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What are the drivers of tax capacity in sub-Saharan Africa?

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Abstract: There is limited research on the underlying institutional framework of tax policy and capacity: how tax collection efficiency changes over time and the importance of institutional factors in this process. This paper fills this gap by devising a measure of tax capacity distinct from commonly used measures of tax effort based on residuals from a tax performance (tax/gross domestic product ratio) regression. The paper uses annual data on 44 sub-Saharan African countries covering the period from 1980 to 2018. The empirical strategy separating performance from underlying fiscal capacity proceeds in three steps: estimating standard tax performance regressions, from which we generate measures of potential and actual tax revenue; decomposing the actual-to-potential tax revenue ratio to use the trend component as a measure of tax capacity; and applying general-to-specific analysis with a wide variety of economic and institutional variables as potential determinants of tax capacity to identify the most important correlates.

Key words: tax capacity, tax performance, general-to-specific, institutional variables

JEL classification: C23, H20, O23, O43

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1 Introduction

Domestic revenue mobilization is recognized as an important development objective that is especially challenging for low- and lower-middle-income countries. Recent data show that median domestic revenue (excluding grants) in low-income countries was 10.6 per cent of gross domestic product (GDP) in 2018, a drop from 13.4 over 2010–17; for sub-Saharan Africa (SSA) low-income countries in 2018 median domestic revenue was 13.1 per cent of GDP (13 per cent over 2010–17).[1] Many studies focus on measures to raise revenue, often in the context of observing 'poor' tax performance (a low tax/GDP ratio); fewer studies address the broader institutional framework of tax policy and performance (loosely termed as tax capacity). While structural variables (proxies for the tax base) are themselves the main determinants of tax performance, they do not adequately explain the differences in tax/GDP ratios across countries. Such differences are also a result of underlying political factors that shape tax capacity. Studies of tax performance in developing countries have focused on features of the economic structure and tax base, often including aid and/or resource rents, sometimes including political factors (such as measures of democracy) or governance indicators intended to capture political regimes (Albers et al. 2020; Baskaran and Bigsten 2013; Chachu 2021; Garcia and von Haldenwang 2016; Gwaindepi 2020). However, these studies do not provide a clear distinction between tax performance and tax capacity. Research on state capacity, in contrast, acknowledges that improving tax efficiency contributes to state-building, but notes challenges in agreeing an operational definition of state and/or fiscal capacity (Kjaer et al. 2021; Moore 2021; Savoia et al. 2021). Related studies identify accountability as an important element of fiscal institutions (Bräutigam et al. 2008; Dom 2018; Ricciuti et al. 2019). A limitation of this literature is that tax capacity is often captured by a tax measure (such as income tax as a share of GDP or revenue) or a measure based on the residual from a tax/GDP regression, so again it is limited in separating tax performance from tax capacity.

This study constructs a new measure of tax capacity for SSA countries which permits a clearer distinction from the tax performance measures employed in the literature and then explores which institutional variables are most important in explaining variations in tax capacity in SSA. Specifically, a measure of tax capacity is derived from estimating the trend component of the ratio of actual to potential tax revenue (removing cyclical and temporary variations to identify underlying performance). Subsequent analysis aims to determine which structural and institutional indicators explain the trend. Non-tax revenue (NTR) variables are included as determinants to capture their importance, especially resource rents, for many SSA countries. Although there is considerable heterogeneity across SSA countries (particularly in their levels of development and natural resource availability and dependence), compared to other developing regions there are similar features in relative terms that are likely to affect tax capacity: low economic growth (at least until the 2000s) and export dependence on primary commodities; experience of slavery and colonialism (which influence trust and state capacity); high poverty and rural/informal shares of the economy (ECA 2019; IMF 2018). To retain focus, this paper uses annual data on 44 SSA countries (although the main analysis is limited to 39 countries) covering the period from 1985 to 2018.

The empirical analysis comprises three steps. First, we estimate tax performance using standard structural characteristics and other revenues—aid (net aid, grants), non-tax revenue, and total natural resource rents—as applied in the literature (Bornhorst et al. 2009; Crivelli and Gupta 2014;

[1] The figures are based on data from the UNU-WIDER Government Revenue Dataset (GRD), version 2020 (UNU-WIDER 2020). The definition of low-income countries follows the World Bank classification.

Gupta 2007; Gwaindepi 2020; Teera and Hudson 2004). We employ a variety of econometric techniques—ranging from homogeneous to heterogeneous models, including models accounting for cross-section dependence and which assume cross-section independence—to see which of the variables are robust to alternative estimation procedures. The most robust variables are then used in a very parsimonious tax performance equation to estimate potential tax revenue, from which we derive the ratio of the difference between actual and potential tax revenue to actual tax revenue. This ratio is termed performance efficiency and is similar to the regression residual-based measure of tax effort commonly applied in the literature. Second, country-specific estimates of the actual-to-potential tax revenue ratio are decomposed to distinguish the trend from stochastic or cyclical elements. The trend component of this ratio is our proposed measure of tax capacity. Third, we apply a general-to-specific method to select the political and institutional variables that are most important in explaining cross-country variation in tax capacity. The general-to-specific method is a variable selection approach to select from a large number of potentially important variables those that are primary determinants of tax capacity. The procedure successively eliminates independent variables with the smallest *t*-statistic and re-estimates until each included variable is significant at the 5 per cent level. This is specifically to identify the main correlates of country-specific measures of tax capacity. In principle, the method is robust as the selection cannot be significantly improved by dropping and/or including further candidate variables and outliers (Bleaney and Nishiyama 2002).

As with other studies, our measure of tax performance is based on the residual from a standard (but parsimonious in our case) tax revenue regression. Only four variables—imports and exports as shares of GDP, real GDP per capita, and agriculture share in GDP—are found to be relatively robust determinants of tax/GDP ratios for SSA countries. The findings demonstrate the fragility of cross-country tax performance regressions and of tax effort measures directly derived from such regressions. In contrast to other studies, we measure tax capacity as the trend component of the performance ratio and investigate which aspects of institutional indicators are correlated with the variations across SSA, focussing on the trend abstracts from shocks and temporary effects on performance to capture changes in underlying capacity over time. The analysis of the most important determinants shows that tax capacity increases with equal distribution of resources, resource rents, and private (household) consumption (as a share of GDP) but is negatively correlated with the level of political corruption. The main contribution is identifying that equity in the provision of public services is the single most important political indicator for promoting greater tax capacity. The analysis also sheds light on which aspects of institutions appear to be most informative for analysis.

Section 2 discusses our approach and how the measure adds to the literature in distinguishing tax capacity from performance. Section 3 presents the data, illustrating patterns in relationships and the trend in capacity, while section 4 discusses the estimation methods employed. The results are discussed in section 5 (with additional analysis in the appendices), and section 6 concludes by considering implications for which institutions determine tax capacity.

2 Conceptual framework: tax performance and capacity

In simple terms, tax revenue is determined by the tax rate applied to the tax base. The tax rate is a political choice, as is what to include in the tax base. Once the parameters of the tax base have been determined (e.g. what types of income and what thresholds or exemptions), given tax rates, the primary determinant of revenue collected is administrative effort. Thus, economic structure determines the potential tax base; political decisions determine the tax rates and which parts of the base will be liable for tax (related to the concept of tax expenditures); and administrative ability

determines how much of the tax liability is collected (collection efficiency). For analysis at the country level, as conducted here, one is unavoidably aggregating over multiple rates and bases using proxy measures.

At the aggregate country level the tax base (*B*) is components of national income and expenditure; for simplicity it is usual to abstract from separate bases for different taxes (e.g., sales, income, capital gains) and from tax expenditures that reduce the amount of the base subject to tax (e.g., tariff exemptions, specific goods exempted from value added tax (VAT), tax deductible allowances). At the aggregate level the tax rate (*t*) is notional—implicitly a weighted average of separate rates for different taxes and multiple rates for some taxes (e.g. income tax). Potential tax revenue (*P*) is notionally the appropriate rates applied to elements of the base (*tB*) and can be compared with actual tax revenue (*T*) so that the ratio *(T-P)/T* is an indicator of collection (performance) efficiency (similar to the notion of tax effort in the literature). In practice, *t* is represented by the tax/GDP ratio whereas the potential is what could be achieved given structural characteristics in comparison to other countries. In this context, tax potential is the expected amount of tax revenue a country can collect given these characteristics.

Although it is feasible to separate the effect of political factors (rates and tax expenditures) from collection or performance efficiency for some individual taxes using administrative data, this distinction cannot be made at the country level. In cross-country studies of total tax performance, it is very difficult to capture the varying factors that determine performance. Most cross-country studies regress *T* on a set of proxies for the tax base and use the size of the error term relative to *T* as a measure of tax effort. A standard approach developed by the International Monetary Fund (IMF) essentially uses the error term from the tax performance regression to derive the measure of tax effort (Bahl 1971; Chelliah et al. 1975; Lotz and Morss 1967; Stotsky and WoldeMariam 1997). Recent studies establish some indicator of *P* and derive measures of performance based on *P-T* (e.g. the frontier estimation approach of Brun and Diakité 2016). While these approaches are informative on how tax performance compares to some baseline standard, they are limited in identifying the sources of over- or under-performance. It is worth remembering that these measures are based on comparison of performance to some averages for other countries rather than an 'optimization' based on factors specific to an individual country (as in Dalamagas et al. 2019)—these factors are swept up in the residual.

More importantly, this approach does not distinguish effort as performance from capacity as capability; the methods of measuring tax effort are not clear indicators of tax or fiscal capacity interpreted as the ability to raise the revenue desired by the government.[2] While tax performance has a standard definition in terms of measuring revenue collected and regressions suggest which characteristics are associated with performance, tax capacity is inherently vague as it includes structural (base), political (rate), and administrative (efficiency) elements which are inter-related (e.g. political institutions can affect both structure and administrative capacity). The regression approach treating the unexplained part of comparative performance as the indicator of tax effort conflates these elements. To the extent that the tax base proxies are poor measures of the true base and subject to measurement error, a large error interpreted as a shortfall of tax relative to the potential—low tax effort—may simply be due to poor performance of the regression specification.

[2] This is also true for measures proposed for fiscal capacity: (i) the total tax-to-GDP ratio (Baskaran and Bigsten, 2013; Besley and Persson, 2011; Masi et al. 2020); (ii) the share of income taxes in total taxes (Besley and Persson 2009, 2011, 2013, 2014; Masi et al. 2020); (iii) the difference between the income tax share and the trade tax share (Besley and Persson 2011); and (iv) the size of the formal sector (Besley and Persson 2011).

This problem is likely to be highly prevalent in developing countries, especially low-income and fragile states, where the formal tax base is small, data quality is low, and large segments of the economy are difficult to measure and tax. The share of agriculture in the economy is usually included to capture the difficulty of taxing the large number of subsistence farmers. This is a poor measure: the share tends to change slowly and follow a downward trend, while tax revenue comes from segments of the sector, especially commercial farmers and exporters. Agricultural exports and the agri-business sector (e.g. food and beverage manufacturers) would be better measures of the tax potential of agriculture but are rarely included (largely due to data limitations). Manufacturing share of the economy is typically included to reflect the private sector but is again limited, as many firms and/or employees are informal—do not pay tax and are often not liable (e.g. have incomes or turnover below the relevant threshold). Manufacturing exports would be a better measure but, again, are not often used. Indeed, to the extent that manufactured exports are associated with multinationals that are difficult to tax, it is not evident that there is a positive correlation; Morrissey et al. (2016) find a negative association between manufacturing exports and tax revenue in low- and middle-income countries, perhaps reflecting tax incentives to attract (foreign) investment.

Political and institutional factors exacerbate these problems with tax performance regressions and inferring tax capacity. For example, the government can decide what rates to apply and which parts of any tax base should be liable. If this results in low revenue relative to other countries with a similar base, this would be interpreted as low tax effort but need not imply low capacity—the revenue may have been what the government intended and expected given the chosen rates and base. What matters for capacity is the institutional setting in which decisions are made. Thus, for example, if the government is weak relative to strong lobbies which secure exemptions and low rates, that reduces fiscal capacity and would also appear as low effort. On the other hand, if a capable technocratic government chooses relatively low taxes, that should not be interpreted as limited capacity—such a government chooses what may appear as low effort. Indicators of the political system related to tax decision-making are required to separate effort from capacity. The economic structure is also relevant, so countries with large resource (non-tax) revenues may choose relatively low tax revenue (low effort). A related issue is the effect of aid; grants are often assumed to reduce tax effort but the empirical evidence for this is very weak (Morrissey and Torrance 2015, review the literature).

Tax administration is another element of capacity but is subject to political influence and therefore institutional features influence how administrative capacity relates to tax capacity. Reforms to enhance administrative performance, such as establishing semi-autonomous revenue authorities, may have only a limited impact on revenue as the administration operates within a set of parameters (such as rates and exemptions) set by political considerations (Dom 2019; Jeppesen 2021). Unfortunately, there are no good measures of administrative capacity covering a large number of SSA countries over a long period. One reason for our approach of constructing a measure of capacity that is separate from performance and using a general-to-specific method to identify significant covariates of that measure is the ability to include variables often included in tax performance regressions as potential determinants of the measure of tax capacity and test for the importance of many indicators of institutions; some of these may be correlated with (unmeasured) administrative capacity but in general that is an unobservable we can only infer.

In sum, an agnostic approach to the determinants of tax performance and capacity is adopted and the analysis seeks to identify patterns in the data that offer insights on important institutional features. Acknowledging that there are also external factors which influence tax revenue, such as shocks or donor influence, justifies the focus on the trend component to represent capacity.

3 Data

The econometric analysis uses annual data on 44 SSA countries covering the period from 1980 to 2018.[3] Revenue data are obtained from the Government Revenue Dataset (GRD), version 2020 (UNU-WIDER 2020)[4] and include total tax and non-tax revenue and components such as income and indirect and trade taxes. In order to separate resource revenues, the main dependent variable is the non-resource tax/GDP ratio. We also obtain a measure of non-tax revenue which comprises taxes, royalties, and other revenues from natural resources, revenues from state-owned enterprises, and other revenue. As it is mostly resource rents,[5] including non-tax revenue permits tests for the 'resource curse' hypothesis (specifically that access to resources provides revenue, undermines governance, encourages corruption, and can therefore reduce tax capacity). Aid data are obtained from the Organisation for Economic Co-operation and Development (OECD) Development Assistance Committee (DAC), version 2020. They include net aid, grants, loans, and technical assistance, all as shares of GDP. Aid is different from resource revenue with regard to a government's incentives to develop tax capacity due to aid conditionality, the level of fungibility, and consistency over time (Altincekic and Bearce 2014; Morrissey 2015; Therkildsen 2002).

The structural (economic) variables are chosen following the literature (Clist and Morrissey 2011; Crivelli and Gupta 2014; Gupta 2007). From the World Development Indicators database, we obtain the share of agriculture value added in GDP, GDP per capita in constant 2010 US$, the respective shares of exports and imports in GDP, and total natural resource rents (% GDP). The share of agriculture in GDP is expected to be negatively correlated with tax performance given the large informal, subsistence nature of the sector. GDP per capita (in levels) is a common indicator of the level of economic development, as well as a proxy for tax administration and compliance capacity (more developed countries tend to have more developed tax systems and better administration). Richer economies have better-off citizens, higher expected revenue from taxation, and higher demand for public services (accountability mechanisms). The shares of imports and exports in GDP are included to reflect the historical importance of trade taxes in SSA. Clist and Morrissey (2011) separate the effects of imports and exports. Imports proxy for tariff revenue and although most countries have reduced tariffs, they are still an important source of revenue. Although most export taxes have effectively been abolished since the 1980s, exports may act as an indicator of economic activity.

Institutions and political variables are captured with indicators from the rich Varieties of Democracy (V-Dem) dataset (Coppedge et al. 2020). The political corruption index measures the extent to which the executive, judiciary, and legislative are susceptible to bribery and embezzlement. It also distinguishes between corruption at the highest echelon of the executive at the level of the cabinet and corruption in the public sector at large. The equal distribution of resources index (a proxy for equity in spending) is composed of indicators for particularistic or public goods, means-tested or universal welfare policies, educational equality, and health equality.[6] In line with the literature on state formation (Moore 2008), a more equitable distribution of public

[3] The list of countries included in the study, the summary statistics, and data sources/definitions can be found in Appendix A.

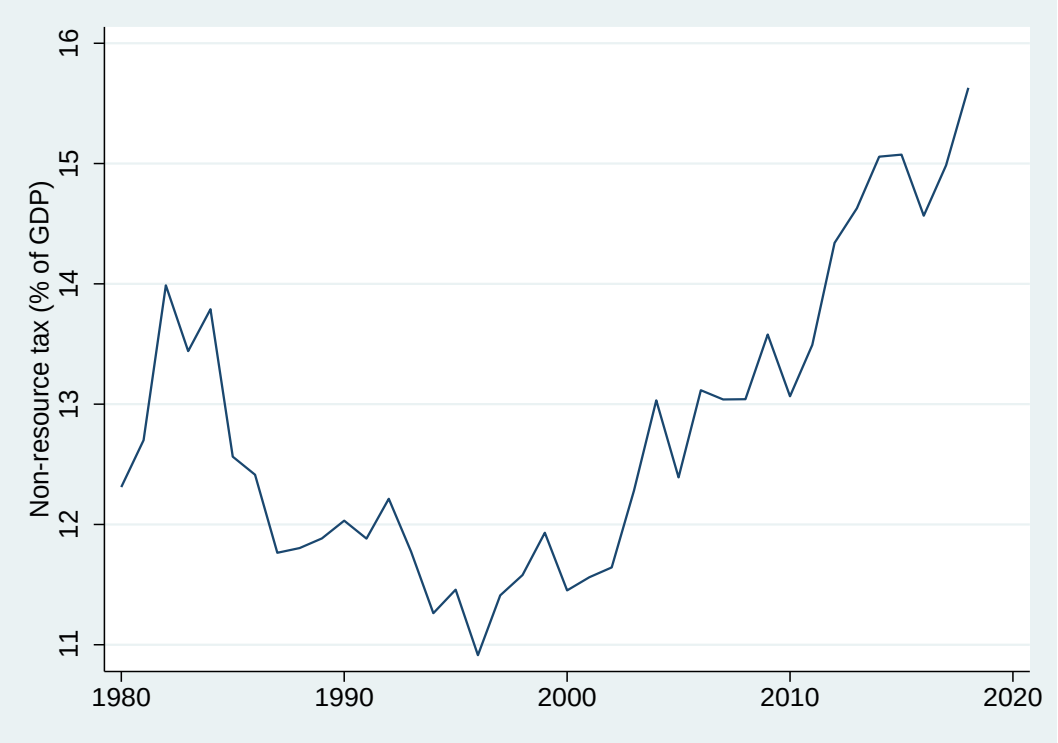
[4] The data collected exclude social contributions and grants.

[5] UNU-WIDER (2020) provides data on resource and non-resource components of non-tax revenue. While the data are sparse, for our sample there are 11 countries for which resource non-tax is larger than non-resource non-tax revenue, and seven countries for which non-resource non-tax is larger.

[6] Equitable distribution of resources is a sub-component of the egalitarian democracy index and, as it is the indicator of greatest relevance, we omit the latter from the analysis.

spending (resources) is expected to be associated with public trust in government and willingness to pay taxes. Vertical accountability incorporates measures of elections and political parties: electoral accountability comprises the quality of elections, the percentage of enfranchised population, and whether the chief executive is directly or indirectly elected; political parties are measured by restrictiveness of barriers to forming a party and the degree to which opposition parties are independent of the ruling regime. Dom (2018) finds a positive association between tax revenue and vertical accountability (but not other accountability measures) with some evidence that increases in direct taxation generate improvements in vertical accountability.

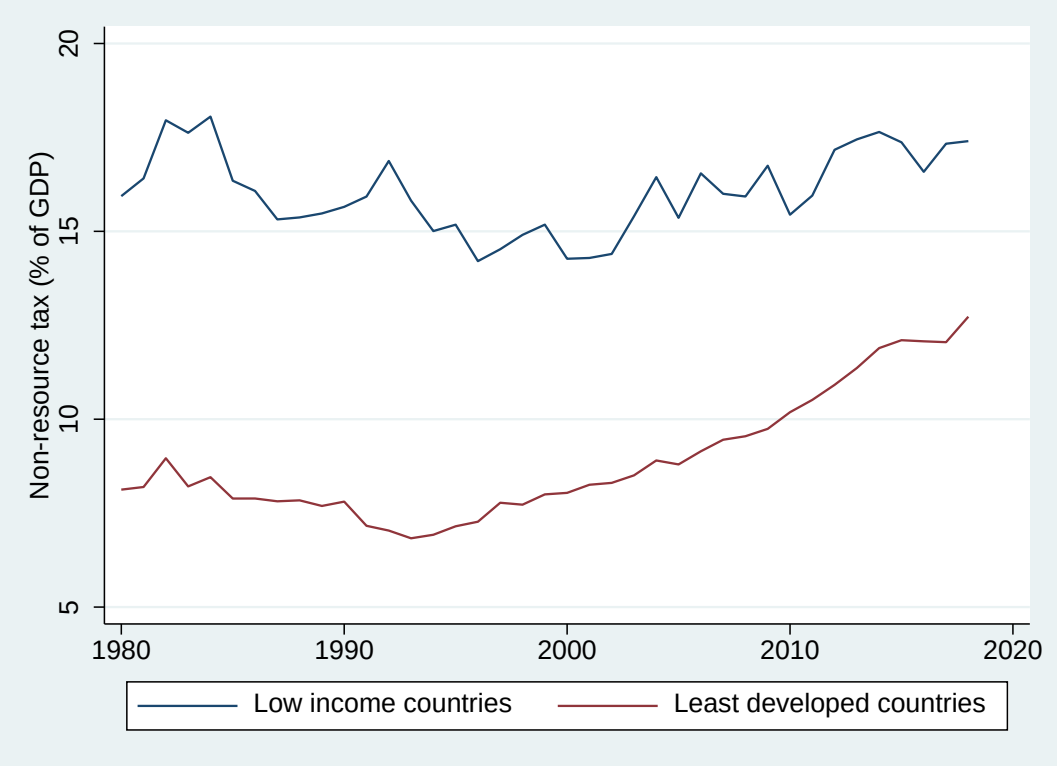
Figure 1: Average tax/GDP ratio, SSA 1980-2018



Source: authors' calculations based on data from UNU-WIDER (2020).

Tax mobilization has improved over the years, from an average of around 12 per cent in 1980 to more than 15.5 per cent in 2018 (Figure 1). There was a considerable drop between 1994 and 1996, coinciding with the period when the structural adjustment programs led to a reduction in trade tax revenues. The average ratio picked up from 2000 onwards, a period in which tax reform has been implemented in most of the countries, resulting in sustained increases in tax collection (ECA 2019). There is heterogeneity among the SSA countries, with least-developed countries collecting less tax revenue than the other low-income countries (Figure 2). The latter collect significantly more tax revenue than the least-developed countries, albeit with more volatility.

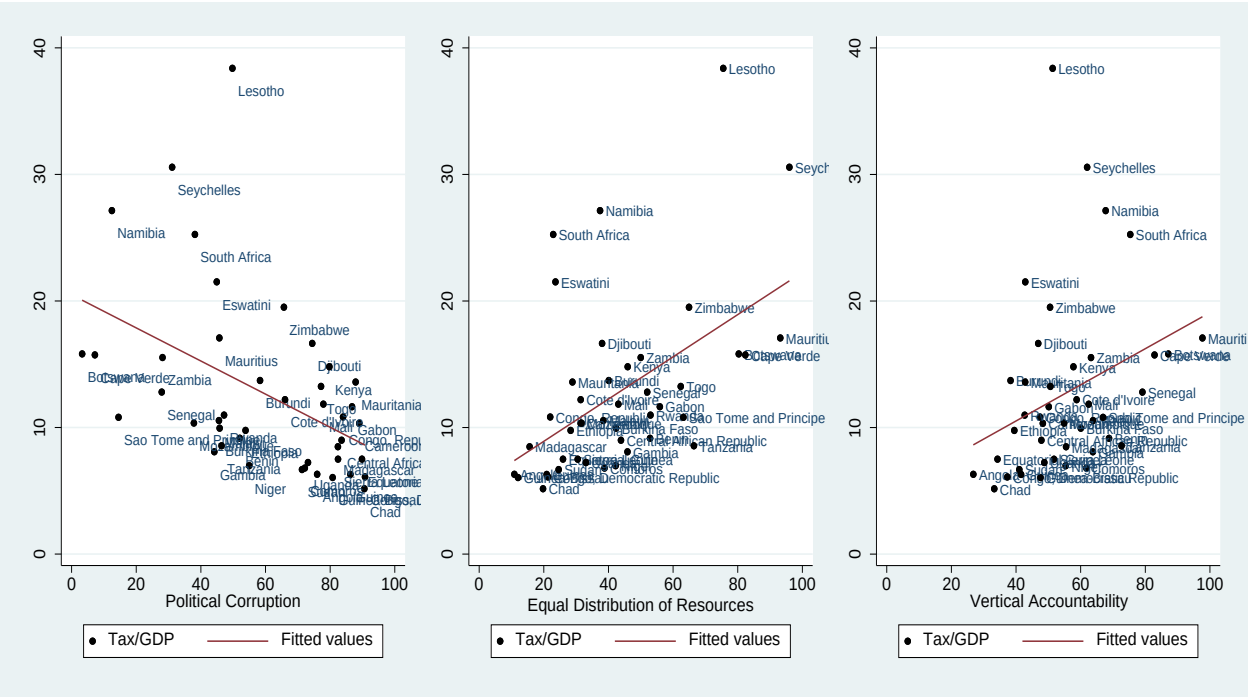
Figure 2: Average tax/GDP ratio, SSA groups of countries



Source: authors' calculations based on data from UNU-WIDER (2020).

Figure 3 shows basic bivariate plots between tax/GDP and the main measures of governance (institutional quality)—vertical accountability, equal distribution of resources, and political corruption—included in the paper. For the vertical accountability and equal distribution of resources indices, higher values indicate better performance. The reverse is true for the political corruption index. The average tax/GDP ratio is plotted against the average value of the three governance indicators of primary interest over the period from 1980 to 2018 for the 44 SSA countries. The relationship is as expected (negative for political corruption and positive for vertical accountability and equal distribution of resources) across all three measures of governance, barring a few outliers in the Southern African region (Lesotho, Namibia, Seychelles, and South Africa). For example, countries like Angola and Chad have lower tax/GDP ratios and correspondingly lower governance measures (higher corruption) whereas Botswana and Mauritius have higher tax/GDP and higher governance measures (lower corruption).

Figure 3: Scatter plots for average tax/GDP and governance measures



Source: authors' calculations based on data from UNU-WIDER (2020) and V-Dem, version 10.

4 Estimation strategy

To distinguish the features of the economic structure and tax bases which influence tax performance across countries from the institutional (political) variables which influence over-/ under-performance in SSA countries, the benchmark equation for tax performance is:

$$tax_{it} = \alpha_i + \beta'_{i1} X_{it} + \beta'_{i2} aid_{it} + \sigma'_i NTR_{it} + \lambda'_i f_t + \varepsilon_{it} \quad (1)$$

Where tax_{it} is the non-resource tax/GDP ratio over time periods t=1, 2,…, T and countries i=1, 2,…, N. X_{it} is a set of controls for economic structure (tax handles), including: the share of agriculture value added in GDP, real GDP per capita, and imports and exports as proportions of GDP. The aid_{it} variable includes alternative measures of foreign aid (e.g., net aid, grants, and loans) as a share of GDP, and NTR is non-tax revenue (a proxy for resource revenue). We also estimate models with a specific measure of resource revenue: total natural resource rents (the sum of oil, natural gas, coal, mineral, and forest rents) as a percentage of GDP. We assume the vectors of parameter coefficients ($\beta_1, \beta_2, \sigma_i$) differ across countries but are constant over time.

Equation (1) is estimated using standard fixed effects (including country and year fixed effects) and more rigorous panel time series estimators to address econometric concerns. First, heterogeneity characterizes the data such that unobserved country-specific, time-invariant characteristics (α_i) influence the structural variables and tax performance. The fixed effects estimator is suited to handle such heterogeneity. Second, as the constellation of structural factors and tax bases that influence tax performance differ from one country to the other (Carter 2013), it is important to allow regressions to differ by country and incorporate these differences in estimating the average effect across countries in the sample. The mean group (MG) estimator is suited to incorporate such cross-country heterogeneity. Third, the unobserved heterogeneity may be a mixture of time-invariant factors as described above (such as resource endowments and

colonial heritage) as well as unobserved common factors (f_t) with heterogeneous factor loadings, λ_i' (Eberhardt 2012). The vector of unobserved common factors captures shocks, including *strong dependence*, which affects all countries albeit to varying degrees (such as the global recession of the 1980s and the 2008 financial crisis) and *weak dependence*, which affects only a subset of countries (such as the spill-over of conflict).

The common correlated effects mean group (CCEMG) and augmented mean group (AMG) estimators are developed to deal with the pervasiveness of unobserved common factors. The CCEMG deals with unobserved common factors by updating equation (1) with cross-section averages (CSAs hereafter) of the dependent and independent variables (Chudik et al. 2011; Pesaran 2006). The CSAs of the variables are computed and added as explanatory variables in each of the *N* regression equations. Subsequently, the estimated $\hat{\beta}_i$ are averaged across panel members. The AMG is a good alternative to the CCEMG when estimating macro panel models. While the CCEMG accounts for cross-section dependence using CSAs, the AMG deals with cross-section dependence by updating regressions with a *common dynamic process*. A pooled regression model is augmented with year dummies and estimated by first difference ordinary least squares (FD-OLS); the coefficients on the differenced dummies are collected and they represent the *common dynamic process* (CDP hereafter) The CDP is then updated in a group-specific regression as an explicit independent variable or imposed on each group member with a unit coefficient by subtracting the estimated process from the dependent variable (Eberhardt 2012; Eberhardt and Bond 2013).

Using the most parsimonious specification of equation (1) we obtain a measure of tax effort from:

$$E_{it} = {[tax_{it} - \widehat{tax}_{it}]}/{tax_{it}} \tag{2}$$

$$C_{it} = {tax_{it}}/{\widehat{tax}_{it}} \tag{3}$$

Where tax_{it} is actual tax revenue (*T*) and $\widehat{tax}_{it}$ is the predicted value or measure of tax potential (*P*), and equation (2) is an indicator of the level of performance efficiency (*E*). Performance efficiency incorporates both tax administration and tax policy efficiency. Equation (3) is the standard measure of tax effort used in the literature (but our measure of *C* only uses the trend component). We separate the trend (permanent) element of *T*/*P* from the cyclical/volatile element and take the trend as the measure of tax capacity (*C*). Using the permanent component is intuitive as it permits analysis of the steady-state performance/collection efficiency and tax elasticity in each country while abstracting from shocks and stochastic factors that affect tax revenue in specific years. A value greater than one is good as it shows over-performance while a value less than one depicts under-performance. Given how the measure is expressed, in countries where the underlying level of performance efficiency is high the underlying level of tax capacity will be high and vice versa.

Standard tax performance models have included various governance and/or political variables (de la Cuesta et al. 2020; Fauvelle-Aymar 1999; Garcia and von Haldenwang 2016; Gwaindepi 2020), as well as interaction terms between governance variables and other covariates that are considered important determinants of tax performance such as aid, resource abundance, and intensity (Botlhole et al. 2012). There is, however, no consensus view on the most important institutional variables. The strategy we pursue—the general-to-specific variable selection approach—is fundamentally different: all potentially important political variables are included in regressions with tax capacity as the dependent variable. Insignificant (unimportant variables) are systematically dropped from the various iterations of the model until the model is deemed appropriately specified, based on pre- and post-estimation diagnostics (Clarke 2014; Herzer and Morrissey 2013;

Hoover and Perez 2004). This approach aims to identify the most important (with consistently high statistical significance) determinants of performance efficiency and tax capacity.

Although the aim is to select the most important variables, this does not imply that other variables are irrelevant—variables not selected among the most important may nevertheless have effects, independently of or in conjunction with the main factors. Political or governance indicators may be robust determinants of tax performance but could influence capacity directly or through their impact on performance efficiency; institutional quality influences capacity, hence how much tax is collected (tax performance), while performance efficiency may be corrosive to institutional quality. As the dependent variable here is the trend component of the ratio T/P (as opposed to the tax/GDP and/or revenue/GDP ratios) and because as many political variables that are deemed relevant are included, the general-to-specific approach is less susceptible to omitted variable bias.

5 Empirical analysis

Given the intention to search for the covariates of tax capacity in the third stage of the analysis, the first stage estimates performance efficiency from a parsimonious specification. To identify the robust determinants of tax/GDP ratios, Appendix B reports the results from estimating a full specification of equation (1) with a range of estimators allowing for fixed effects, heterogeneous but cross-sectionally independent tax performance, and heterogeneous and cross-sectionally dependent tax performance (Tables B1 to B5). Most explanatory variables are not robust in moving from basic to more sophisticated estimators. Only four variables are regularly significant in most cases: the share of agriculture in GDP, GDP *per capita*, and the shares of exports and imports in GDP; only the last of these is significant across all regressions. These four variables comprise the parsimonious specification to estimate country-specific values of performance efficiency (E) and measures of tax capacity (C). Variables that were never or very rarely significant determinants of tax performance will be included as potential determinants of tax capacity in the third stage of the analysis.

5.1 Estimating and reporting performance efficiency

Equation (1) is estimated with the four robust variables using five estimators. The MG estimator is preferred to the FE estimator because it allows for cross-country heterogeneity. The MG is preferred to the CCEMG and AMG estimators because it is efficient with fewer degrees of freedom (they are more demanding of the data).[7] The results for MG (column 2) show that of the four variables, only GDP per capita and the share of imports in GDP are significant positive determinants of tax/GDP (the other variables have negative coefficients). Resource exports, the prices of which are determined in international markets, are important for many SSA countries and are volatile. Furthermore, taxes on exports have been reduced or eliminated to encourage trade openness. Imports are the only variable significant for all estimators, and MG is the only estimator for which four variables are significant. The consistent significance of imports suggests it is a proxy for economic activity rather than indicating the importance of tariff revenue. The reductions in tariffs and declining importance of trade taxes in SSA are due to external forces (donor influence, trade agreements, and regional integration) more than to domestic fiscal issues (Jones et al. 2011). We provide two robustness checks. First, we confine the analysis to the 1990s onwards, given that major reduction in tariffs had been achieved by the early 1990s; except for the FE estimator with

[7] The null hypothesis of weak cross-sectional dependence (Pesaran 2015) cannot be rejected for the mean group estimator, with the distribution of the correlation matrix very normal.

year fixed effects, imports are strongly significant in all models.[8] Second, private (household) consumption is included as a structural variable to account for the importance of VAT (and the sales tax before that) in total revenue but is consistently insignificant.[9] As shown in Appendix B, adding other plausible determinants adds little, as few are ever significant. This highlights the fragility in cross-country tax performance estimates and the unreliability of deriving measures of tax effort from the residual.

Using the residuals from the MG estimates in Table 1, we generate potential tax revenue *P* from which we obtain *(T-P)/T* as the measure of performance efficiency (*E*). If *T-P* is positive, *E* is positive, indicating more performance efficiency; negative *E* implies performance inefficiency. Higher values indicate more efficiency. Over time, countries moved from negative to positive *E* with, on average, a trend of gradually improving performance efficiency.

Table 1: Baseline estimates of the parsimonious model

Variables	FE	MG	CCEMG	AMG	UnAMG
Agriculture	-0.039	-0.151**	-0.094	-0.153*	-0.130**
	(0.150)	(0.072)	(0.091)	(0.079)	(0.059)
GDP per capita	0.284	0.287**	0.329	0.180	0.024
	(0.181)	(0.141)	(0.227)	(0.146)	(0.042)
Imports	0.192*	0.260***	0.107*	0.191***	0.215***
	(0.111)	(0.082)	(0.057)	(0.073)	(0.076)
Exports	-0.132	-0.126**	-0.051	-0.080*	-0.076
	(0.088)	(0.055)	(0.056)	(0.047)	(0.055)
Observations	1,264	1,256	1,256	1,256	1,256
R-Squared	0.233	-	-	-	-
Country FE	Yes	-	-	-	-
Year FE	Yes	-	-	-	-
RMSE	-	0.153	0.109	0.147	0.151
CD Test	-1.214	0.010	0.139	-1.695	0.809
(*p*-value)	(0.225)	(0.992)	(0.890)	(0.090)	(0.419)
N	41	39	39	39	39

Note*:* estimators are: FE – fixed effects; MG – Mean Group (Pesaran and Smith 2015); CCEMG – Common Correlated Effects Mean Group (Pesaran 2006); AMG – Augmented Mean Group (Eberhardt and Bond 2013); UnAMG – Unit-imposed Augmented Mean Group (Eberhardt and Bond 2013). For the fixed effects, three countries (Djibouti, Ghana, and São Tomé and Príncipe), and for the other estimators five (Central African Republic, Djibouti, Ghana, Mali, and São Tomé and Príncipe*)* of the 44 countries are dropped due to lack of data*.* Robust standard errors are reported in parentheses (***p<0.01, ** p<0.05, * p<0.1).

Source: authors' calculations.

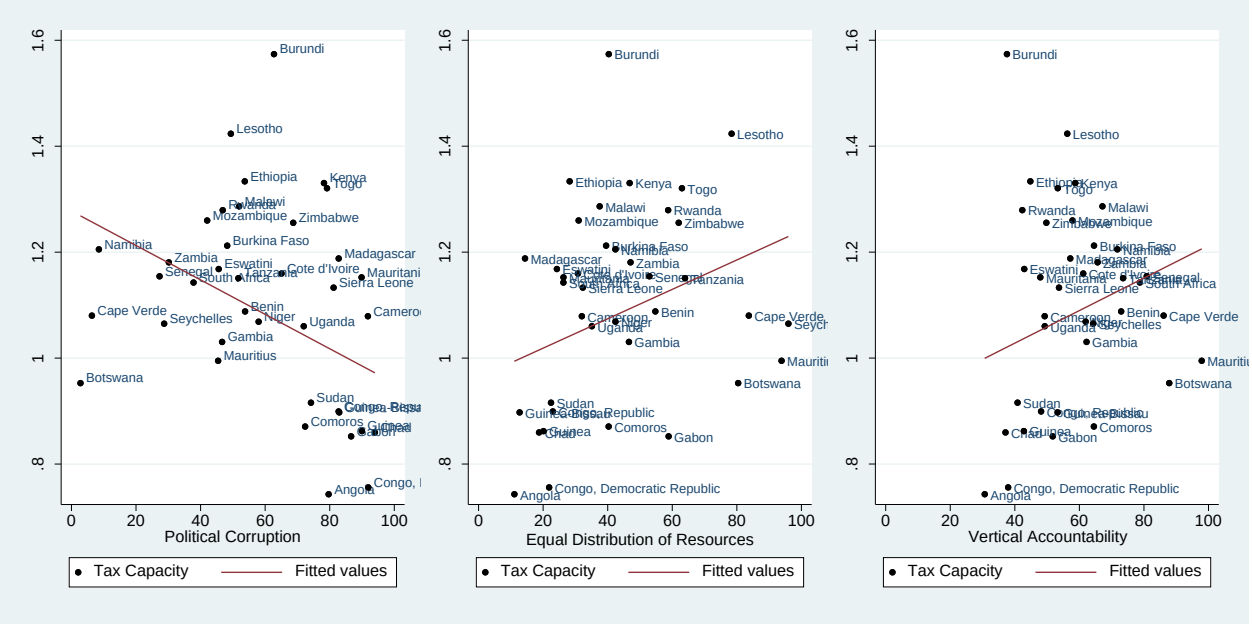
[8] The results are available upon request.

[9] The variable is occasionally negative across specifications, perhaps reflecting the pervasiveness of VAT and other sales tax exemptions in many SSA countries. The results are available upon request.

5.2 Deriving and reporting *C*

To obtain *C*—which, by definition, is the trend or permanent component of *T*/*P*—we apply the Hodrik-Prescott (HP) filter to the country-specific measures of *T*/*P*, applying 100 as the smoothing parameter as annual data are used (Ravn and Uhlig 2002). The HP filter is preferred to other alternatives as it performs better for non-stationary variable series.[10] As *C* represents the underlying level of *T*/*P*, interpretation is similar: higher values of *C* indicate greater tax performance relative to potential and higher fiscal capacity, and vice versa. Figure 4 shows bivariate scatter plots between *C* and the main measures of governance.[11] The plots show a strong negative relationship, which matches a priori expectations: higher scores on the governance variables are associated with higher capacity (*C* greater than 1). Countries with high *C* (such as Cape Verde, Kenya, Mauritania, and Rwanda) corresponding have higher governance measures and vice versa.

Figure 4: Bivariate scatter plots between average tax capacity and measures of governance



Source: authors' calculations based on data from UNU-WIDER (2020) and V-Dem, version 10.

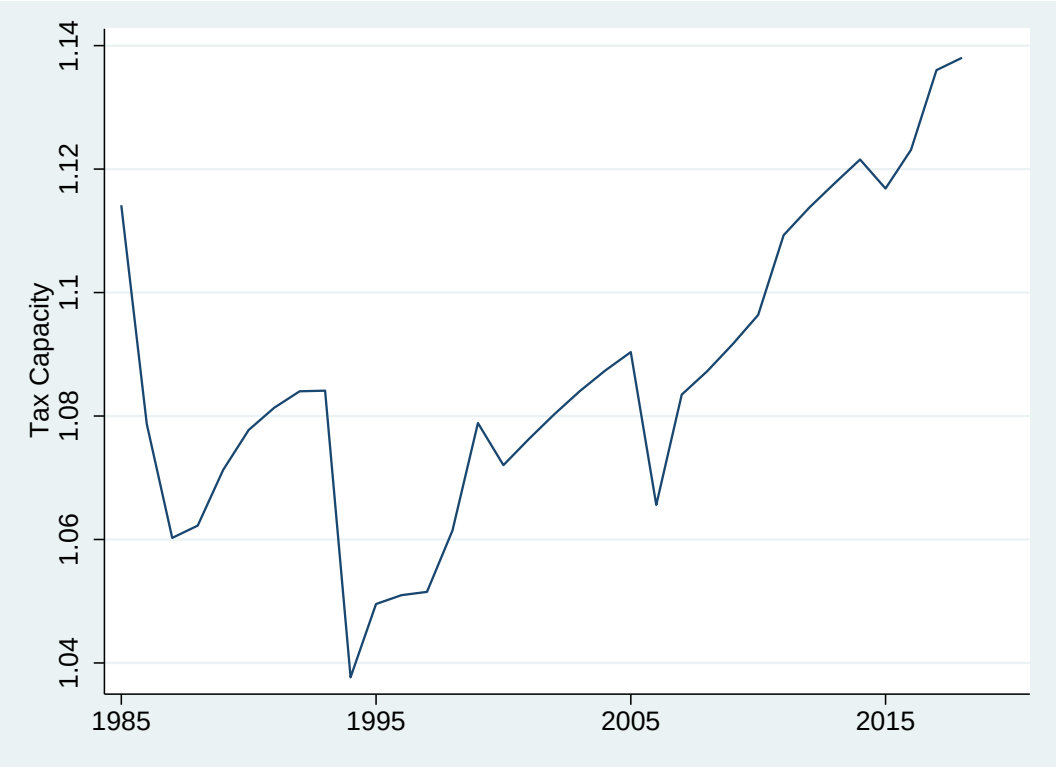
Countries do not necessarily have relatively high values on all three governance measures; Cape Verde and Mauritania are exceptions, whereas Kenya performs relatively better on equitable distribution of resources. Burundi and Lesotho are clear outliers—the high apparent tax capacity in Lesotho probably reflects revenue transfers from South Africa (tax revenues are higher than predicated because of the Common External Tariff sharing formula). Botswana scores relatively well on all three governance measures although tax capacity is moderate (*C* is less than one). In general, countries with relatively better governance scores have higher tax capacity; the countries with the lowest tax capacity (*C* less than 0.8) have among the lowest values for all three governance measures—Angola, Congo DR, Guinea, and Chad. This suggests that these governance indicators are good candidates as determinants of tax capacity.

[10] Although this study does not delve into the stationary properties of variables series, panel unit root tests are applied to the main variables and results (available upon request) show that the variables are nonstationary in levels and stationary in first differences.

[11] To get a better linear fit for the bivariate plots, Figure 4 excludes Equatorial Guinea (included in Figure A1 in the Appendix), an outlier with very low average tax capacity.

Figure 5 shows the evolution of the mean value of C for the 39 countries in Table 1 since 1985. On average, the trend is fluctuating, with a significant plunge between 1994 and 1997 (coinciding with the main structural adjustment and tariff reform period in many countries) until about 2008 and with improvement thereafter. It is noteworthy that, on average, the values are greater than one, i.e. tax over-performance indicating performance efficiency and 'good' tax capacity. The relatively good performance in the mid-1980s is indicative of the contribution of trade taxes during a period of weak economic performance (hence weak structural characteristics).

Figure 5: Evolution of *C*, SSA 1985–2018



Source: authors' calculations.

5.3 Identifying the covariates of C

Building fiscal capacity entails investing in institutions which govern taxation (Besley and Persson 2014), introducing new taxation structures, as well as improving the efficiency of revenue collection (for example, through training and organizational restructuring in revenue authorities). Such investment may be financed by aid or more generally influenced by reform policies advocated by donors and agencies such as the IMF and World Bank. Any such reforms will require time to affect structural and institutional variables that affect tax capacity. Given this, and the potential endogeneity of all explanatory variables (as tax performance is the root of estimated capacity), log lags are desirable, so all variables are lagged five years to handle these potential dynamics. The analysis could provide candidates for subsequent attempts to identify causal factors, but this would not be a promising avenue in the current exploratory cross-country analysis, given the number of plausible 'causal mechanisms' and potentially complex interactions that can vary across countries (and time).

Given the level of multi-collinearity across variables (especially V-Dem data), including all the variables in one specification is not ideal. Although the general-to-specific method can essentially handle multi-collinearity in variables—by sequentially dropping different sets of variables to eventually select the most significant factors—we adopt the alternative approach of not including

all variables at once. In essence, rather than including alternative sets of variables, we vary the total included in different estimates. Private consumption as a share of GDP is a structural variable while 'other income' variables include net aid, grants, non-tax revenue, and resource rents (all as shares of GDP). Although most of these structural variables were not significant in explaining revenue, they could still be correlated with capacity, for example through indirect effects (such as interaction with institutions). The first stage estimates for tax *revenue* assumed that structural variables determine potential revenue, so only significant structural variables are included while behavioural variables are omitted. However, tax *capacity* is the trend component which can be influenced by structural variables that affect behaviour (e.g., private consumption, aid, and resource rents). Such structural variables could be correlated with core determinants of capacity.

The institutional variables include the vertical accountability index, the equal distribution of resources index, and the political corruption index. Other institutional measures considered are democracy indices (egalitarian, electoral, liberal, participatory, and deliberative democracy) and accountability indices (horizontal and diagonal). Although it may appear a useful way to incorporate multiple indicators, V-Dem variables are not combined using principal components because: i) we are testing for which aspects of institutions affect performance (each V-Dem indicator has distinct components); ii) any composite measure would be more difficult to interpret; and iii) some V-Dem indices have elements based on principal components.

The dataset comprises 39 countries over the 1985–2018 period (the years 1980–85 are omitted due to volatility). All V-Dem indicators are rescaled to range from 0 to 100 and the structural and non-income variables are in natural logs, then lagged. We start by estimating a general model in which all potentially important independent variables are included. This general model is tested for validity via a series of statistical tests. Using the full sample, 90 per cent of the sample is retained and 10 per cent is set aside for out-of-sample testing. Variables are ranked by the size of their *t*-statistics, then five simplification paths are applied. Each of the five variables with the lowest *t*-statistic is removed, yielding the fifth search path. If each equation passes the battery of tests, insignificant variables are eliminated. This goes on until either all the insignificant variables have been eliminated or there are no more variables that can successfully be dropped. The potential terminal specification is also subject to a battery of tests for model adequacy. Finally, each of the five terminal specifications is compared and if they are different, the final specification is determined using encompassing (*F*-tests) or information criteria (Bleaney and Niyishama 2002; Clarke 2014; Herzer and Morrissey 2013).

The final specification is reported in Table 2.[12] All significant variables have the expected sign. The equal distribution of resources index, resource rents, private consumption, and the political corruption index are the robust determinants of tax capacity. Cross-country variations in tax capacity are driven by these four variables. The equal distribution of resources index is positively associated with tax capacity, consistent with the view that taxpayers are more willing to pay tax if the allocation of public spending is perceived as fair. There is a strong positive relationship between private (household) consumption and tax capacity, suggesting that increased household incomes increase the underlying capacity of the government to raise taxes. This tax policy framework is inextricably linked to the VAT policy—i.e. the number of VAT exemptions for essential goods—such that the pervasiveness of VAT exemptions in SSA does not offset the positive tax-generating impact of household spending. Resource rents also have a positive relationship with capacity, showing that, conditional on any adverse effects of other incomes (of which resource rents may

[12] The final specification fails two of four standard misspecification tests (normality and model specification) so we employ heteroskedasticity-robust standard errors. The in-sample and out-of-sample Chow tests for equality of coefficients are not rejected. Nonetheless, our findings should be interpreted with caution.

be a component), resource wealth can improve tax collection efficiency. The political corruption index is negatively associated with tax capacity. This variable, which captures corruption at the executive, judicial, and legislative levels, shows that corruption pertaining to bribery and embezzlement of state funds dampens incentives to invest in tax capacity.

Table 2: Selected determinants of *C*

Independent variables	Coefficients (*t*-statistics)
Private consumption (% GDP)	0.256*** (11.29)
Resource rents (% GDP)	0.021*** (7.96)
Equal distribution of resources	0.003*** (8.20)
Political corruption index	-0.002*** (-9.83)
Diagnostics	
Adjusted R^2	0.31
F-statistic (*p*-value)	68.75 [0.00]
Observations	929
N (countries)	39

Note: the models are estimated using the *genspec* command in STATA (Clarke 2014). Coefficients are presented, with *t*-statistics in parentheses (***p<0.001, **p<0.05, *p<0.1 indicate significance at 1%, 5%, and 10%, respectively). Robust standard errors are applied. The *F*-statistic is for joint significance of all independent variables, with its corresponding *p*-value.

Source: authors' calculations.

Although non-tax revenue, aid-to-GDP, and grants-to-GDP were not selected in Table 2, suggesting they have no direct impact on tax capacity, they may indirectly influence the main determinants of tax capacity. To gauge the links between these variables and the main determinants, we estimate a general specification including all the potential variables (Table 3) and provide correlation coefficients (Table 4). In the general model with all potential variables included (Table 3), the significance of the main variables still stands. Some variables not selected as a main factor are significant: vertical accountability and non-tax revenue are positive and significant. The egalitarian and electoral democracy indices are both negatively associated with tax capacity.

Table 4 shows the pairwise correlation coefficients between the main variables and those that are insignificant and/or omitted from the preferred selection (Table 2). Most of the variables are significantly correlated with each other. The equal distribution of resources index is positively correlated with the egalitarian democracy index (as expected, given that equal distribution of resources is a sub-component of egalitarian democracy) and other institutional measures, while the political corruption index is negatively correlated with most institutional variables. Private consumption is also significantly correlated with other variables, and highly (negatively) correlated with non-tax revenue. Resource rents are negatively correlated with all institutional variables but positively correlated with non-tax revenue, as expected. Although the correlations are relatively low, vertical accountability is positively related to equity and negatively related to resources and corruption (and private consumption), consistent with more accountable processes being associated with higher tax capacity and better institutions.

Table 3: General specification of determinants of *C*

Independent variables	*t*-statistics
Private consumption (% GDP)	13.28***
Resource rents (% GDP)	6.02***
Grants-to-GDP	0.85
Net aid-to-GDP	0.51
Non-tax revenue	4.34***
Vertical accountability	2.26**
Equal distribution of resources	7.77***
Political corruption	-1.18***
Horizontal accountability	4.33***
Diagonal accountability	6.25***
Egalitarian democracy	-6.42***
Electoral democracy	-3.68***
Deliberative democracy	7.04***
Participatory democracy	1.58
Liberal democracy	0.48
Diagnostics	
Adjusted R^2	0.89
F-statistic (*p*-value)	45.65 [0.00]
Observations	872
N (countries)	39

Note: the models are estimated using the *genspec* command in STATA (Clarke 2014). Coefficients are presented, with *t*-statistics in parentheses (***p<0.001, **p<0.05, *p<0.1 indicate significance at 1%, 5%, and 10%, respectively). Robust standard errors are applied. The *F*-statistic is for joint significance of all independent variables, with its corresponding *p*-value.

Source: authors' calculations.

Table 4: Correlation coefficients

	Political corruption	Equal distribution	Private consumption	Resource rents
Vertical accountability	-0.36***	0.44***	-0.15***	-0.27***
Horizontal accountability	**-0.52*** **	**0.53*** **	-0.06	-0.35***
Diagonal accountability	-0.21***	0.39***	-0.07	-0.21***
Egalitarian democracy	**-0.51*** **	**0.65*** **	-0.08***	-0.36***
Electoral democracy	-0.40***	0.47***	-0.11***	-0.27***
Deliberative democracy	-0.45***	**0.52*** **	-0.12***	-0.28***
Participatory democracy	-0.43***	0.45***	-0.11***	-0.29***
Liberal democracy	**-0.54*** **	**0.55*** **	-0.13***	-0.34***
Net aid-to-GDP	-0.03	0.07***	0.44***	0.02
Non-tax revenue	-0.02	0.02	**-0.62*** **	0.36***

Note: ***, **, * indicate significance at 1%, 5%, and 10%, respectively. Figures in **bold** represent correlations that are greater than or equal to 0.5.

Source: authors' calculations.

Unexpected or apparently inconsistent signs may be due to including together variables that are highly correlated. This is probably the case for the democracy indicators; some are positive but others have a negative coefficient. Failure to fully account for endogeneity is another issue. For example, grants are a greater proportion of aid in poorer countries which also tend to have lower tax/GDP ratios, and lagging only one year will not account for potential endogeneity—Clist and

Morrissey (2011) find that longer lags increase the likelihood of finding a positive coefficient on grants.

5.4 Country heterogeneity

Heterogeneity is explored by splitting the samples according to income (low-income countries (LICs) vs non-LICs) and resource rich (RR) vs resource poor (non-RR). Table 5 compares means of the core variables for the different groups over the sample period. All differences are statistically significant although often small in magnitude and with high standard deviation.

Table 5: Mean differences of core variables by income and resources

Variables	Groups of countries									
	LICs (N=20)		non-LICs (N=24)			RR (N=23)		non-RR (N=21)		
	mean	sd	mean	sd	*p*-value	mean	sd	mean	sd	*p*-value
Tax capacity	1.12	0.24	1.03	0.26	0.03***	1.03	0.33	1.11	0.16	0.00***
Tax/GDP	8.86	3.34	16.01	8.74	0.00***	10.45	5.88	14.17	7.92	0.00***
Vertical accountability	54.41	20.14	60.89	22.71	0.00***	52.57	21.03	63.83	21.14	0.00***
Equal distribution	37.25	17.84	48.14	25.54	0.00***	33.12	15.19	54.21	24.99	0.00***
Political corruption	67.57	21.41	54.92	30.01	0.00**	69.29	23.13	51.23	28.15	0.00***
Horizontal accountability	46.92	21.79	54.28	23.12	0.00***	45.45	21.23	56.95	22.99	0.00***
Diagonal accountability	60.15	20.24	64.03	22.16	0.00***	57.96	21.12	66.98	20.69	0.00***
Egalitarian democracy	29.24	16.72	36.63	26.64	0.00***	26.15	18.01	41.04	25.21	0.00***
Electoral democracy	39.78	19.69	47.38	27.29	0.00***	38.06	20.69	50.33	26.53	0.00***
Deliberative democracy	29.94	19.22	38.91	28.03	0.00***	28.38	20.91	41.88	26.79	0.00***
Participatory democracy	32.13	18.07	40.05	26.68	0.00***	30.10	19.90	43.38	25.15	0.00***
Liberal democracy	27.71	18.56	37.50	28.35	0.00***	26.40	20.52	40.32	27.11	0.00***
Exports	20.04	9.45	39.34	22.87	0.00***	26.77	16.78	33.81	22.89	0.00***
Private consumption	79.90	9.44	63.67	17.57	0.00***	73.43	16.02	69.73	16.43	0.00***
Resource rents	12.08	7.85	10.05	13.43	0.00***	15.54	12.06	5.90	7.60	0.00***
Non-tax revenue	1.36	1.15	5.11	6.20	0.00***	3.55	5.59	3.18	4.20	0.16
Net aid/GDP	14.11	10.32	7.34	8.84	0.00***	11.88	10.93	8.86	8.88	0.00***
Grants/GDP	11.95	8.13	6.16	8.13	0.00***	9.90	9.25	7.62	9.10	0.00***

Note: the mean and standard deviation (sd) are unweighted and the covariances across groups are unequal. The *p*-value is based on a *t*-statistic for difference in sample means. *** (**) denote significance at 1% (5%) level.

Source: authors' calculations.

Tax/GDP is higher in more developed (non-LICs) countries, consistent with tax performance being positively associated with per capita GDP, and in the resource poor (non-RR), consistent with access to rents reducing reliance on tax revenue. Tax capacity is, however, slightly higher in LICs, suggesting that low tax/GDP is due to their structural characteristics (exports are notably lower than in non-LICs although private consumption is higher), even if values of institutional indicators are all lower. Political corruption is higher (worse) in low-income and resource-rich countries, consistent with the resource curse hypothesis and the above finding that it is associated with lower capacity. Vertical accountability and equal distribution of resources, both found to be positively associated with capacity, are higher (notably in the case of equity) in richer countries and notably lower (especially equity) in resource-rich countries. This reinforces the selection of these three governance measures as important determinants of capacity that incorporate (or capture) other characteristics likely to be associated with the quality of tax institutions.

Both accountability and all democracy measures are higher in richer and resource-poor countries. This is unsurprising given the correlations with the three governance measures selected as

important determinants of capacity. Exports are also higher (notably so) for richer countries and, perhaps surprisingly, for resource-poor countries; the latter may indicate the importance of agriculture (cash crop) exports for many SSA countries—as the sector is 'hard to tax', this is consistent with finding that exports do not contribute to tax performance or capacity (and with relatively high capacity given characteristics). Private consumption is also higher in richer and resource-poor countries, perhaps because investment is relatively lower. Unsurprisingly, resource rents are much higher in resource-rich countries, as are non-tax revenues to a lesser extent. However, although resource rents are higher, non-tax revenues are lower in poorer countries—some LICs have significant resources. Net aid and grants are higher in poorer and resource-rich countries; the former is to be expected (especially for grants), while the latter reinforces the fact that some relatively poor countries are rich in resources (and the resource curse is one reason why they may not benefit from the resources). As poorer countries tend to have lower tax revenue and capacity, this is one reason why results for the relationship between different measures of aid and capacity are mixed—any benefits of aid, or donor policy recommendations, take time to affect behaviour, outcomes, and institutions.

6 Conclusion

This study set out to construct a measure of fiscal capacity that is separate from the tax performance or tax effort estimates common in the literature. The measure of fiscal capacity is based on isolating the trend difference between potential and actual tax revenue (removing cyclical and temporary variations). For a sample of 44 SSA countries over the period from 1980 to 2018, the analysis aimed to identify the institutional indicators that are most robust in explaining the trend in fiscal capacity. There are three elements to the analysis.

First, including the variety of variables employed in the literature estimating tax performance shows that no variables are consistently significant across a range of specifications and estimators. This is consistent with results in the literature and cautions against using standard measures of tax effort based on residuals from tax performance regressions as indicators of underlying fiscal capacity. Only four variables are found to be relatively robust determinants of tax/GDP ratios for the SSA countries: tax revenue increases with imports (as a share of GDP) and per capita GDP but decreases with the share of agriculture in GDP and exports (as a share of GDP).

Second, these three consistent determinants are used in a parsimonious tax performance regression to derive a measure of administrative inefficiency constructed as the difference between potential and actual tax revenue. Country-specific estimates of the difference are decomposed to distinguish the trend component, the measure of tax capacity, from stochastic and cyclical elements of the difference. There appears to be a positive correlation between administrative efficiency and indicators of better governance (such as egalitarian democracy, accountability, and an equitable distribution of public spending).

Third, a general-to-specific methodology is employed to identify variables that are determinants of the cross-country variation in tax capacity. Only four variables are consistently significant: tax capacity increases with private consumption, resource rents, and equal distribution of resources, but decreases with corruption. The finding for resources suggests that, while access to alternative sources of revenue is associated with lower tax revenue, it does not reduce the efficiency of tax collection. These results should not be interpreted as causal given the relatively short lags included—changes in the composition of alternative revenue sources can influence behaviour over the medium to long term (resources may encourage corruption). A more equal distribution of resources, greater equity in the allocation of public spending such as for education and health, does

appear to increase fiscal capacity. This is consistent with arguments that equitable distribution of public spending is associated with greater public trust in government and willingness to pay taxes (Moore 2008). This could be enhanced by vertical accountability; Dom (2018) finds some evidence that higher (direct) tax revenue improves vertical accountability (suggesting taxpayers exert their interest in improving the process of selecting leaders). Governance institutions which enhance public perceptions that government allocates public spends fairly and is accountable may not increase tax revenue but do appear to improve administrative efficiency and fiscal capacity.

References

Albers, T.N., M. Jerven, and M. Suesse (2020). 'The Fiscal State in Africa: Evidence from a Century of Growth'. Lund University: African Economic History Working Paper Series 55/2020. Available at: https://www.aehnetwork.org/wp-content/uploads/2020/09/AEHN-WP-55.pdf (accessed 25 June 2021).

Altincekic, C., and D.H. Bearce (2014). 'Why There Should Be No Political Foreign Aid Curse'. *World Development*, 64: 18–32. https://doi.org/10.1016/j.worlddev.2014.05.014

Bahl, R. (1971). 'A Regression Approach to Tax Effort and Tax Ratio Analysis'. *IMF Staff Papers*, 18(3): 570–612. https://doi.org/10.2307/3866315

Baskaran, T., and A. Bigsten, A. (2013). 'Fiscal Capacity and the Quality of Government in sub-Saharan Africa'. *World Development*, 45(C): 92–107. https://doi.org/10.1016/j.worlddev.2012.09.018

Besley, T., and T. Persson (2009). 'The Origins of State Capacity: Property Rights, Taxation, and Politics'. *American Economic Review*, 99(4): 1218–44. https://doi.10.23943/princeton/9780691152684.001.0001

Besley, T., and T. Persson (2011). *Pillars of Prosperity: The Political Economics of Development Clusters*. Princeton, NJ: Princeton University Press.

Besley, T., and T. Persson (2013). 'Taxation and Development'. In A. Auerbach, R. Chetty, M. Feldstein, and E. Saez (eds), *Handbook of Public Economics Volume 5*. Amsterdam: Elsevier. https://doi.org/10.1016/B978-0-444-53759-1.00002-9

Besley, T., and T. Persson (2014). 'Why Do Developing Countries Tax So Little?'. *Journal of Economic Perspectives*, 28(4): 99–120. https://doi.org/10.1257/jep.28.4.99

Bleaney, M., and A. Nishiyama (2002). 'Explaining Growth: A Contest Between Models'. *Journal of Economic Growth*, 7(1): 43–56. https://doi.org/10.1023/A:1013466526642

Bornhorst, F., S. Gupta, and J. Thornton (2009). 'Natural Resource Endowments and the Domestic Revenue Effort'. *European Journal of Political Economy*, 25(4): 439–46. https://doi.org/10.1016/j.ejpoleco.2009.01.003

Botlhole, T., J. Asafu-Adjaye, and F. Carmignani (2012). 'Natural Resource Abundance, Institutions and Tax Revenue Mobilisation in Sub-Sahara Africa'. *South African Journal of Economics*, 80(2): 135–56. https://doi.org/10.1111/j.1813-6982.2011.01305.x

Bräutigam, D., O.-H. Fjeldstad, and M. Moore (2008) *Taxation and State-building in Developing Countries—Capacity and Consent*. Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511490897

Brun, J.-F., and M. Diakité (2016). 'Tax Potential and Tax Effort: An Empirical Estimation for Non-resource Tax Revenue and VATs Revenue'. Études et Documents No 10. Clermont-Ferrand : CERDI)

Carter, P. (2013). 'Does Foreign Aid Displace Domestic Taxation?'. *Journal of Globalization and Development*, 4(1): 1–47. https://doi.org/10.1515/jgd-2013-0023

Chachu, D. (2021). 'Good Institutions and Tax Revenue Outcomes in Resource-rich Countries: When "Good" is Not Enough'. WIDER Working Paper 2021/75. Helsinki: UNU-WIDER. https://doi.org/10.35188/UNU-WIDER/2021/013-9

Chelliah, R., H. Baas, and M. Kelly (1975). 'Tax Ratios and Tax Effort in Developing Countries'. *IMF Staff Papers*, 21: 187–205. https://doi.org/10.2307/3866592

Chudik, A., M.H. Pesaran, and E. Tosetti (2011). 'Weak and Strong Cross-section Dependence and Estimation of Large Panels'. *The Econometrics Journal*, 14(1): C45–C90. https://doi.org/10.1111/j.1368-423X.2010.00330.x

Clarke, D. (2014). 'General-to-Specific Modelling in Stata'. *The Stata Journal*, 14(4): 895–908. https://doi.org/10.1177/1536867X1401400412

Clist, P., and O. Morrissey (2011). 'Aid and Tax Revenue: Signs of a Positive Effect Since the 1980s'. *Journal of International Development*, 23(2): 165–80. https://doi.org/10.1002/jid.1656

Coppedge, M., J. Gerring, C.H. Knutsen, S.I. Lindberg, J. Teorell, D. Altman, M. Bernhard, M.S. Fish, A. Glynn, A. Hicken, A. Lührmann, K.L. Marquardt, K. McMann, P. Paxton, D. Pemstein, B. Seim, R. Sigman, S.E. Skaaning, J. Staton, A. Cornell, L. Gastaldi, H. Gjerløw, V. Mechkova, J. von Römer, A. Sundström, E. Tzelgov, L. Uberti, Y. Wang, T. Wig, and D. Ziblatt (2020). *V-Dem Codebook v10*. University of Gothenburg Varieties of Democracy (V-Dem) Project. Gothenburg: University of Gothenburg. https://doi.org/10.2139/ssrn.3557877

Crivelli, E., and S. Gupta (2014). 'Resource Blessing, Revenue Curse? Domestic Revenue Effort in Resource-rich Countries'. *European Journal of Political Economy*, 35: 88-101. https://doi.org/10.1016/j.ejpoleco.2014.04.001

Dalamagas, B., P. Palaios, and S. Tantos (2019). 'A New Approach to Measuring Tax Effort'. *Economies*, 7(3): 77. https://doi.org/10.3390/economies7030077

de la Cuesta, B., L. Martin, H.V. Milner, and D.L. Nielson (2020). 'Do Indirect Taxes Bite? How Hiding Taxes Erases Accountability Demands from Citizens'. Technical Report. Available at: https://scholar.princeton.edu/sites/default/files/vat_dec2020.pdf (accessed 18 February 2021).

Dom, R. (2018). 'Taxation and Accountability in sub-Saharan Africa'. ODI Working Paper 544. London: Overseas Development Institute.

Dom, R. (2019). 'Semi-Autonomous Revenue Authorities in Sub-Saharan Africa: Silver Bullet or White Elephant'. *Journal of Development Studies*, 55(7): 1418–35. https://doi.org/10.1080/00220388.2018.1469743

Eberhardt, M. (2012). 'Estimating Panel Time-Series Models with Heterogeneous Slopes'. *The Stata Journal*, 12(1): 61–71. https://doi.org/10.1177/1536867X1201200105

Eberhardt, M., and S. Bond (2013). 'Accounting for Unobserved Heterogeneity in Panel Time Series Models'. Available at: https://lezme.github.io/markuseberhardt/BEMC.pdf (accessed 22 October 2020).

ECA (2019). *Fiscal Policy for Financing Sustainable Development in Africa*. Addis Ababa: United Nations Economic Commission for Africa.

Fauvelle-Aymar, C. (1999). 'The Political and Tax Capacity of Government in Developing Countries'. *Kyklos*, 52(3): 391–413. https://doi.org/10.1111/j.1467-6435.1999.tb00224.x

Garcia, M.M., and C. von Haldenwang (2016). 'Do Democracies Tax More? Political Regime Type and Taxation'. *Journal of International Development*, 28(4): 485–506. https://doi.org/10.1002/jid.3078

Gupta, A.S. (2007). 'Determinants of Tax Revenue Efforts in Developing Countries'. IMF Working Paper WP/07/184. Washington, DC: International Monetary Fund. https://doi.org/10.5089/9781451867480.001

Gwaindepi, A. (2020). 'Domestic Revenue Mobilization in Developing Countries: An Exploratory Analysis of sub-Saharan Africa and Latin America'. *Journal of International Development*, 33(2): 396–421. https://doi.org/10.1002/jid.3528

Herzer, D., and O. Morrissey (2013). 'Foreign Aid and Domestic Output in the Long Run'. *Review of World Economics*, 149(4): 723–48. https://doi.org/10.1007/s10290-013-0169-y

Hoover, K.D., and S.J. Perez (2004). 'Truth and Robustness in Cross–country Growth Regressions'. *Oxford Bulletin of Economics and Statistics*, 66(5): 765–98. https://doi.org/10.1111/j.1468-0084.2004.101_1.x

IMF (2018). *Regional Economic Outlook: Sub-Saharan Africa*. April 2018. Washington, DC: International Monetary Fund.

Jeppesen, M. (2021). 'What We Hoped for and What We Achieved: Tax Performance of Semi-autonomous Revenue Authorities in sub-Saharan Africa'. *Public Administration and Development*, 41(3): 115–27. https://doi.org/10.1002/pad.1952

Jones, C., O. Morrissey, and D. Nelson (2011). 'Did the World Bank Drive Tariff Reforms in Eastern Africa?'. *World Development*, 39(3): 324–335. https://doi.org/10.1016/j.worlddev.2010.08.003

Kjaer, A., A. Forged, and M. Jeppesen (2021). 'Fiscal States in sub-Saharan Africa: Conceptualization and Empirical Trends'. Paper presented at the WIDER Online Workshop on 'Fiscal States—The Origins and Development Implications', 16 June 2021.

Lotz, J.R., and E.R. Morss (1967). 'Measuring "Tax Effort" in Developing Countries'. *IMF Staff Papers*, 14(3): 478-499. https://doi.org/10.2307/3866266

Masi, T., A. Savoia, and K. Sen (2020). 'Is There a Fiscal Resource Curse?: Resource Rents, Fiscal Capacity, and Political Institutions in Developing Economies'. WIDER Working Paper 2020/10. Helsinki: UNU-WIDER. https://doi.org/10.35188/UNU-WIDER/2020/767-5

Moore, M. (2008). 'Between Coercion and Contract: Competing Narratives on Taxation and Governance'. In D. Bräutigam, O.-H. Fjeldstad, and M. Moore (eds), *Taxation and State-Building in Developing Countries: Capacity and Consent*. Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511490897.002

Moore, M. (2021). Glimpse of Fiscal States in sub-Saharan Africa. Paper presented at the WIDER Online Workshop on 'Fiscal States—The Origins and Development Implications', 22 June 2021.

Morrissey, O. (2015). 'Aid and Domestic Resource Mobilization with a Focus on Sub-Saharan Africa'. *Oxford Review of Economic Policy*, 31(3–4): 447–61. https://doi.org/10.1093/oxrep/grv029

Morrissey, O., and S. Torrance (2015). 'Aid and Taxation'. In M. Arvin and B. Lew (eds), *Handbook on the Economics of Foreign Aid*. Cheltenham: Edward Elgar. https://doi.org/10.4337/9781783474592.00042

Morrissey, O., C. Von Haldenwang, A. Von Schiller, M. Ivanyna, and I. Bordon (2016). 'Tax Revenue Performance and Vulnerability in Developing Countries'. *Journal of Development Studies*, 52(12): 1689–703. https://doi.org/10.1080/00220388.2016.1153071

Pesaran, M.H. (2006). 'Estimation and Inference in Large Heterogeneous Panels with a Multifactor Error Structure'. *Econometrica*, 74(4): 967–1012. https://doi.org/10.1111/j.1468-0262.2006.00692.x

Pesaran, M.H. (2015). 'Testing Weak Cross-sectional Dependence in Large Panels'. *Econometric Reviews,* 34(6–10): 1089–117. https://doi.org/10.1080/07474938.2014.956623

Ravn, M.O., and H. Uhlig (2002). 'On Adjusting the Hodrick-Prescott Filter for the Frequency of Observations'. *Review of Economics and Statistics*, 84(2): 371–76.

Ricciuti, R., A. Savoia and K. Sen (2019). 'What Determines Administrative Capacity in Developing Countries?'. *International Tax and Public Finance*, 26(5): 972–98. https://doi.org/10.1007/s10797-019-09535-y

Savoia, A., K. Sen, and A. Tagem (2021). 'How do Political Institutions Matter in Creating Taxation States?'. Paper presented at the WIDER Online Workshop on 'Fiscal States—The Origins and Development Implications', 15 June 2021.

Stotsky J., and A. WoldeMariam (1997). 'Tax Effort in Sub-Saharan Africa'. IMF Working Paper 97/107. Washington DC: International Monetary Fund. https://doi.org/10.5089/9781451852943.001

Teera, J.M., and J. Hudson (2004). 'Tax Performance: A Comparative Study'. *Journal of International Development*, 16(6): 785–802. https://doi.org/10.1002/jid.1113

Therkildsen, O. (2002). 'Keeping the State Accountable: Is Aid No Better Than Oil?'. *IDS Bulletin*, 33(3): 1–17. https://doi.org/10.1111/j.1759-5436.2002.tb00037.x

UNU-WIDER (2020). 'Government Revenue Dataset'. Version 2020. Helsinki: UNU-WIDER. Newest version available at: https://www.wider.unu.edu/project/grd-%E2%80%93-government-revenue-dataset (accessed 30 September 2020).

World Bank (2020). *World Development Indicators*. Washington, DC: World Bank. Available at: https://datacatalog.worldbank.org/search/dataset/0037712 (accessed 15 October 2020).

Appendix A

List of countries

Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo Dem. Rep., Congo Rep., Cote D'Ivoire, Djibouti, Equatorial Guinea, Eswatini, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Rwanda, São Tomé and Príncipe, Senegal, Seychelles, Sierra Leone, South Africa, Sudan, Tanzania, Togo, Uganda, Zambia, Zimbabwe.

Table A1: Summary statistics

Variable	Mean	Std. dev.	Min.	Max.	*N*
Total tax revenue	12.77	7.71	0.60	59.98	1,524
Total non-tax revenue	3.41	4.91	0	46.92	1,581
Performance efficiency	0.04	1.81	-23.26	35.03	1,142
Tax capacity	1.09	0.23	-0.27	1.68	1,142
Equal distribution of resources	42.88	23.14	0	100	1,716
Vertical accountability	55.48	22.69	0	100	1,716
Political corruption index	60.67	27.19	0	100	1,496
Net aid	10.53	10.11	-0.25	94.44	1,645
Grants	8.76	9.17	0.0004	11.36	1,645
Loans	3.15	3.52	0.0002	41.18	1,616
Technical assistance	2.71	4.88	0.0004	59.38	1,645
Agriculture value added	23.93	14.56	0.89	71.76	1,534
GDP per capita	1,473.40	2,453.107	100.03	22,942.58	1,663
Exports	29.79	19.99	3.34	158.37	1,487
Imports	38.68	19.47	2.98	191.46	1,487
Resource rents	10.71	10.93	0	84.23	1,659
Private consumption	71.85	16.67	13.98	139.22	1,437
Egalitarian democracy index	33.30	23.00	0.20	100	1,487
Electoral democracy index	43.95	24.45	5.70	100	1,487
Participatory democracy index	36.48	23.52	1.10	100	1,487
Deliberative democracy index	34.86	24.84	0	100	1,487
Liberal democracy index	33.08	24.90	0	100	1,487
Horizontal accountability	50.94	22.81	0	100	1,496
Diagonal accountability	62.27	21.39	0.20	100	1,496

Note: the summary statistics for structural variables, other income, and tax/GDP are for the period from 1980 to 2018 while the statistics for tax capacity, performance efficiency, and institutional variables cover the period from 1985 to 2018.

Source: authors' calculations based on data from UNU-WIDER (2020), V-Dem, version 10, and the World Development Indicators.

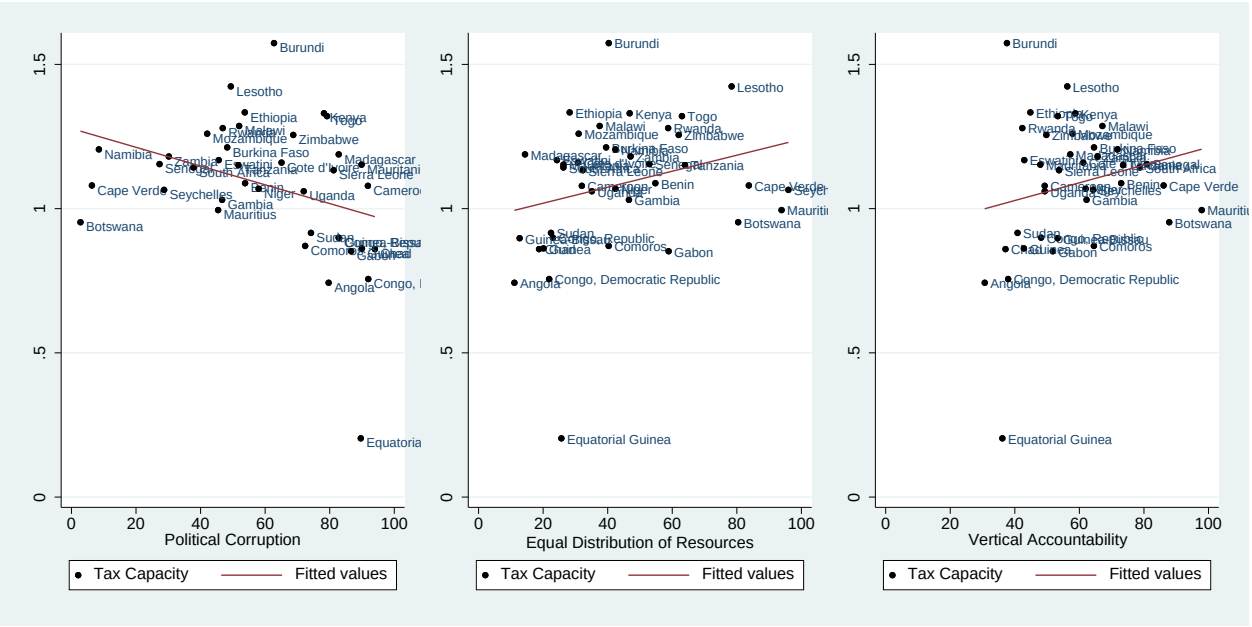
Table A2: Variable definitions and sources

Variable name	Definition	Source
Total tax revenue	Total tax revenue excluding grants and social contributions.	GRD
Total non-tax revenue	Total non-tax revenue, excluding grants.	GRD
Performance efficiency	Ratio of the difference between actual and potential (predicted) tax revenue to actual tax revenue.	Authors' calculation
Tax capacity	Trend (permanent) component of the ratio of actual tax revenue to potential (predicted) tax revenue.	Authors' calculation
Equal distribution of resources	The extent to which resources—both tangible and intangible—are distributed in society.	V-DEM
Vertical accountability	The extent to which citizens have the power to hold the government accountable through elections and participation in political parties.	V-DEM
Political corruption index	The pervasiveness of political corruption. The directionality of the index runs from less corrupt to more corrupt.	V-DEM
Net aid	Total net official development assistance (ODA) (net of loan repayments) from official donors.	OECD DAC
Grants	Total ODA grants from all official donors.	OECD DAC
Loans	Total ODA loans from all official donors.	OECD DAC
Technical assistance	Total ODA technical cooperation from all official donors.	OECD DAC
Agriculture value added	Corresponds to ISIC divisions 1-5 and includes forestry, hunting, and fishing, as well as cultivation of crops and livestock production. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs.	WDI
GDP per capita	Gross domestic product divided by population.	WDI
Exports	The value of all goods and other market services provided to the rest of the world.	WDI
Imports	The value of all goods and other market services received from the rest of the world.	WDI
Resource rents	The sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents.	WDI
Private consumption	The market value of all goods and services, including durable products (such as cars, washing machines, and home computers), purchased by households.	WDI
Egalitarian democracy index	The extent to which the ideal of egalitarian democracy is achieved. The egalitarian principle of democracy holds that material and immaterial inequalities inhibit the exercise of formal rights and liberties and diminish the ability of citizens from all social groups to participate.	V-DEM
Electoral democracy index	The extent to which the ideal of electoral democracy in its fullest sense is achieved.	V-DEM
Participatory democracy index	The extent to which the ideal of participatory democracy is achieved. The participatory principle of democracy emphasizes active participation by citizens in both electoral and non-electoral processes.	V-DEM
Deliberative democracy index	The extent to which the ideal of liberal democracy is achieved. The deliberative principle of democracy focuses on the process by which decisions are reached in a polity.	V-DEM
Liberal democracy index	The extent to which the ideal of liberal democracy in its fullest sense is achieved.	V-DEM
Horizontal accountability	The power of state institutions to oversee the government by demanding information, questioning officials, and punishing improper behaviour.	V-DEM
Diagonal accountability	The range of actions and mechanisms that citizens, civil society organizations, and an independent media can use to hold the government accountable.	V-DEM

Note: GRD – Government Revenue Dataset; OECD DAC (Table 2a) – Development Assistance Committee; V-Dem – Varieties of Democracy; WDI – World Development Indicators.

Source: authors' calculations.

Figure A1: Bivariate scatter plots between average tax capacity and measures of governance



Source: authors' calculations based on data from UNU-WIDER (2020) and V-Dem, version 10.

Appendix B: Complete tax performance regression estimates

Tables B1 to B5 show the results from estimating a full specification of equation (1). The estimators respectively allow for homogeneous tax performance (fixed effects in Table B1), heterogeneous but cross-sectionally independent tax performance (MG in Table B2), and heterogeneous and cross-sectionally dependent tax performance (CCEMG, and the two types of AMG in Tables B3–B5).[13] The fixed effects model includes country and year fixed effects.

Column 1 of each table includes strictly structural (economic) characteristics: the agriculture value added in GDP (*lnagric*), GDP per capita in constant 2010 US$ (*lngdppc*), the share of imports in GDP (*lnimports*), and the share of exports in GDP (*lnexports*). Column 2 includes the structural characteristics and grants (*lngrants*), column 3 includes structural characteristics, grants and loans (*lnloans*), and column 4 includes the structural variables and net aid (*lnaid*). Column 5 includes the economic variables and non-tax revenue (*lnnontax*), the latter of which may include resource revenues. Column 6 includes the structural variables and a more explicit measure of natural resource rents (*lnrents*). Column 7 includes the structural variables, measures of aid (grants and loans), and non-tax revenue, while column 8 includes the same set of variables from column 7 but replacing non-tax revenue with total resource rents.

Moving from Tables B1 to B5, we see that the variables have the expected signs but few are consistently significant. Agriculture is negatively associated with tax performance, while GDP per capita is positively associated with tax performance. Imports are also positively associated with tax performance. The aid variables—net aid, grants, and loans—are not robust across specifications although they tend to be positive whenever they are significant. Of the three aid variables, loans tend to be more robust across specifications. The measures of resource rents are also not robust across specifications. Whenever non-tax revenue is significant, it is positive: this would indicate that the component of resource revenue in non-tax revenue is marginal and the rest of the non-tax revenue is explained by revenue from state-owned enterprises and other sources. When resource rents are significant, they have a negative relationship with tax performance: confirming the political resource curse hypothesis in the sample of countries. In summary, most of the variables are not robust when we move from basic to more sophisticated regression frameworks.

[13] Homogeneity here mans the influence of structural variables on tax/GDP is the same across all countries in the model. Heterogeneity means the way the structural variables influence tax/GDP differs by country.

Table B1: Fixed effects (FE) estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
lnagric	-.039	-.04	-.018	-.044	-.055	-.006	-.03	.02
	(.149)	(.148)	(.142)	(.148)	(.155)	(.147)	(.154)	(.144)
lngdppc	.284	.349**	.255*	.335**	.257	.324*	.2	.235
	(.181)	(.165)	(.147)	(.165)	(.181)	(.16)	(.172)	(.141)
lnimport	.192*	.133	.156*	.137	.13	.152	.164*	.176**
	(.111)	(.098)	(.091)	(.099)	(.107)	(.092)	(.097)	(.082)
lnexport	-.132	-.116	-.096	-.118	-.146*	-.047	-.119	-.032
	(.088)	(.086)	(.087)	(.086)	(.086)	(.083)	(.089)	(.085)
lngrants		.075	.049		.062	.074	.041	.052
		(.045)	(.033)		(.043)	(.044)	(.033)	(.032)
lnloans			.063**				.061**	.058**
			(.027)				(.023)	(.027)
lnaid				.075				
				(.048)				
lnnontax					.099		.06	
					(.064)		(.049)	
lnrents						-.072***		-.069***
						(.017)		(.016)
_cons	.204	-.212	.223	-.134	.536	-.304	.681	.085
	(1.359)	(1.252)	(1.247)	(1.245)	(1.509)	(1.134)	(1.499)	(1.14)
Observations	1,264	1,250	1,229	1,248	1,177	1,240	1,156	1,219
R-squared	.232	.248	.322	.25	.289	.285	.342	.359
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	42	42	41	41	41	41	41	41

Note: robust standard errors are in parentheses. *** p<.01, ** p<.05, * p<.1. Dependent variable: log(non-resource tax/GDP)

Source: authors' calculcations.

Table B2: Mean group (MG) estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
lnagric	-.151**	-.167**	-.115*	-.128*	-.186***	-.205***	-.128**	-.161***
	(.072)	(.076)	(.061)	(.073)	(.067)	(.063)	(.05)	(.059)
lngdppc	.287**	.354**	.376**	.398***	.393***	.464***	.429***	.407***
	(.141)	(.146)	(.15)	(.143)	(.132)	(.157)	(.135)	(.147)
lnimport	.26***	.219**	.189**	.227***	.217***	.16*	.204***	.161**
	(.082)	(.086)	(.077)	(.087)	(.069)	(.088)	(.068)	(.073)
lnexport	-.126**	-.098*	-.105*	-.1*	-.09*	-.073	-.081	-.064
	(.055)	(.06)	(.058)	(.055)	(.052)	(.051)	(.053)	(.06)
lngrants		.02	-.007		.012	.017	-.009	-.004
		(.022)	(.023)		(.023)	(.025)	(.019)	(.022)
lnloans			.021				.009	.013
			(.015)				(.013)	(.012)
lnaid				.013				
				(.021)				
lnnontax					.014		.018	
					(.026)		(.022)	
lnrents						.013		.02
						(.036)		(.031)
_cons	.075	.121	-.078	-.542	-.375	-.569	-.496	-.536
	(1.077)	(1.145)	(1.124)	(1.145)	(1.099)	(.957)	(.969)	(.896)
Observations	1,256	1,242	1,216	1,240	1,169	1,232	1,135	1,198
RMSE	0.1529	0.1452	0.1253	0.1475	0.1172	0.1373	0.1043	0.1207
CD test	0.010	0.012	0.259	0.582	0.412	0.083	-0.099	0.025
N	39	39	38	39	39	39	37	37

Note: robust standard errors are in parentheses. *** p<.01, ** p<.05, * p<.1. Dependent variable: log(non-resource tax/GDP).

Source: authors' calculations.

Table B3: CCE mean group (CCEMG) estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
lnagric	-.094	-.102	-.134	-.132	-.097	-.094	-.125*	-.077
	(.091)	(.099)	(.083)	(.094)	(.072)	(.089)	(.075)	(.078)
lngdppc	.329	.247	.265*	.247	.344**	.338*	.306*	.356*
	(.227)	(.203)	(.154)	(.212)	(.174)	(.195)	(.163)	(.185)
lnimport	.107*	.097	.086	.074	.094	.094	.074	.052
	(.057)	(.063)	(.055)	(.06)	(.063)	(.06)	(.06)	(.057)
lnexport	-.051	-.078	-.045	-.015	-.061	.012	-.023	-.003
	(.056)	(.058)	(.067)	(.049)	(.041)	(.052)	(.055)	(.056)
lngrants		.015	-.006		.001	.013	-.004	-.005
		(.018)	(.018)		(.022)	(.019)	(.017)	(.018)
lnloans			.01				.013	.012
			(.011)				(.009)	(.01)
lnaid				.047*				
				(.026)				
lnnontax					.017		.021	
					(.018)		(.018)	
lnrents						-.034		-.022
						(.039)		(.034)
_cons	1.058	1.334	-.837	-.677	2.101	1.621	.874	-.659
	(1.905)	(1.957)	(1.592)	(2.006)	(1.935)	(1.903)	(1.684)	(1.368)
Observations	1,256	1,242	1,216	1,240	1,169	1,232	1,135	1,198
RMSE	0.1085	0.099	0.0841	0.0977	0.0781	0.0902	0.0713	0.0782
CD test	0.139	0.272	-1.471	-0.064	0.544	-0.253	-0.687	-1.513
N	39	39	38	39	39	39	37	37

Note: robust standard errors are in parentheses. *** p<.01, ** p<.05, * p<.1. Dependent variable: log(non-resource tax/GDP).

Source: authors' calculations.

Table B4: Augmented mean group (AMG) estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
lnagric	-.153*	-.145*	-.131**	-.13*	-.172***	-.197***	-.136**	-.142**
	(.079)	(.081)	(.061)	(.071)	(.066)	(.07)	(.06)	(.067)
lngdppc	.18	.28**	.289**	.294**	.246*	.411***	.3**	.364**
	(.146)	(.14)	(.142)	(.139)	(.134)	(.135)	(.142)	(.146)
lnimport	.191***	.156**	.151**	.126*	.161***	.142**	.146**	.147**
	(.073)	(.069)	(.06)	(.065)	(.06)	(.066)	(.058)	(.06)
lnexport	-.08*	-.097**	-.068	-.067	-.047	-.028	-.023	-.029
	(.047)	(.046)	(.052)	(.047)	(.046)	(.046)	(.05)	(.053)
lngrants		.021	-.006		.013	.023	-.003	.002
		(.023)	(.021)		(.023)	(.023)	(.016)	(.019)
lnloans			.023*				.008	.022**
			(.014)				(.013)	(.011)
lnaid				.028				
				(.024)				
lnnontax					.03		.023	
					(.022)		(.016)	
lnrents						-.015		-.057*
						(.035)		(.032)
_cons	.537	.574	.277	.025	.34	-.285	-.233	-.126
	(1.163)	(1.093)	(1.102)	(1.122)	(1.113)	(.93)	(1.096)	(.995)
Observations	1,256	1,242	1,208	1,240	1,161	1,224	1,135	1,198
RMSE	0.1471	0.1400	0.1195	0.1420	0.1107	0.1319	0.0979	0.1130
CD test	-1.695	-1.630	-1.874	-1.172	-1.188	-1.106	-1.825	-1.352
N	39	39	37	39	38	38	37	37

Note: robust standard errors are in parentheses. *** p<.01, ** p<.05, * p<.1. Dependent variable: log(non-resource tax/GDP).

Source: authors' calculations.

Table B5: Unit-imposed augmented mean group (uAMG) estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
lnagric	-.13**	-.144**	-.079	-.102*	-.155***	-.156***	-.092*	-.124**
	(.059)	(.068)	(.057)	(.06)	(.06)	(.058)	(.049)	(.057)
lngdppc	.135	.242*	.265*	.241*	.219*	.323**	.233*	.259*
	(.126)	(.141)	(.146)	(.143)	(.126)	(.161)	(.131)	(.151)
lnimport	.215***	.208**	.174**	.189**	.157**	.149*	.188***	.137*
	(.076)	(.085)	(.075)	(.083)	(.068)	(.088)	(.067)	(.076)
lnexport	-.076	-.04	-.042	-.073	-.036	-.026	-.022	-.009
	(.055)	(.06)	(.061)	(.054)	(.056)	(.051)	(.052)	(.056)
lngrants		.027	-.003		.02	.02	-.003	-.003
		(.022)	(.022)		(.022)	(.023)	(.018)	(.022)
lnloans			.024*				.012	.017
			(.014)				(.012)	(.011)
lnaid				.028				
				(.021)				
lnnontax					.023		.011	
					(.026)		(.02)	
lnrents						-.015		-.009
						(.032)		(.027)
_cons	1.063	.608	.407	.19	.808	.021	.914	.113
	(.988)	(1.112)	(1.064)	(1.15)	(1.027)	(.98)	(.837)	(1.04)
Observations	1,256	1,242	1,216	1,240	1,169	1,232	1,135	1,198
RMSE	0.1510	0.1443	0.1236	0.1459	0.1150	0.1363	0.1022	0.1187
CD test	0.809	1.375	-0.635	1.456	1.395	2.084	-0.761	-0.527
N	39	39	38	39	39	39	37	37

Note: robust standard errors are in parentheses. *** p<.01, ** p<.05, * p<.1. Dependent variable: log(non-resource tax/GDP).

Source: authors' calculations.