percent had made adjustments to their audit program, with over half of the administrations noting a shift from face-to-face to desk audits.

**Figure 5. Compliance Risk Management, Digitalization, and Staff Size Out of Labor Force**



Source: ISORA (2017).

## IV. EMPIRICAL METHODOLGY

17. **To empirically explore the impact of practices and characteristics of tax administrations, the two-step approach proposed by Hsiao (2003) is used.** The ISORA dataset is only available for 2014-17, and there is little variation in tax administration features within such a short period. Thus, the typical panel estimation with fixed effects cannot be applied.[13] So, we employ the "two-step approach" proposed by Hsiao (2003). Several studies have adopted this approach to address the problem posed by time-invariant variables in the panel dataset.[14]

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[13] Currently ISORA data are available only for four fiscal years, during which period the indices and ratios described do not change significantly. To illustrate the limited change in index values over this period, the correlation between the compliance risk management, third-party data and service orientation indices for 2015 and for 2017 are 0.87, 0.84, and 0.86, respectively. The correlation between 2015 and 2017 ratios for FTEs to labor forces and active taxpayers to labor force are 0.96 and 0.93, respectively (Appendix 2).

[14] Alesina et al. (1999) applied the two-step approach and found that a country with stronger budget institution (which is a time invariant) has better outturn of primary balance in Latin America. Recently, Baum et al. (2019) studied how corruption (time invariant) affects the performance of SOEs using firm level data across more than 80 countries. Plümper and Troeger (2007) proposed a similar approach but with a three-step procedure, where the first two steps are same as Hsiao (2003) but pooled OLS regression is added at the last step to produce more reliable estimates. However, Greene (2011) suggested using only the first two steps because the third step is based on the incorrect covariance matrix.

**First Step**

18.      **At the first step, we estimate the coefficients for the time-varying control variables, including tax policy changes, using a fixed effect panel regression.** The model for the first stage regression can be written as follows:

$$y_{i,t} = \beta_0 X_{i,t} + u_i + \gamma_t + \varepsilon_{it}$$

where $y$ is the tax to GDP ratio excluding trade taxes and social security contributions, $X$ is a set of time variant control variables, $u_i$ is a set of estimated tax collection after controlling other factors (i.e., country fixed effects), $\gamma_t$ is a set of time fixed effects, and $\varepsilon_{it}$ is the residual.[15] As time varying control variables, macro-economic data such as GDP, CPI, trade openness, and external debt are included. We also control for the structure of economy by adding the share of oil export and agriculture out of GDP.

19.      **At this first step, we also employ a novel approach to control for tax policy changes.** In examining tax performance, controlling for tax policy changes is technically challenging, as there is no convenient variable representing tax policy of each country. In the absence of information on effective tax rates across countries, we use "projected" tax revenues as a proxy for the revenues reflecting all anticipated changes of tax policy. As the projected revenues may reflect not only tax policy changes but some gains from improving the tax administration, we also test other indicators as robustness check.[16] These proxies have their own deficiencies in measuring tax policy. Despite the limitations, however, our consistent findings suggest robustness.

- *The difference between the budgeted revenue of this year as share of projected GDP and the actual revenue of last year as share of actual GDP:*[17] The budgeted revenue reflects planned tax policies and the economic forecast when the budget is prepared. Since macroeconomic changes are controlled separately in the regressions and within-year tax policy changes are rare, this gap can reflect the effect from changes in tax policy.[18]

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[15] Considering that many countries have separate entities for collecting customs and tariffs, we excluded trade tax revenues from total tax revenues. We primarily used the tax data from IMF's World Economic Outlook (WEO) database and replace the whole tax series of a country with corresponding OECD data, if there are missing values in the WEO database. The classifications of taxes from IMF and OECD are similar except that OECD includes social security contributions as a form of taxes, so we excluded social security contributions when using OECD data.

[16] If any tax administration improvement effects are already anticipated in the budgeted revenue, this only reinforces our findings in the second stage regression. Tax administration features are still significant in the second stage despite some of the explanatory power having been captured in the first stage.

[17] The WEO April version vintage data for year *t* are used as the projected tax and GDP data for year *t*. (The data from the May version of the OECD economic outlook are complements of WEO data.)

[18] The level of projected and actual tax revenues reflects the tax structure of a country (such as degree of progressivity, exemptions, tax holiday and so on) along with macroeconomic situations. Since we use the gap as a proxy, the level of tax revenue cancels out and the gap captures the changes in tax policy and macroeconomic development.

- *The difference between the budgeted revenue of this year as share of projected GDP and the budgeted revenue in last year as share of projected GDP*: While less accurate a proxy for the tax policy changes in year *t*, this gap can reduce possible systematic biases in budget process such as continuous over or underperformance of actual revenue vs. the revenue projections in the budget.

- *Top tax rates:* Changes in tax rates may lead to change in tax collections. Since our tax rate data from the IMF Tax Rate Database (DART) record only the top tax rates for tax types, any tax policy changes such as tax cuts, changing the tax bracket, and exemptions which does not affect top rate cannot be captured.

**Second Step**

20. **At the second step, the estimated fixed effect values (from the first step) are regressed on the time-invariant tax administration variables.** This step looks at the part of tax collection (as share of GDP) for each country, $i$, that cannot be explained by the time varying variables in the first stage, $u_i$ and estimates the relationship between this and the practices and characteristics of countries' tax administration using ISORA data. The model for the second stage regression can be written as follows:

$$\widehat{u_i} = \beta_1 I_i + h_i$$

where $\widehat{u_i}$ is the estimated tax collection after controlling for other factors from the first stage, $I_i$ is the set of time invariant tax administration' practices and characteristics, and $h_i$ is the unobserved heterogeneity.[19]

21. **The role of the practices and characteristics of tax administration agencies is investigated at three different levels.** First, we develop a compound index measuring the operational strength of the agency by averaging the individual sub-indices. Second, we run regressions with the individual sub-indices to test which practices and characteristics are positively correlated with tax outcomes. This approach reduces the possible multicollinearity problem given that the good practices and characteristics are correlated with each other. Lastly, we try to investigate the impact of multiple features of tax administration by including all tax administration sub-indices in the regression and distinguishing the significant ones that are tightly associated with tax revenue performance. This complements the second approach, as the inclusion of all variables may lead to multicollinearity, while regressions with one variable only may lead to omitted variable problem.

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[19] We used the weighted least square estimation method to correct for heteroskedasticity. The outcomes turn out to be robust regardless of the techniques to control for the standard errors such as Bootstrap and Huber-White estimations.

## V. EMPIRICAL FINDINGS

**First-Stage Regression Results**

22.      **As expected, macro-economic and economic structure variables are significantly associated with tax collections, so controlling for their effect from the data is necessary (Table 2)**.[20] Regardless of the choice of proxies for tax policy, per capita GDP is positively associated with tax performance as it is expected to be a good indicator of the overall level of economic development (Gupta, 2007). The results also find that the coefficient for trade openness (measured by the combined share of exports and import) is positive and statistically significant, consistent with the literature (Leuthold, 1991; Ghura,1998). The effect of inflation on tax revenue is negative, possibly reflecting the Olivera-Tanzi effect (the lags in revenue collection reduce revenue relative to GDP). The degree of external indebtedness of a country turns out to be insignificant suggesting its mixed effects on tax collections.[21] To control for the structure of the economy, we also include variables for oil export and agriculture as a share of GDP. The coefficient of oil exports is positive and statistically significant (likely reflecting larger tax collection from the sector in larger oil exporters). The share of the agricultural sector in GDP turns out to be insignificant (likely reflecting possible multicollinearity between the share of agriculture and per capita GDP). The coefficients of all proxies of tax policy are positive and statistically significant, suggesting a robust effect on collections, as expected.

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[20] A Hausman test confirmed the validity of the fixed-effect estimator vs. a random effect alternative.

[21] Having external funding sources could reduce the needs for mobilizing higher revenues while, on the other hand, a country may choose to increase taxes with a view to generate revenue to service the public part of external debt which leads to higher revenue (Tanzi, 1992).

## Table 2. First Stage Regression Outcomes

| Dependent variable: Tax revenue/GDP | (1)<br>Tax Rate | (2)<br>Bdgt-Act | (3)<br>Bdgt-Bdgt |
|---|---|---|---|
| *Log (PerCapitaGDP_PPP), lagged* | *0.1810\*\*\** | *0.1374\*\*\** | *0.1417\*\*\** |
| | *(0.0402)* | *(0.0406)* | *(0.0419)* |
| *Square log (PerCapitaGDP_PPP), lagged* | *-0.0110\*\*\** | *-0.0084\*\*\** | *-0.0088\*\*\** |
| | *(0.0024)* | *(0.0024)* | *(0.0025)* |
| *Trade openness (out of GDP), lagged* | *0.0228\*\*\** | *0.0236\*\*\** | *0.0251\*\*\** |
| | *(0.0058)* | *(0.0066)* | *(0.0067)* |
| External debt (out of GDP), lagged | -0.0005 | -0.0038 | -0.0063 |
| | (0.0033) | (0.0046) | (0.0051) |
| *CPI, lagged* | -0.0094 | *-0.0348\*\*\** | *-0.0308\*\** |
| | (0.0119) | *(0.0131)* | *(0.0128)* |
| Terms of Trade (2000=1), lagged | 0.0020 | 0.0021 | 0.0038 |
| | (0.0038) | (0.0039) | (0.0039) |
| *Oil exports (as a % of GDP), lagged* | *0.1414\*\*\** | *0.1570\*\*\** | *0.1452\*\*\** |
| | *(0.0254)* | *(0.0224)* | *(0.0225)* |
| Log (Agri, %GDP), lagged | 0.0029 | -0.0032 | -0.0006 |
| | (0.0046) | (0.0054) | (0.0056) |
| Control Corruption, lagged | 0.0056 | 0.0027 | 0.0047 |
| | (0.0044) | (0.0047) | (0.0049) |
| Top Combined CIT Rate (%), lagged | 0.0002 | | |
| | (0.0003) | | |
| Top Combined PIT Rate (%), lagged | 0.0002 | | |
| | (0.0002) | | |
| *Standard VAT Rate (%), lagged* | *0.0030\*\*\** | | |
| | *(0.0006)* | | |
| *Budgeted (t) minus Actual (t-1) tax rev.* | | *0.1273\*\*\** | |
| | | *(0.0407)* | |
| *Budgeted (t) minus Budgeted (t-1) rev.* | | | *0.1953\*\*\** |
| | | | *(0.0323)* |
| Constant | -0.6443\*\*\* | -0.4239\*\* | -0.4323\*\* |
| | (0.1655) | (0.1707) | (0.1744) |
| Observations | 675 | 894 | 830 |
| R-squared | 0.2301 | 0.1984 | 0.2441 |
| Number of countries | 105 | 127 | 125 |
| Country FE | YES | YES | YES |
| Year FE | YES | YES | YES |

Note: Estimation of equation by panel fixed effect. Standard Errors in Parentheses. \*, \*\*, \*\*\* denote statistical significance at the 1, 5, and 10 percent levels, respectively. Bold italics means statistically significant at least 10 percent level.

## Second-Stage Regression Results

23.    **The fixed-effect values estimated in the first stage are regressed against: (i) an operational strength index (aggregated ISORA sub-indices); (ii) each sub-index of ISORA data separately; and (iii) all sub-indices in the regression at the same time.**

24.      **The regression results on the operational strength confirm that the strength of tax administration, as measured by the index compiled from ISORA data, is highly relevant for tax performance (Table 3).** [22] The estimated tax collection after controlling for the influence of other relevant factors from the first stage—the estimated country fixed effect—was regressed on the operational strength index of tax administration, which is the average score of seven sub-indices ranging from 0 and 1. The coefficients of the index are positive and statistically significant, and the finding also holds when the sample is restricted to emerging and low income countries. Variables considering the relative size of the administration such as the share of staff in tax administration agency in a country's total labor force and the share of active taxpayers in the labor force are included to control for features of the agencies that might not be captured by the operational strength index.

**Table 3. Second Stage Regression Outcomes (Panel Between Estimation) [23]**

| Dependent variable: Estimated Country Fixed Effects | All Countries | | | EMs and LIDCs | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| *Operational Strength* | *0.2226\*\*\** | *0.1767\*\*\** | *0.1228\*\*\** | *0.1546\*\*\** | *0.1485\*\*\** | *0.1277\*\*\** |
| | *(0.0349)* | *(0.0358)* | *(0.0417)* | *(0.0357)* | *(0.0377)* | *(0.0438)* |
| *#Tax Staff/LaborForce* | | *0.0802\*\*\** | *0.0535\*\** | | *0.0472\** | 0.0487 |
| | | *(0.0235)* | *(0.0250)* | | *(0.0278)* | (0.0366) |
| *Sq(#Tax Staff/LaborForce)* | | *-0.0157\** | -0.0130 | | -0.0058 | -0.0110 |
| | | *(0.0083)* | (0.0087) | | (0.0112) | (0.0171) |
| *ActiveTaxpayer/LaborForce* | | | *0.0443\*\*\** | | | *0.0346\** |
| | | | *(0.0122)* | | | *(0.0196)* |
| Constant | -0.1187\*\*\* | -0.1444\*\*\* | -0.1122\*\*\* | -0.0729\*\*\* | -0.1027\*\*\* | -0.0965\*\*\* |
| | (0.0222) | (0.0235) | (0.0273) | (0.0215) | (0.0245) | (0.0297) |
| R-squared | 0.2911 | 0.4937 | 0.5753 | 0.1935 | 0.3672 | 0.3941 |
| Number of countries | 101 | 85 | 70 | 80 | 64 | 54 |

Note 1: Above second stage regression outcomes are based on the first stage regression using the difference between the budgeted and actual tax revenue as a proxy for the tax policy.[24]
Note 2: Estimation of equation by panel between effect with least Square Estimation. Standard Errors in Parentheses. \*, \*\*, \*\*\* denote statistical significance at the 1, 5, and 10 percent levels, respectively. Bold italics means statistically significant; at least 10 percent level.

25.      **The square term of tax administration staff controls for the non-linear relationship between the size of staff and tax performance.** The coefficients for this term—marginally significant for all countries and insignificant for EMs and LIDCs—are negative. This suggests the

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[22] We used the gap between budgeted revenue and actual revenue as our baseline model in the first stage. Again, regression outcomes are consistent regardless of proxies for tax policy (Appendix 6).

[23] The second stage regressions adopted the between estimation of panel dataset. Given that the between estimation uses averages of the explanatory and response variables, the regression results are similar to those of cross section analysis on a certain year, except that observations in the cross-section analysis are often smaller than those of the between estimation due to missing variables in years.

[24] Other tax policy proxies such as tax rates and the gap between the budgeted revenue of this year and last year are also tested and similar outcomes are obtained (presented in Appendix 5).

decreasing marginal tax gains as the staff level incrementally increases among all countries, leading to a threshold where additional staffing does not increase revenue. However, EMs and LIDCs do not reach this threshold yet, implying potential for ramping up revenue by hiring staff (see Appendix 4 for details).

26. **Based on the results, we further estimate the possible magnitude of tax gains by improving the operational strength of the tax administration agency.** Among EMs and LIDCs, a country at the top 25 percentile threshold in terms of operational strength collects larger tax revenues by 3.25 percent of GDP than a country at the lowest 25 percent threshold, assuming other conditions are equal (we estimate tax collections at both quartiles using the estimates from the column (5) in Table 3).[25] Though our analysis does not prove strict causality between operational strength and tax outcomes, the estimated results suggest that a country with stronger tax operational capacity collects significantly more tax revenues in EMs and LIDCs.

**Figure 6. Operational Strengths and Estimated Tax Collections**
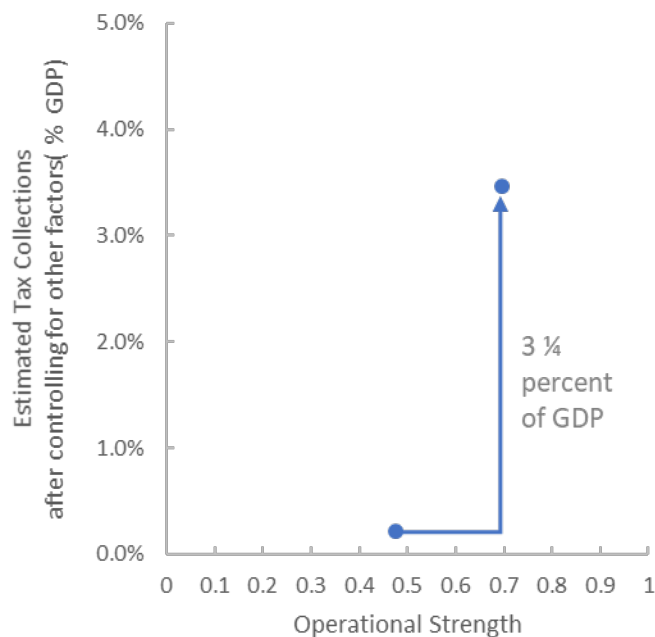


Sources: ISORA (2017) and authors' calculation.

27. **The results on each ISORA sub-index suggest that most indices on practices and characteristics of tax administration are positive and statistically significant.** Here we regress the country fixed effects from the first stage on these sub-indices separately to identify which features of tax administration play an important role in explaining the tax collection. The regressions found that six sub-indices out of seven are significant. Interestingly, the goodness of

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[25] The share of active taxpayers out of labor force is not included in our baseline model due to the high correlation with the operational strength. A higher active taxpayer ratio may reflect the tax administration's efforts to broaden taxpayer bases by ensuring that all taxpayers comply with their tax obligations.

fit measures (R-squares) are quite varying among sub-indices, which provides a rough guidance to the relative importance of specific features in explaining tax performances. The establishment of the LTO was not found to be significant. Most countries indicated the existence of an LTO, but the nature of program for large taxpayers varies considerably, according to data provided in ISORA. While many countries segmented taxpayers by size for ease of collections, including programs for LTOs, the impact of the establishment of an LTO is not confirmed. This suggests that the LTO needs to be effectively operationalized (see Appendix 8 for details).

**Table 4. Second Stage Regression Outcomes with Sub-Indices – Single Variate**[26]

| Dependent var: Estimated Country Fixed Effects | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| *Comp. Risk Management* | *0.1154\*\*\** | | | | | | |
| | (0.0184) | | | | | | |
| *Third Party Data* | | *0.1136\*\*\** | | | | | |
| | | (0.0181) | | | | | |
| *Digitalization* | | | *0.0830\*\*\** | | | | |
| | | | (0.0197) | | | | |
| *Service Orientation* | | | | *0.1175\*\*\** | | | |
| | | | | (0.0348) | | | |
| *Public Accountability* | | | | | *0.0874\*\*\** | | |
| | | | | | (0.0286) | | |
| *Autonomy* | | | | | | *0.0809\*\** | |
| | | | | | | (0.0322) | |
| Est. LTO | | | | | | | -0.0245 |
| | | | | | | | (0.0325) |
| Constant | -0.0457\*\*\* | -0.0240\*\*\* | -0.0273\*\* | -0.0592\*\* | -0.0245 | -0.0408\* | 0.0416 |
| | (0.0117) | (0.0089) | (0.0125) | (0.0238) | (0.0155) | (0.0245) | (0.0317) |
| R-squared | 0.2835 | 0.2843 | 0.1515 | 0.1034 | 0.0860 | 0.0600 | 0.0057 |
| Number of countries | 101 | 101 | 101 | 101 | 101 | 101 | 101 |

Note: Estimation of equation by panel between effect with least Square Estimation. Standard Errors in Parentheses. \*, \*\*, \*\*\* denote statistical significance at the 1, 5, and 10 percent levels, respectively. Bold italics means statistically significant at least 10 percent level.

28.     **Among other variables, enhancing CRM and actively using third-party data show stronger correlation with tax collections.** When all tax administration sub-indices together with quantitative variables are included in the second stage regressions, CRM and the use of third-party data remain significant, while other variables become insignificant (Table 5). It implies that given the tax administrations' limited resources, priority should be given to the enhancement of the tax administration's ability to identify taxpayers' risk profiles, apply different treatments to different risk groups, and establish computer-based information system enabling data from third parties. This is not to say that the other activities do not matter—but, as a matter

[26] Given the low $R^2$ values for some variables, we tested the normality of residuals and found that normality cannot be rejected, which supports the validity of our test results (Appendix 9).

of priority, removing bottlenecks in compliance risk management and use of third-party data seems to deliver stronger tax collection.

29.      **The size of staff in tax administration is also significantly associated with tax collections, up to a point.** The share of tax staff out of labor force is positively associated with tax collection while its quadratic term is negatively associated with tax collections. It suggests that tax performance could improve with increasing size of staff in tax agencies, but there is an optimal size beyond which this effect is no longer present.

**Table 5. Second Stage Regression Outcomes – Multivariate**

| Dependent variable: Estimated Country Fixed Effects | (1) | (2) | (3) |
|---|---|---|---|
| ***Compliance Risk Management*** | ***0.0830**** | ***0.0772**** | ***0.0873**** |
| | (0.0212) | (0.0226) | (0.0247) |
| ***Third Party Data*** | ***0.0763**** | ***0.0607**** | ***0.0612**** |
| | (0.0199) | (0.0206) | (0.0237) |
| Digitalization | 0.0228 | 0.0098 | 0.0016 |
| | (0.0215) | (0.0220) | (0.0225) |
| Service Orientation | -0.0297 | -0.0295 | -0.0425 |
| | (0.0438) | (0.0432) | (0.0472) |
| Est. LTO | -0.0087 | -0.0162 | 0.0123 |
| | (0.0271) | (0.0271) | (0.0295) |
| Public Accountability | -0.0033 | 0.0112 | -0.0180 |
| | (0.0314) | (0.0318) | (0.0340) |
| Autonomy | 0.0160 | 0.0140 | 0.0103 |
| | (0.0315) | (0.0319) | (0.0331) |
| ***#Tax Staff/LaborForce*** | | ***0.0725**** | ***0.0641**** |
| | | (0.0228) | (0.0242) |
| ***Sq (#Tax Staff/LaborForce)*** | | ***-0.0153**** | ***-0.0177**** |
| | | (0.0081) | (0.0086) |
| ***ActiveTaxpayer/LaborForce*** | | | ***0.0301**** |
| | | | (0.0132) |
| Constant | -0.0508 | -0.0809** | -0.0891** |
| | (0.0332) | (0.0350) | (0.0375) |
| R-squared | 0.4210 | 0.5755 | 0.6492 |
| Number of countries | 101 | 85 | 70 |

Note: Estimation of equation by panel between effect with least Square Estimation. Standard Errors in Parentheses. *, **, *** denote statistical significance at the 1, 5, and 10 percent levels, respectively. Bold italics means statistically significant at least 10 percent level.

*Robustness Checks*

30.     **These results are robust in several directions. We conduct several robustness checks:[27]**

- *Control variables*: We also consider selecting control variables with a low level of correlation in order to reduce multicollinearity problems given tax administration sub-indices are interlinked to each other (as depicted in Table 1). To test the significance of each of the sub-indices (e.g., degree of digitalization, service orientation), we drop the variables with correlation higher than 0.4 and conduct panel between regression analysis across all countries.[28] Our main results broadly remain unchanged with the regressions using these selection processes of control variables. The variables significant in our baseline models stay significant while insignificant variables in our baseline models remain insignificant. Some variables showing negative signs (for instance service orientation and public accountability) in case all sub-indices are included as regressors now have expected positive signs though still insignificant.

- *Limiting the sample to EMs and LIDCs:* One may argue that our findings are driven largely by the strong tax revenue performances and good practices and characteristics of AE tax administrations. We tested our models only to EMs and LIDCs and the findings remain broadly unchanged except that the quadratic term of staffing loses its significance, implying that these tax administration agencies are mostly understaffed. It again supports our main theme: enhancing key practices and characteristics of tax administration could reap significant gains in tax collections among the countries with strong needs for mobilizing domestic revenues.

- *Keeping the same sample size across the first stage regressions:* Given that we are using three proxies separately to control for the effects of changing tax policies in the first stage, the sizes of sample in the first stage are different across the selection of tax policy proxies (Table 2). While two proxies (i.e., the difference between the budgeted revenue and tax revenue, and the difference between the budgeted revenue of this year and the last year) broadly capture the changes in tax bases, the tax rates proxy looks narrowly at the changes in top tax rates in CIT, PIT, and VAT. As robustness checks, we ran regressions keeping the same sample size across the three regressions and the outcomes are quite similar to the ones presented in Table 2, which suggests that including the tax base does not have any significant impact and hence we use the full sample as in the presentation.

- *Calculating standard errors with different econometric methods:* Our baseline regressions adopt the weighted least square method to correct for heteroskedasticity. Different techniques for estimating the standard errors are also employed such as the Bootstrapping

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[27] The results of robustness checks are available upon request.

[28] For instance, in order to test the effect of improving service orientation on tax collection, we drop the compliance risk management, third party data, digitalization, public accountability and autonomy indices showing correlation higher than 0.4 with the service orientation index.

and Huber-White estimation. We found the regression outcomes are robust to the techniques.

- *Additional variables in the second stage*: We also consider variables presumably static and reflecting structural factors affecting tax collections (e.g., land-locked country, inequality, informality of the economy, and control of corruption). [29] The operational strength of tax administrations remains significant with the regressions using these additional control variables in the second stage.

## VI. CONCLUSIONS

31.     **The design and practices of tax administration agencies matter significantly for tax performance.** As far as we know, ours is a novel research empirically examining the importance of the design features and actual practices of tax administration agencies on tax collection. The operational strength of the agency is closely associated with tax collections—among EMs and LIDCs, countries at the top 25 percent (in terms of operational strength index) collect larger tax revenues (by 3.25 percent of GDP) than countries at the lowest 25 percent, assuming other conditions are equal.[30]

32.     **Our empirical analyses emphasize the importance of CRM and the use of third-party data.** Our analyses find that adopting key tax administration practices and characteristics—such as stronger CRM, active use of third-party data, higher level of digitalization, enhancing service orientation, public accountability, and autonomy—are associated with higher tax collections, with CRM and the use of third-party data seemingly delivering stronger tax collection. To enhance tax collection, tax administration reform efforts could prioritize: (i) strengthening CRM by adopting automated risk profiling and electronic audits; and (ii) utilizing third party data by adopting computer systems for processing the data and prefilling returns. These efforts would likely also facilitate effective functioning of LTOs.

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[29] The Gini coefficient and the landlocked country dummy were found to be insignificant, while the control of corruption variable shows significant association with tax collections. However, we decided not to introduce the control of corruption in our baseline second stage model because of the high correlation with other control variables (such as the ratios of tax administration staff to the labor force and active taxpayers/labor force). One possible explanation is that the control of corruption variable captures broader societal attitudes including taxpaying culture, which are also associated with tax administration characteristics. In addition, we also considered a measure of informality (employment in the informal sector as a share of the labor force) but dropped it because the sample shrinks too much for accurate inference. Finally, one may argue that structural variables such as the share of agriculture and oil export to GDP should be in the second stage, but they are quite volatile over time and hence belong to the first stage.

[30] Changing the operational strength index substantially implies the implementation of extensive tax administration reform. Generally comprehensive programs to reform tax administration require sustained effort over years. For example, two TADAT assessments of Uganda (https://www.tadat.org/assets/files/Uganda_Final_PAR.pdf), five years apart, showed improvement in CRM practices, as well as enhancements in the approach to ensuring taxpayers are registered, institutional risk management, the introduction of mandatory e-payment, and improved audit programs.

33.     **Furthermore, properly staffing tax administration agencies is important, but excessive staffing may not necessarily bring intended effects.** Our analyses find that larger staffing of a tax administration agency improves revenue performance but its marginal benefit decreases as staff increase and becomes counter-productive. To this end, it is worth noting that, among all countries, the critical threshold point seems to be 0.25 percent of labor force, beyond which the marginal benefit of additional staffing may turn negative. Interestingly, our findings suggest that EMs and LICDs have not passed this threshold and additional staffing is likely to be associated with higher tax collection.

34.     **This paper also empirically confirms the importance of broadening a taxpayer base.** The relative size of the number of active taxpayers is found to be relevant for tax collection. Fuller analyses by tax item and type of taxpayers (e.g., corporate and individual) would be needed to draw more robust conclusion. For countries where the relative size of active taxpayers is low (e.g., LIDCs), it is relevant to identify if this is owing to any issues associated with tax administration or tax policy (e.g., tax exemptions), with a view to exploring an appropriate strategy to address it.

35.     **In light of challenges faced by tax administration during the recent global pandemic situation, these findings have important policy implications.** Countries with weaker tax administrations could be more susceptible to relatively large tax revenue losses during the pandemic.  They should aim to prioritize and address specific risks to revenue arising out of pandemic-related measures implemented to provide relief to taxpayers (IMF, 2020). In all countries, striving to preserve taxpayer compliance using data from third parties through digital technology would be useful in mitigating the impact of pandemics on budget revenues and maintaining continuity in tax administration. Moreover, where the tax administration is already understaffed, preserving existing staff is likely to pay off well in terms of safeguarding revenue collections.

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**Appendix I. Sub-Indices Compiled to Reflect Facets of Revenue Administration[31]**

| Sub-Indices | Components | Description | Weight |
|---|---|---|---|
| Compliance risk management | 3 | Formal approach for identifying; | 1/3 |
| | | Assessing and prioritizing key compliance risks; | 1/3 |
| | | Automated risk profiling; electronic audit | 1/3 |
| Use of third-party data | 12 | Computer based information systems for processing various forms of third-party data: | |
| | | • Financial institutions, | 1/22 |
| | | • International exchange, | 1/22 |
| | | • Online trading, | 1/22 |
| | | • Wage and Salary, | 1/22 |
| | | • Insurance company, | 1/22 |
| | | • Property sale, | 1/22 |
| | | • Other government agencies, | 1/22 |
| | | • Asset leasing, | 1/22 |
| | | • Prescribed contractors with report of payment, | 1/22 |
| | | • VAT invoices, and | 1/22 |
| | | • Others | 1/22 |
| | | Use of third-party data in prefilling returns | 1/2 |
| Degree of digitalization | 10 | E-filing mandatory for some/all taxpayers | 1/3 |
| | | E-payment mandatory for some/all taxpayers | 1/3 |
| | | Web-based information and communication services; | |
| | | • Tools and calculators on the webpage, | 1/24 |
| | | • Online application for taxpayer, | 1/24 |
| | | • Capture data from third parties, | 1/24 |
| | | • Digital mailbox for communication with taxpayers, | 1/24 |
| | | • Information on the webpage, | 1/24 |
| | | • Integrated taxpayer account, | 1/24 |
| | | • Electronic invoicing system, and | 1/24 |
| | | • Others | 1/24 |
| Service orientation | 14 | Measures to facilitate taxpayer compliance and improve services to taxpayers: | |
| | | • Have a formal service strategy, | 1/14 |
| | | • Have a formal set of service standards, | 1/14 |
| | | • Conduct taxpayer satisfaction surveys, | 1/14 |
| | | • Registration possible through other agencies, | 1/14 |
| | | • Provision of rulings to taxpayers, | 1/14 |
| | | • Availability of online application for taxpayers, | 1/14 |

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[31] Each sub-index is constructed by making averages of responses to the binary questions in ISORA. In case that a question has several sub-questions, we make average of the responses to the sub-questions and use the average value to calculate the sub-index in order to address different level of information contained in questions.

| Sub-Indices | Components | Description | Weight |
|---|---|---|---|
| | | • Make special provisions for taxpayers with disabilities, | 1/14 |
| | | • Provision of services in unofficial language(s), | 1/14 |
| | | • Use of information on compliance burden, | 1/14 |
| | | • End-user testing of new services, | 1/14 |
| | | • End-user involvement in design of new services, | 1/14 |
| | | • Simultaneous Registration for multiple tax types, | 1/14 |
| | | • Formal document covering taxpayer rights, and | 1/14 |
| | | • Mechanism for managing taxpayer complaints | 1/14 |
| Public accountability | 12 | Measures enhancing tax agency's accountability to the public: | |
| | | • Publish its strategic plan, | 1/12 |
| | | • Publish its annual business/operation plan | 1/12 |
| | | • Make public a formal set of service delivery standards | 1/12 |
| | | • Publish its achievements vis-a-vis the standards | 1/12 |
| | | • Publish its annual reports | 1/12 |
| | | • Use of an external auditor | 1/12 |
| | | • Make key compliance risk public | 1/12 |
| | | • Make reports of outcomes in addressing compliance risk public | 1/12 |
| | | • Publish the results of taxpayer satisfaction surveys | 1/12 |
| | | • Document that formally set out taxpayer rights | 1/12 |
| | | • Have a specific mechanism for managing taxpayer complaints, and | 1/12 |
| | | • Publish periodic estimates of the tax gap | 1/12 |
| Autonomy | 14 | Institutional form, degree of autonomy in managing expenditure and human resources: | |
| | | • Autonomous vs. operating within Ministry, | 1/14 |
| | | • Discretion over designing internal structure, | 1/14 |
| | | • Discretion over operational budget, | 1/14 |
| | | • Discretion over capital budget, | 1/14 |
| | | • Authority to set performance standards, | 1/14 |
| | | • Determination of work requirements, | 1/14 |
| | | • Appointment of new staff, | 1/14 |
| | | • Promotion of existing staff, | 1/14 |
| | | • Decide on qualifications for appointment, | 1/14 |
| | | | 1/14 |

| Sub-Indices | Components | Description | Weight |
|---|---|---|---|
| | | • Decision whether work is carried out by permanent or contractual staff, <br> • Placement of staff in salary band, <br> • Termination of employment, <br> • Responsible for debt collection and enforcement, and <br> • Provision of tax policy advice | 1/14 <br> 1/14 <br> 1/14 <br><br> 1/14 |
| Large Taxpayer Office (LTO) | 1 | An office or a program dedicated to large taxpayers is in operation | 1 |
| **Operational Strength** | **7 sub-indices** *(65 individual components)* | Compound index determined as average of seven indices | |

**Appendix II. Correlation Between Tax Administration Sub-Indices in 2015 and 2017**

| Variables | Correlation |
|---|---|
| Compliance risk management | 0.8677 |
| Use of third party data | 0.8439 |
| Degree of digitalization | 0.7290 |
| Service orientation | 0.8559 |
| Public Accountability | 0.8825 |
| Autonomy | 0.8319 |
| Est. of LTO | Status the same for 93 percent of tax administrations |
| Tax admin staff out of labor force | 0.9561 |
| Active taxpayer out of labor force | 0.9267 |

## Appendix III. Cross Section Regression Results[32]

**The results suggest the significance of tax administration in explaining tax performance but this approach has critical shortcomings, requiring an alternative approach.** The effect of tax administration measured by the operational strength is positively associated with tax collection, indeed the single most relevant factor in the regressions. Unlike the existing literature, many macro-economic variables turn out to be statistically insignificant. However, this approach significantly limits time variation and reduces the effectiveness of the analysis. While tax performance is often affected by cyclical factors, such factors would not be taken into account, as a period average is used for the analysis. The two-stage regression exploits both within country changes over time and cross-country differences to address the problem.

### Appendix Table 1. Cross Section Regression Outcomes

|  | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| ***PerCapitaGDP_PPP*** | 0.0518 | 0.1151 | ***0.0270*** | ***0.0281*** |
|  | (0.0673) | (0.0938) | (0.0052) | (0.0064) |
| Sq(PerCapitaGDP_PPP) | -0.0019 | -0.0051 |  |  |
|  | (0.0042) | (0.0059) |  |  |
| Trade openness (out of GDP) | 0.0124 | 0.0134 | 0.0138 | 0.0142 |
|  | (0.0134) | (0.0158) | (0.0143) | (0.0170) |
| External debt (out of GDP) | 0.0031 | 0.0106 | 0.0033 | 0.0095 |
|  | (0.0080) | (0.0107) | (0.0077) | (0.0099) |
| CPI | 0.1725 | 0.0860 |  |  |
|  | (0.1808) | (0.1825) |  |  |
| ***Terms of Trade*** | ***-0.0254**** | -0.0029 |  |  |
|  | (0.0148) | (0.0133) |  |  |
| ***Oil export (as a % of GDP)*** | 0.1269 | -0.1966 | 0.0647 | ***-0.2606*** |
|  | (0.1371) | (0.1295) | (0.1353) | (0.0978) |
| Log (Agri, %GDP) | -0.0054 | 0.0054 |  |  |
|  | (0.0136) | (0.0121) |  |  |
| Control Corruption | 0.0097 | 0.0144 |  |  |
|  | (0.0087) | (0.0118) |  |  |
| Budgeted(t)-Actual Rev(t-1) | -0.6087 | -0.3909 | -0.3904 | -0.3886 |
|  | (0.4181) | (0.4712) | (0.3799) | (0.4167) |
| ***Operational Strength*** | ***0.1129*** |  | ***0.0973*** |  |
|  | (0.0358) |  | (0.0327) |  |
| Constant | -0.1881 | -0.4832 | -0.1530*** | -0.1063** |
|  | (0.2635) | (0.3588) | (0.0384) | (0.0512) |
| Observations | 96 | 122 | 96 | 122 |
| R-squared | 0.5651 | 0.4061 | 0.5373 | 0.3877 |

Note: Estimation of equation by OLS regressions with robust standard errors. Standard Errors in Parentheses. *, **, *** denote statistical significance at the 1, 5, and 10 percent levels, respectively. Bold italics means statistically significant at least 10 percent level.

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[32] Given the limited availability of the historical series of the ISORA dataset, we use a period average (2010-18) of a dependent variable (tax to GDP (excluding trade tax)) and independent variables.

## Appendix IV. The Impact of Staffing and Taxpayers on Tax Collection

*Unlike most ISORA data based on binary questions, there are some quantitative questions. We tested how two quantitative variables measuring the size of tax administration in terms of staffing and taxpayer base affect tax performances.[33]*

### Staff in the tax agency and tax performance

**Staff level is positively associated with tax collections, but with diminishing returns.** The staff level variables are statistically significant, while the coefficient of the quadratic term is negative and significant. This suggests the decreasing marginal tax revenue as the staff level incrementally increases. This declining trend of efficiency leads to a threshold, above which additional staffing does not increase revenues. Based on the second regression of Table 3, Appendix Table 2 illustrates a marginal increase in tax collection with an increased in the staff level by 0.01 percent of labor force. When the initial level of staff is low, the increase would bring larger tax collection on average, while the marginal increase in tax collection would turn negative when the initial level of staff is high (at 0.25 percent of labor force).

**EMs and LIDCs do not reach this threshold but a wide variation in tax performance at staff level implies room for efficiency gains.** Appendix Figure 1 shows the staff level in EMs and LIDCs is below the threshold while some AEs pass that point. Especially, in LICs, tax administrations appear understaffed, suggesting potential for ramping up revenue by hiring staff, desirably combined with other productivity enhancing reform measures. On the other hand, some countries suffer from low tax collection despite relatively high level of staffing, which means that they have room for efficiency gains.

### Appendix Figure 1. Staffing and Estimated Country Fixed Effect
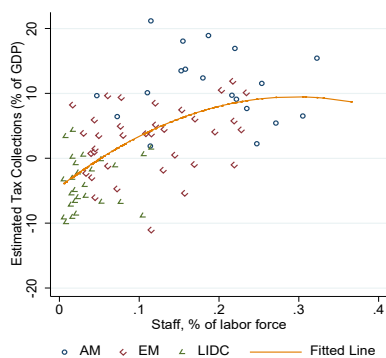


Sources: ISORA and authors' calculation.

### Appendix Table 2. Tax Gains From Increasing Staff
*(by 0.01 percent of labor force)*

| Initial Level of Staff (% of labor force) | Additional Tax (% of GDP) |
|---|---|
| 0.05 | 0.67 |
| 0.10 | 0.49 |
| 0.15 | 0.31 |
| 0.20 | 0.13 |
| 0.25 | -0.06 |

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[33] Note that unlike the categorical and binary variables that are answered by all participating tax administrations, some administrations do no provide data for all quantitative questions. LIDCs are less likely to provide numerical data than AEs and EMs.

**Taxpayer base and tax performance**

**The share of active taxpayer out of labor force is positively and significantly associated with tax collection.[34]** The size of active taxpayers is measured by the sum of active taxpayers in Personal Income Tax (PIT), Corporate Income Tax (CIT), tax withheld by employers from employees (e.g., PAYE), and VAT. There is a wide variation in the scale of taxpayer base amongst advanced, emerging and low-income economies. In general, advanced economies have larger taxpayer base than those of emerging economies, followed by low income economies.

**The share is significantly low in many LIDCs, suggesting a scope for expanding their taxpayer bases.** Almost all LIDCs show far lower share of active taxpayers than others. The low rate is not only accredited to the administrative efforts to ensure compliance to tax laws, but also reflects the size of the informal economy, the underlying tax policy and provisions and the tax paying culture of countries, etc.[35] To enhance tax collection, it may be worth exploring the factors for the low taxpayer base and, where possible, expanding the taxpayer base.

**Appendix Figure 2. Size of Taxpayer and Tax Performance**
(country fixed effects, after controlling for other relevant factors)
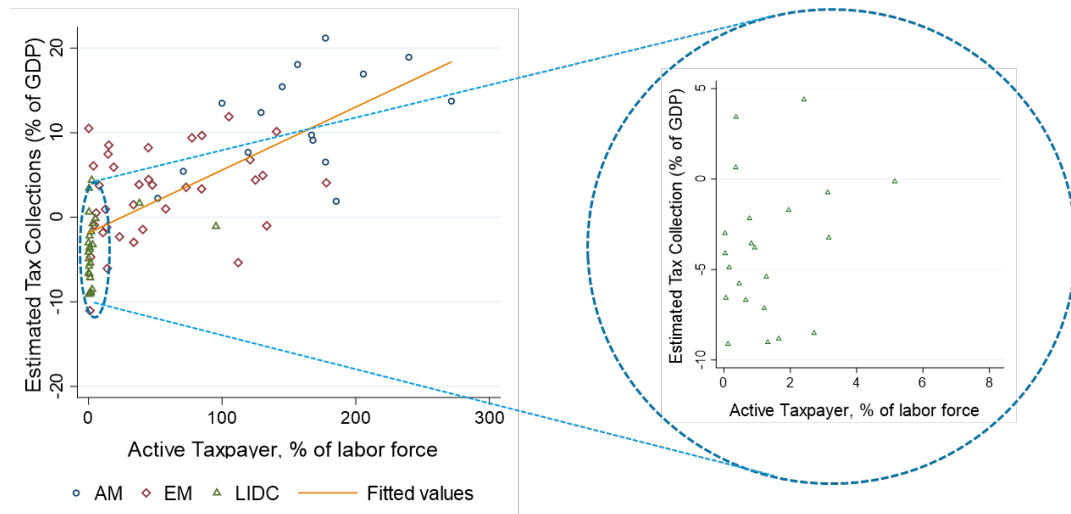


Note: The chart on the left-hand side shows the correlation between country fixed effects, after controlling for other relevant factors and the share of active taxpayer out of labor force. The chart on the right-hand size shows the relationship among LIDCs.

Sources: ISORA (2017) and authors' calculation.

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[34] The definition of active taxpayer means that an engagement with the administration or the filing of a return would be expected from the taxpayer. For PAYE, the number of employers that withhold tax from employees is captured in ISORA.

[35] This ratio is correlated with the sub-indices for compliance risk management and the use of third-party data. This supports our argument that the size of active taxpayers is largely associated with tax administration efforts. Due to this correlation, we do not include this variable in our baseline regression, though the inclusion of this variable does not change our regression outcomes.

**Appendix V. Second Stage Regression Outcomes Based on Different First Stage Regressions – Operational Strength Index**

**(1) All Countries**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| | Tax Rate | Bdgt-Actal | Bdgt-Bdgt | Tax Rate | Bdgt-Actal | Bdgt-Bdgt | Tax Rate | Bdgt-Actal | Bdgt-Bdgt |
| *Operational Strength* | 0.1902*** | 0.2226*** | 0.2317*** | 0.1196*** | 0.1767*** | 0.1864*** | 0.0901* | 0.1228*** | 0.1297*** |
| | (0.0404) | (0.0349) | (0.0373) | (0.0401) | (0.0358) | (0.0372) | (0.0476) | (0.0417) | (0.0420) |
| *#Tax.Staff/LaborForce* | | | | 0.1059*** | 0.0802*** | 0.0875*** | 0.0739** | 0.0535** | 0.0616** |
| | | | | (0.0242) | (0.0235) | (0.0244) | (0.0278) | (0.0250) | (0.0254) |
| *Sq(#Tax.Staff/LaborForce)* | | | | -0.0239*** | -0.0157* | -0.0170* | -0.0179* | -0.0130 | -0.0152* |
| | | | | (0.0083) | (0.0083) | (0.0087) | (0.0090) | (0.0087) | (0.0089) |
| *#ActiveTaxpayer/LaborForce* | | | | | | | 0.0329*** | 0.0443*** | 0.0472*** |
| | | | | | | | (0.0116) | (0.0122) | (0.0128) |
| Constant | -0.1159*** | -0.1187*** | -0.1239*** | -0.1402*** | -0.1444*** | -0.1537*** | -0.1212*** | -0.1122*** | -0.1209*** |
| | (0.0276) | (0.0222) | (0.0237) | (0.0285) | (0.0235) | (0.0246) | (0.0341) | (0.0273) | (0.0278) |
| R-squared | 0.2049 | 0.2911 | 0.2841 | 0.4721 | 0.4937 | 0.5089 | 0.5432 | 0.5753 | 0.5934 |
| Number of countries | 88 | 101 | 99 | 74 | 85 | 84 | 62 | 70 | 70 |

 * Estimation of equation by panel between effect with least Square Estimation.
  Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

## (2) Emerging and Low-income Countries

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| | Tax Rate | Bdgt-Actal | Bdgt-Bdgt | Tax Rate | Bdgt-Actal | Bdgt-Bdgt | Tax Rate | Bdgt-Actal | Bdgt-Bdgt |
| *Operational Strength* | 0.1223*** | 0.1546*** | 0.1585*** | 0.1060** | 0.1485*** | 0.1539*** | 0.1114** | 0.1277*** | 0.1304*** |
| | (0.0422) | (0.0357) | (0.0378) | (0.0417) | (0.0377) | (0.0391) | (0.0477) | (0.0438) | (0.0441) |
| *#Tax Staff/LaborForce* | | | | 0.0861*** | 0.0472* | 0.0551* | 0.0955** | 0.0487 | 0.0641* |
| | | | | (0.0310) | (0.0278) | (0.0292) | (0.0383) | (0.0366) | (0.0373) |
| *Sq(#Tax Staff/LaborForce)* | | | | -0.0192 | -0.0058 | -0.0078 | -0.0264 | -0.0110 | -0.0177 |
| | | | | (0.0125) | (0.0112) | (0.0120) | (0.0165) | (0.0171) | (0.0175) |
| *ActiveTaxpayer/LaborForce* | | | | | | | 0.0209 | 0.0346* | 0.0404** |
| | | | | | | | (0.0177) | (0.0196) | (0.0200) |
| Constant | -0.0678** | -0.0729*** | -0.0756*** | -0.1076*** | -0.1027*** | -0.1098*** | -0.1217*** | -0.0965*** | -0.1052*** |
| | (0.0272) | (0.0215) | (0.0228) | (0.0306) | (0.0245) | (0.0256) | (0.0362) | (0.0297) | (0.0302) |
| R-squared | 0.1130 | 0.1935 | 0.1880 | 0.3965 | 0.3672 | 0.3802 | 0.4333 | 0.3941 | 0.4156 |
| Number of countries | 68 | 80 | 78 | 54 | 64 | 63 | 46 | 54 | 54 |

\* Estimation of equation by panel between effect with least Square Estimation.
   Standard errors in parentheses: *** $p<0.01$, ** $p<0.05$, * $p<0.1$

**Appendix VI. Second Stage Regression Outcomes Based on Different First Stage Regressions – Single Variates**

| | (1) Tax Rate | (2) Bdgt-Actal | (3) Bdgt-Bdgt | (4) Tax Rate | (5) Bdgt-Actal | (6) Bdgt-Bdgt | (7) Tax Rate | (8) Bdgt-Actal | (9) Bdgt-Bdgt |
|---|---|---|---|---|---|---|---|---|---|
| *Compliance Risk Management* | *0.1052\*\*\** | *0.1154\*\*\** | *0.1192\*\*\** | | | | | | |
| | (0.0187) | (0.0184) | (0.0197) | | | | | | |
| *Third Party Data* | | | | *0.1027\*\*\** | *0.1136\*\*\** | *0.1196\*\*\** | | | |
| | | | | (0.0182) | (0.0181) | (0.0195) | | | |
| *Digitalization* | | | | | | | *0.0540\*\** | *0.0830\*\*\** | *0.0853\*\*\** |
| | | | | | | | (0.0238) | (0.0197) | (0.0209) |
| Constant | -0.0546\*\*\* | -0.0457\*\*\* | -0.0475\*\*\* | -0.0359\*\*\* | -0.0240\*\*\* | -0.0253\*\*\* | -0.0242 | -0.0273\*\* | -0.0285\*\* |
| | (0.0130) | (0.0117) | (0.0125) | (0.0102) | (0.0089) | (0.0094) | (0.0168) | (0.0125) | (0.0132) |
| R-squared | 0.2682 | 0.2835 | 0.2733 | 0.2702 | 0.2843 | 0.2802 | 0.0566 | 0.1515 | 0.1465 |
| Number of countries | 88 | 101 | 99 | 88 | 101 | 99 | 88 | 101 | 99 |

| VARIABLES | (1) Tax Rate | (2) Bdgt-Actl | (3) Bdgt-Bdgt | (4) Tax Rate | (5) Bdgt-Actl | (6) Bdgt-Bdgt | (7) Tax Rate | (8) Bdgt-Actl | (9) Bdgt-Bdgt | (10) Tax Rate | (11) Bdgt-Actl | (12) Bdgt-Bdgt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Service Ori* | *0.1041\*\** | *0.1175\*\*\** | *0.1242\*\*\** | | | | | | | | | |
| | (0.0403) | (0.0348) | (0.0368) | | | | | | | | | |
| *Public Acc* | | | | *0.0661\*\** | *0.0874\*\*\** | *0.0900\*\*\** | | | | | | |
| | | | | (0.0312) | (0.0286) | (0.0307) | | | | | | |
| *Autonomy* | | | | | | | *0.0610\** | *0.0809\*\** | *0.0791\*\** | | | |
| | | | | | | | (0.0358) | (0.0322) | (0.0340) | | | |
| Est. LTO | | | | | | | | | | -0.0405 | -0.0245 | -0.0231 |
| | | | | | | | | | | (0.0262) | (0.0325) | (0.0358) |
| Constant | -0.0627\*\* | -0.0592\*\* | -0.0635\*\* | -0.0250 | -0.0245 | -0.0258 | -0.0362 | -0.0408\* | -0.0397 | 0.0481\* | 0.0416 | 0.0402 |
| | (0.0291) | (0.0238) | (0.0251) | (0.0181) | (0.0155) | (0.0165) | (0.0283) | (0.0245) | (0.0258) | (0.0252) | (0.0317) | (0.0350) |
| R-squared | 0.0721 | 0.1034 | 0.1053 | 0.0497 | 0.0860 | 0.0813 | 0.0326 | 0.0600 | 0.0527 | 0.0270 | 0.0057 | 0.0043 |
| N of countries | 88 | 101 | 99 | 88 | 101 | 99 | 88 | 101 | 99 | 88 | 101 | 99 |

\* Estimation of equation by panel between effect with least Square Estimation. Standard errors in parentheses: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

# Appendix VII. Second Stage Regression Outcomes Based on Different First Stage Regressions – Multivariate

<div style="writing-mode: vertical-rl">40</div>

| VARIABLES | (1) Tax Rate | (2) Bdgt-Actal | (3) Bdgt-Bdgt | (4) Tax Rate | (5) Bdgt-Actal | (6) Bdgt-Bdgt | (7) Tax Rate | (8) Bdgt-Actal | (9) Bdgt-Bdgt |
|---|---|---|---|---|---|---|---|---|---|
| *Compliance Risk Management* | 0.0816*** | 0.0830*** | 0.0840*** | 0.0726*** | 0.0772*** | 0.0778*** | 0.0955*** | 0.0873*** | 0.0930*** |
| | (0.0201) | (0.0212) | (0.0228) | (0.0209) | (0.0226) | (0.0237) | (0.0238) | (0.0247) | (0.0248) |
| *Third Party Data* | 0.0747*** | 0.0763*** | 0.0807*** | 0.0494** | 0.0607*** | 0.0644*** | 0.0492** | 0.0612** | 0.0675*** |
| | (0.0200) | (0.0199) | (0.0214) | (0.0200) | (0.0206) | (0.0215) | (0.0242) | (0.0237) | (0.0239) |
| Digitalization | 0.0007 | 0.0228 | 0.0240 | 0.0008 | 0.0098 | 0.0083 | -0.0026 | 0.0016 | -0.0023 |
| | (0.0233) | (0.0215) | (0.0230) | (0.0224) | (0.0220) | (0.0229) | (0.0234) | (0.0225) | (0.0226) |
| Service Orientation | -0.0195 | -0.0297 | -0.0223 | -0.0188 | -0.0295 | -0.0209 | -0.0085 | -0.0425 | -0.0331 |
| | (0.0457) | (0.0438) | (0.0471) | (0.0426) | (0.0432) | (0.0451) | (0.0479) | (0.0472) | (0.0477) |
| Est. LTO | -0.0231 | -0.0087 | -0.0085 | -0.0248 | -0.0162 | -0.0176 | 0.0005 | 0.0123 | 0.0124 |
| | (0.0233) | (0.0271) | (0.0300) | (0.0219) | (0.0271) | (0.0295) | (0.0242) | (0.0295) | (0.0304) |
| Public Accountability | -0.0050 | -0.0033 | -0.0055 | -0.0065 | 0.0112 | 0.0117 | -0.0429 | -0.0180 | -0.0260 |
| | (0.0334) | (0.0314) | (0.0337) | (0.0317) | (0.0318) | (0.0333) | (0.0358) | (0.0340) | (0.0345) |
| Autonomy | 0.0131 | 0.0160 | 0.0121 | 0.0122 | 0.0140 | 0.0101 | 0.0103 | 0.0103 | 0.0061 |
| | (0.0338) | (0.0315) | (0.0336) | (0.0331) | (0.0319) | (0.0329) | (0.0351) | (0.0331) | (0.0330) |
| *#Tax Staff/LaborForce* | | | | 0.0914*** | 0.0725*** | 0.0802*** | 0.0845*** | 0.0641** | 0.0725*** |
| | | | | (0.0235) | (0.0228) | (0.0237) | (0.0266) | (0.0242) | (0.0242) |
| *Sq(#Tax Staff/LaborForce)* | | | | -0.0216*** | -0.0153* | -0.0166* | -0.0226** | -0.0177** | -0.0197** |
| | | | | (0.0081) | (0.0081) | (0.0085) | (0.0088) | (0.0086) | (0.0086) |
| *ActiveTaxpayer/LaborForce* | | | | | | | 0.0174 | 0.0301** | 0.0320** |
| | | | | | | | (0.0128) | (0.0132) | (0.0135) |
| Constant | -0.0465 | -0.0508 | -0.0538 | -0.0876** | -0.0809** | -0.0871** | -0.1162*** | -0.0891** | -0.0962** |
| | (0.0332) | (0.0332) | (0.0361) | (0.0338) | (0.0350) | (0.0373) | (0.0369) | (0.0375) | (0.0380) |
| R-squared | 0.4103 | 0.4210 | 0.4085 | 0.5922 | 0.5755 | 0.5870 | 0.6525 | 0.6492 | 0.6744 |
| Number of countries | 88 | 101 | 99 | 74 | 85 | 84 | 62 | 70 | 70 |

\* Estimation of equation by panel between effect with least Square Estimation.

Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

**Appendix VIII. LTO and Tax Revenue Performance**

**The analysis of the existence of LTOs did not yield any relationship of statistical significance with tax revenue performance**. This result may be surprising, as the segmentation of taxpayers (e.g., establishing an LTO) has led to tangible results in some countries (Almunia and Lopez-Rodriquez, 2018), and it is often seen as one of the top reform priorities. In the ISORA dataset, most tax administrations (92 percent) had an LTO, and all LIDCs tax administrations indicate the existence of an LTO. Because LTOs are now so widely established across sample countries, there is insufficient data to analyze the impacts of establishing an LTO from a cross-section of country data. Further, from ISORA information on audit practices, it is evident that most countries that do not indicate an LTO nevertheless apply segmentation in their audit approach.

**The results on LTOs—even when examining their characteristics—do not prove statistically significant.** According to ISORA data, the LTOs vary extensively in their resourcing and operations. The proportion of staff allocated to LTO functions ranges from below 1 percent to close to 20 percent, while the ratio of corporate taxpayers managed though the LTO per staff member varies from less than one, to almost 200. To explore different characteristics and functions of LTOs, we further examined the relative size of human resources in LTOs, the proportion of "large taxpayers," and the proportion of revenue collected through the LTO, though none of these variables proved to be statistically significant. To assess the effectiveness of LTOs, more granular analyses would be required, for example, with thorough assessment on the degree of digitalization and risk management capacity. Moreover, the concentration of the economy may also make some LTOs appear more efficient than others. A study on the impact of the LTO in Spain (Almunia and Lopez-Rodriguez, 2018) concluded that the broader enforcement environment is also important for its effectiveness.

**The results may suggest that setting up an LTO would not be enough, but it has to be effectively operationalized.** Staff allocation to LTOs and LTO's proportional revenue collection are loosely correlated (Appendix Figure 3), suggesting scope for improving LTO performance in some developing countries. In some cases (especially in EMs and LIDCs), additional staff in LTO is not necessarily associated with larger revenue collection by LTO. Given that LIDCs have relatively larger staff proportions allocated to LTO than AEs and EMs, there is room for LIDCs to improve the efficiency of staff by improving compliance risk management and using third-party data.

**Appendix Figure 3. Staff in LTO and Revenue Collected by LTO**
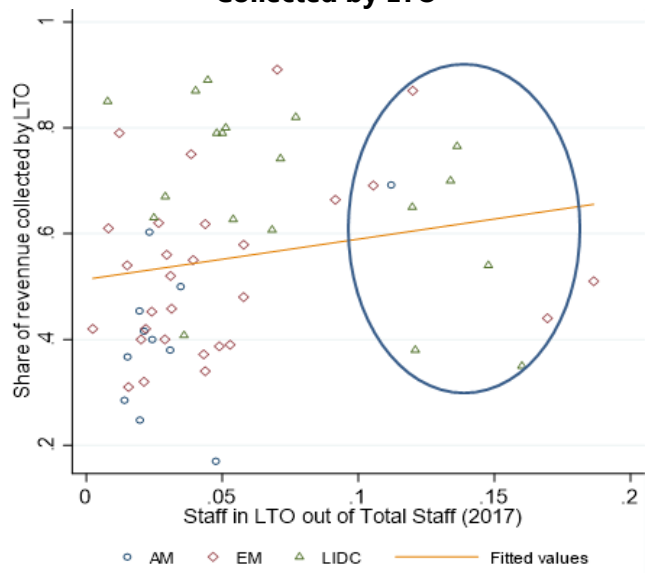


Source: ISORA (2017).

## Appendix IX. The Normality Test of Error Terms[36]

### Skewness/Kurtosis Tests for Normality

| Variable | Obs | Pr(Skewness) | Pr(Kurtosis) | Joint | |
| --- | --- | --- | --- | --- | --- |
| | | | | adj chi2(2) | Prob>chi2 |
| Comp. risk mgmt | 96 | 0.3677 | 0.9966 | 0.83 | 0.6612 |
| Third party data | 96 | 0.8722 | 0.4051 | 0.73 | 0.6934 |
| Digitalization | 96 | 0.218 | 0.5923 | 1.85 | 0.3964 |
| Service orientation | 96 | 0.0777 | 0.6974 | 3.36 | 0.1866 |
| Public accountability | 96 | 0.0371 | 0.4808 | 4.84 | 0.0888 |
| Autonomy | 96 | 0.1817 | 0.5836 | 2.14 | 0.3431 |
| Est. of LTO | 96 | 0.1355 | 0.4218 | 2.96 | 0.2281 |

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[36] Sktest outcomes from STATA are presented in the table. It tests the normality based on both skewness and on kurtosis and then combines the two tests into an overall test statistic. The null hypothesis assumes the normal distribution.