ONLINE APPENDIX

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

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Appendix A

This appendix includes additional econometric analysis, details on the sample and summary statistics, and plots showing trends and variance over time for all main variables.

A1   Estimates of performance and determinants of tax efficiency

Equation (1) in the text 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, 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).

Table A1: 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^2	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; and UnAMG – Unit-imposed Augmented Mean Group (Eberhardt and Bond 2013). Robust standard errors in parentheses (***p<0.01, ** p<0.05, * p<0.1).

Source: authors' calculations (detailed results in Tagem and Morrissey [2021]).

Table A1 reports the results of estimating Equation (1) with the four robust variables using five estimators (results for estimating the full specification are available in Tagem and Morrissey 2021). The MG estimator is preferred to the FE estimator because it allows for cross-country heterogeneity, and to the CCEMG and AMG estimators because it is efficient with fewer degrees of freedom (they are more demanding of the data). The results for MG (column 2) show that all four variables are significant, but only GDP per capita and the share of imports in GDP are positive determinants of tax/GDP. The negative coefficient on agriculture is consistent with expectations. The negative coefficient on exports may be because 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 is the only significant variable for all estimators, and MG is the only estimator for which all 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 (reductions in tariffs and declining importance of trade taxes in SSA is largely due to donor influence and trade agreements). Robustness checks confine the analysis to the 1990s onwards, given that major reduction in tariffs had been achieved by the early 1990s (imports are strongly significant in most cases), and include private (household) consumption to account for the importance of VAT (and the sales tax before that) in total revenue (consistently insignificant). 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 A1, we generate potential tax revenue P from which we obtain T/P as the measure of performance efficiency (E), the trend component of which is our measure of C.

Table A2: Selected determinants of tax efficiency (E)

Independent variables	Coefficients (*t*-statistics)
Private consumption (% GDP)	0.260*** (11.30)
Resource rents (% GDP)	0.021*** (7.45)
Equal distribution of resources	0.002*** (7.40)
Political corruption index	-0.002***(-8.82)
Diagnostics	
Adjusted R^2	0.26
F-statistic (*p*-value)	65.09 [0.00]
Observations	929
N (countries)	39

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

Source: authors' calculations.

Table A3: General specification of determinants of tax efficiency (E)

Independent variables	*t*-statistics
Private consumption (% GDP)	12.83***
Resource rents (% GDP)	5.67***
Non-tax revenue (% GDP)	3.64***
Equal distribution of resources	6.29***
Political corruption	-10.30***
Horizontal accountability	4.43***
Diagonal accountability	5.76***
Egalitarian democracy	-5.45***
Electoral democracy	-2.68***
Deliberative democracy	6.02***
Diagnostics	
Adjusted R^2	0.42
F-statistic (*p*-value)	50.59 [0.00]
Observations	872
N (countries)	39

Note: as for Table A2.

Source: authors' calculations.

Section 5.2 in the paper presents the general-to-specific estimates of the main variables associated with cross-country variation in C. As noted, the correlation between E and C is very high, at 0.96, indicating that on average countries are close to their (structural) potential; although deviations are clear in Figure below, it is not surprising that determinants are the same. This is shown in Table A2 (corresponding to Table 1 for C): the same four variables are significant with almost identical coefficients. Almost all variables associated with variation in C (Table 2) are also significant in a general specification of determinants of E (Table A3) with the same sign. The only notable difference is that vertical accountability is now insignificant; the positive coefficients tend to be somewhat lower whereas the negative coefficients are greater.

Table A4: Main determinants of revenue capacity

Independent variables	Coefficients (t-statistics)
Private consumption (% GDP)	0.186*** (6.17)
Resource rents (% GDP)	0.046***(9.01)
Nontax revenue (% GDP)	0.056***(6.41)
Aid (% GDP)	0.049***(7.32)
Vertical accountability	-0.003***(-4.82)
Equal distribution of resources	0.002*** (5.64)
Diagnostics	
Adjusted R^2	0.19
F-statistic (*p*-value)	56.27 [0.00]
Observations	879
N (countries)	39

Note: as for Table A2.

Source: authors' calculations.

As a final test, the variables associated with cross-country variation in *C* measured for total *revenue* are estimated. There are differences in determinants of revenue capacity compared to tax capacity. Regarding the main determinants, political corruption is not significant but vertical accountability is significant and negative (as this captures how government is held accountable through political processes it is likely to be lower when corruption is higher and may pick up effects associated with corruption, hence the negative sign); NTR and aid are both positive and significant (Table A4). Recall that this is not indicating association with higher revenue – likely for NTR (included) but aid is not included as revenue – but rather that access to alternative resources appears to increase capacity, as found for tax. In the general specification, none of the accountability variables are significant; of the democracy variables, liberal becomes significant (positive), participatory remains insignificant, and the others remain significant (egalitarian and electoral with negative coefficients, consistent with result for vertical accountability); exports (negative, suggesting it may capture resources and corruption) and aid grants (positive) are significant for revenue capacity (Table A5).

Table A5: General specification of determinants of revenue capacity

Independent variables	t-statistics
Exports (% GDP)	-7.50***
Resource rents (% GDP)	9.26***
Nontax revenue (% GDP)	7.24***
Private consumption (% GDP)	2.58*
Grants (% GDP)	7.38***
Equal distribution of resources (% GDP)	8.80***
Political corruption index (% GDP)	3.58***
Egalitatian democracy	-7.69***
Electoral democracy	-2.45***
Liberal democracy	3.70***
Deliberative democracy	5.42***
Diagnostics	
Adjusted R^2	0.33
F-statistic (*p*-value)	44.70 [0.00]
Observations	877
N (countries)	39

Note: as for Table A2.

Source: authors' calculations.

A2   Sample and summary statistics

Table A6 provides summary statistics averaged over all countries and the whole period to show the extent of variation (notably high standard deviations) and sample sizes. This is elaborated in Table A7 which lists the 39 countries in the sample and indicates the classification as LICs/non-LICs and RR/non-RR with mean values of tax/GDP and capacity for the two periods, and also Table A8 with all variables for the two groups and periods.

Table A6: Overall summary statistics

Variable	Mean	Std. dev.	Min.	Max.	*N*
Total revenue	17.37	10.52	0.68	65.15	1,634
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 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	36.48	23.52	1.10	100	1,487
Deliberative democracy	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: 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 (Coppedge et al. 2020), and the World Development Indicators (World Bank 2020).

Table A7: Summary statistics for tax and capacity by period and country groups

	LICs (N=18)				Non-LICs (N=21)				RR (N=20)				Non-RR (N=19)			
	1985-2001		2002-2018		1985-2001		2002-2018		1985-2001		2002-2018		1985-2001		2002-2018	
	Tax	C	Tax	C	Tax	C	Tax	C	Tax	C	Tax	C	Tax	C	Tax	C
Angola					5.64	0.69	6.96	0.72	5.64	0.69	6.96	0.72				
Benin	7.77	0.99	10.64	1.06									7.77	0.99	10.64	1.06
Botswana					12.03	0.91	19.51	0.98					12.03	0.91	19.51	0.98
Burkina Faso	8.49	1.07	12.35	1.15					8.49	1.07	12.35	1.15				
Burundi	14.27	1.45	13.21	1.35					14.27	1.45	13.21	1.35				
Cameroon					8.90	0.98	11.29	1.03	8.90	0.98	11.29	1.03			19.03	1.07
Cape Verde					13.39	1.04	19.03	1.07					13.39	1.04		
Chad	5.19	0.80	5.45	0.78					5.19	0.80	5.45	0.78				
Comoros					6.75	0.88	7.03	0.85					6.75	0.88	7.03	0.85
Congo, Democratic Republic of the	4.39	0.10	7.45	0.89					4.39	0.10	7.45	0.89				
Congo, Republic of the					10.68	0.95	9.84	0.81	10.68	0.95	9.84	0.81				
Cote d'Ivoire					12.34	1.13	10.31	1.00					12.34	1.13	10.31	1.00
Equatorial Guinea					9.85		2.01	0.21	9.85		2.01	0.21				
Eswatini					19.30	1.13	24.12	1.17					19.30	1.13	24.12	1.17
Ethiopia	8.53		11.31	1.18					8.53		11.31	1.18				
Gabon					11.58	0.89	11.69	0.87					11.58	0.89	11.69	0.87
Gambia	7.48	0.90	9.03	0.99					7.48	0.90	9.03	0.99				
Guinea	3.97	0.62	8.63	0.92					3.97	0.62	8.63	0.92				
Guinea-Bissau	4.91	0.76	6.68	0.90					4.91	0.76	6.68	0.90				
Kenya					14.38	1.27	15.61	1.22					14.38	1.27	15.61	1.22
Lesotho					35.88		41.90	1.34					35.88		41.90	1.34
Madagascar	7.99	1.06	8.96	1.03									7.99	1.06	8.96	1.03
Malawi	8.23	1.06	13.45	1.21					8.23	1.06	13.45	1.21				
Mauritania					13.66	1.16	13.24	1.05	13.66	1.16	13.24	1.05				
Mauritius					16.94	10.40	17.14	0.95					16.94	10.40	17.14	0.95
Mozambique	7.19	0.99	14.49	1.16					7.19	0.99	14.49	1.16				
Namibia					25.86	1.23	27.89	1.20					25.86	1.23	27.89	1.20
Niger	5.19	0.86	8.04	1.03					5.19	0.86	8.04	1.03				

	LICs (1985–2001)		LICs (2002–18)		non-LICs (1985–2001)		non-LICs (2002–18)		RR (1985–2001)		RR (2002–18)		non-RR (1985–2001)		non-RR (2002–18)	
	Tax	C	Tax	C	Tax	C	Tax	C	Tax	C	Tax	C	Tax	C	Tax	C
Rwanda	9.45	1.15	13.02	1.21									9.45	1.15	13.02	1.21
Senegal					11.34	1.06	14.66	1.11					11.34	1.06	14.66	1.11
Seychelles					31.58	1.12	28.65	1.03					31.58	1.12	28.65	1.03
Sierra Leone	5.72	0.90	8.96	1.06									5.72	0.90	8.96	1.06
South Africa					24.41	1.21	27.35	1.15	24.41	1.21	27.35	1.15				
Sudan					6.34	0.98	5.64	0.81					6.34	0.98	5.64	0.81
Tanzania	7.79	1.06	9.69	1.05									7.79	1.06	9.69	1.05
Togo	11.15	1.13	15.27	1.21									11.15	1.13	15.27	1.21
Uganda	6.08	0.93	9.37	1.05					6.08	0.93	9.37	1.05				
Zambia					15.54	1.25	13.67	1.08	15.54	1.25	13.67	1.08				
Zimbabwe					22.51	1.37	14.86	1.03	22.51	1.37	14.86	1.03				
C < 1 (%)		58		27		37		38		61		35		33		26
Tax and C increase (%) in 2002-18 vs 1985-2001				72				29				55				37

Note: classification is according to the World Bank; abbreviations are: LICs – low-income countries; non-LICs – middle-income countries; RR – resource rich countries; non-RR – resource poor countries. Means of non-resource tax/GDP (*Tax*) and tax capacity (*C*) for two periods, 1985–2001 and 2002–18, are reported. Each country has statistics based on their classification. For example, Benin falls under LICs and non-RR.

Source: World Bank classifications.

Some observations on Table A7 are warranted. First, three countries only enter the sample with observations for tax and C in the second period: Equatorial Guinea (non-LIC RR), Ethiopia (LIC RR) and Lesotho (non-LIC non-RR) – all are excluded from measures of the percentage with *C*<1 or that improved in the second period. Second, three countries have extreme values in one period: Congo DR (LIC RR, 1985-2001), Equatorial Guinea (non-LIC RR, 2002-18), and Mauritius (non-LIC non-RR, 1985-2001). Sudan was affected by the creation of South Sudan (hence why classed as non-RR) so comparing the two periods is not fully justified. While these countries do affect the unweighted means, they do not have undue influence on the estimations. Third, of the six non-LICs where performance deteriorated (lower *C* and tax), four are RR (Congo Rep., Mauritania, Zambia and Zimbabwe). While *C* declined in some LICs in the 2000s, such as Chad and Madagascar, Burundi was the only LIC (RR) with a decline in *C* and tax. The general pattern is clear: a clear majority of LICs (72%) improved *C* and tax by the 2000s, whereas only 29% of non-LICs improved; a slight majority of RR improved (55%) but only 37% of non-RR. However, most non-LICs with a decline in *C* and tax were RR.

Table A8: Mean differences of core variables by country groups

Variables	Groups of countries									
	LICs (N=18)		non-LICs (N=21)			RR (N=20)		non-RR (N=19)		
	mean	sd	mean	sd	p-value	mean	sd	mean	sd	p-value
Revenue/GDP	10.79	3.89	22.80	10.99	0.00***	15.37	8.75	19.54	11.60	0.00***
Tax/GDP	8.91	3.93	15.86	8.92	0.00***	10.27	5.76	15.06	8.72	0.00***
Tax capacity	1.01	0.21	1.03	0.20	0.18	0.98	0.26	1.06	0.13	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: based on the 39 countries; 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. Recall that we use non-resource tax/GDP for tax/GDP and distinguish this from (total) revenue. For most countries without significant resource wealth, both variables are very similar, and revenue is the sum of tax and NTR. For countries with significant resource wealth, such as Angola, the difference is large. As the means in Table A8 average over the whole period and the groups combine different types (LICs and non-LICs are each a mixture of RR and non-RR and vice-versa), the sum of tax and NTR does not equal total revenue.

Source: authors' calculations.

As noted above, the correlation between C and E is very high. However, the correlation between C and tax/GDP is a much lower 0.59 (for E and tax it is 0.61), consistent with our finding that determinants of performance (above) differ from those for efficiency and capacity. Table A9 presents correlations of variables found to be significant in the general specification of determinants of C. The correlations are consistent with equity supporting capacity and being positively correlated with accountability, suggesting that the perception of equitable distribution has an enhanced effect on capacity where accountability is greater. All variables except aid are negatively correlated with private consumption and all except aid and NTR with resource rents, while political corruption is negatively correlated with all institutional variables; this may simply indicate that governance indicators tend to be lower where consumption, corruption or resources are higher. The egalitarian and electoral democracy indices are both negatively associated with tax capacity in Table 2 of the paper (deliberative is positive and significant) and, as could be expected, all democracy indicators are positively correlated with equity. This suggests that it is elements of democracy, rather than democracy *per se*, that have indirect effects on capacity: egalitarian incorporates equity, electoral promotes accountability whereas deliberative captures aspects of process correlated with equity. Equitable distribution is the principal factor, but more accountable processes are associated with higher tax capacity.

Table A9: 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: figures in **bold** represent correlations that are greater than or equal to 0.5; ***, **, * indicate significance at 1%, 5%, and 10%, respectively.

Source: authors' calculations.

The V-Dem variables are reported according to various scales and ranges so for consistency we rescale their ranges to lie between 0 and 100. For example, vertical accountability ranges from -5 to 5 so is rescaled such that it ranges from 0 to 100, lower values representing lower vertical accountability. Thus, a country rated -5 (5) in any year will appear as 0 (100) in our data, hence why some maxima are 100 and some minima 0. For clarity we provide definitions of the variables used from the V-Dem codebook (Coppedge *et al.* 2020). Electoral democracy aims to capture the responsive of rulers to citizens through free and fair electoral competition and suffrage: '[it] is understood as an essential element of any other conception of representative democracy' (p 42). It is incorporated in the other V-Dem indicators (pp 42-4): Liberal (protection of civil rights through rule of law and checks and balances); Participatory (ability of citizens to participate in all political processes); Deliberative (openness in which decisions are reached); and Egalitarian (protecting rights and freedoms of individuals, distributing resources equally and equal access to power).

The equal distribution of resources index, part of the Egalitarian Democracy index, incorporates measures of public goods provision and equity in health and education with the aim of capturing 'not only measures of poverty and the distribution of goods and services, but also the levels of inequality in these distributions, and the proportion of the population who are not eligible for social services' (p 54). Vertical accountability captures the ability to hold government accountable through elections and political parties; horizontal accountability captures legislative and regulatory checks on the behaviour of government; and diagonal accountability captures the oversight role and freedom of civil society and media (pp 268-70). The political corruption index (p 279) includes measures of corruption at all levels including executive, legislative and judicial; we rescale so that higher values indicate more corruption.

A3 Plots of trends and variations in core variables

Figures A1–A3 report the trends in means of tax/GDP, total revenue/GDP, C and E for the 39 countries since 1980 (1985 for of C and E) and separates LICs and non-LICs, repeating Figure 1 in the text. Figure A1 shows that average tax and revenue follow a similar pattern over time, both declining from the mid-1980s to mid-1990s, followed by gradual growth until early 2000s and more rapid growth thereafter. Trends in C and E follow similar patterns to each other and broadly follow the trend in tax. The differences between LICs and non-LICs are clear: Figure A2 shows the lower tax levels for LICs with a strong increase and improvement in C and E from about 2000. In the

case of non-LICs (Figure A3) tax declines from the mid-1980s to 2000, then increases slowly; C declines to below 1.0 in the 2000s and does not get back above 1.0 until 2018.

Figures A4 and A5 add comparison of resource rich (RR) and non-RR countries. Broad patterns are similar and both groups exhibit considerable volatility: RR have significantly lower tax but once resource revenues are included both groups have similar total revenue; RR have lower C and E, generally below 1.0, and both groups show improvement after about 2008. The rest of the appendix presents figures with various data plots.

Figure A1: Average revenue/GDP ratio, tax/GDP ratio and tax capacity trend, SSA 1980–2018
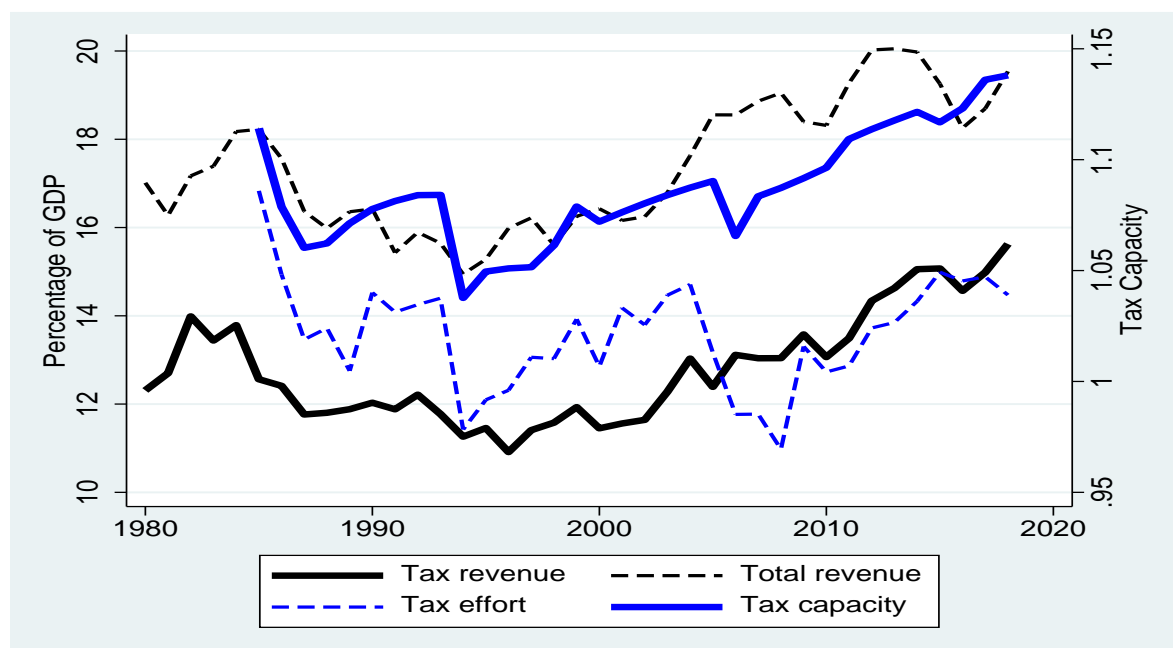
Figure A2: Average revenue/GDP ratio, tax/GDP ratio and tax capacity trend in low-income countries, SSA 1980–2018
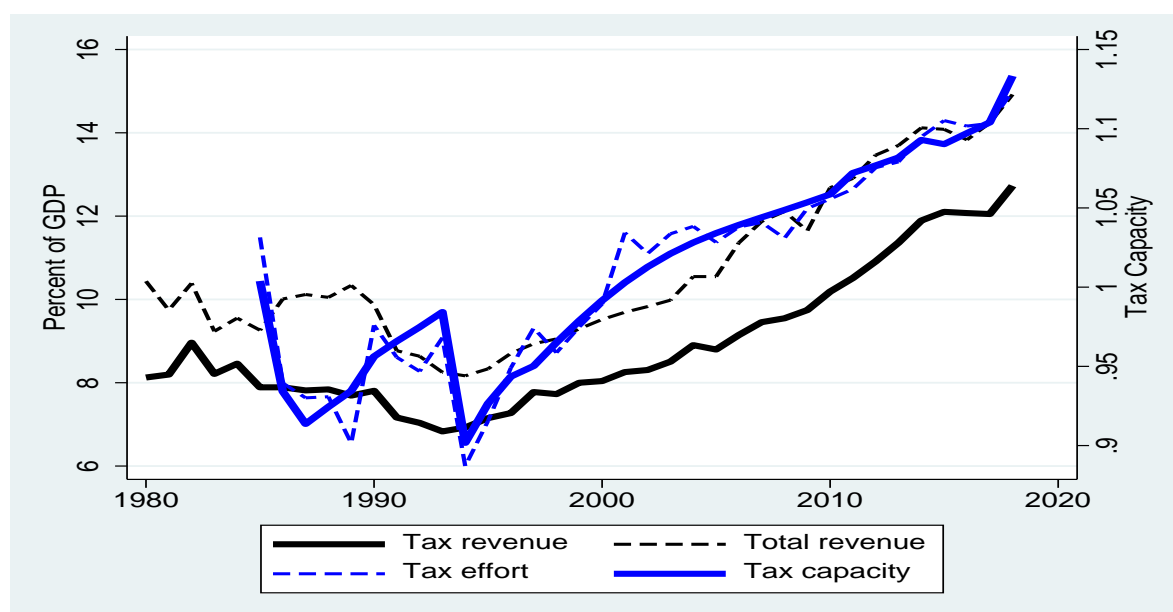
Figure A3: Average revenue/GDP ratio, tax/GDP ratio and tax capacity trend in non-low-income countries, SSA 1980–2018
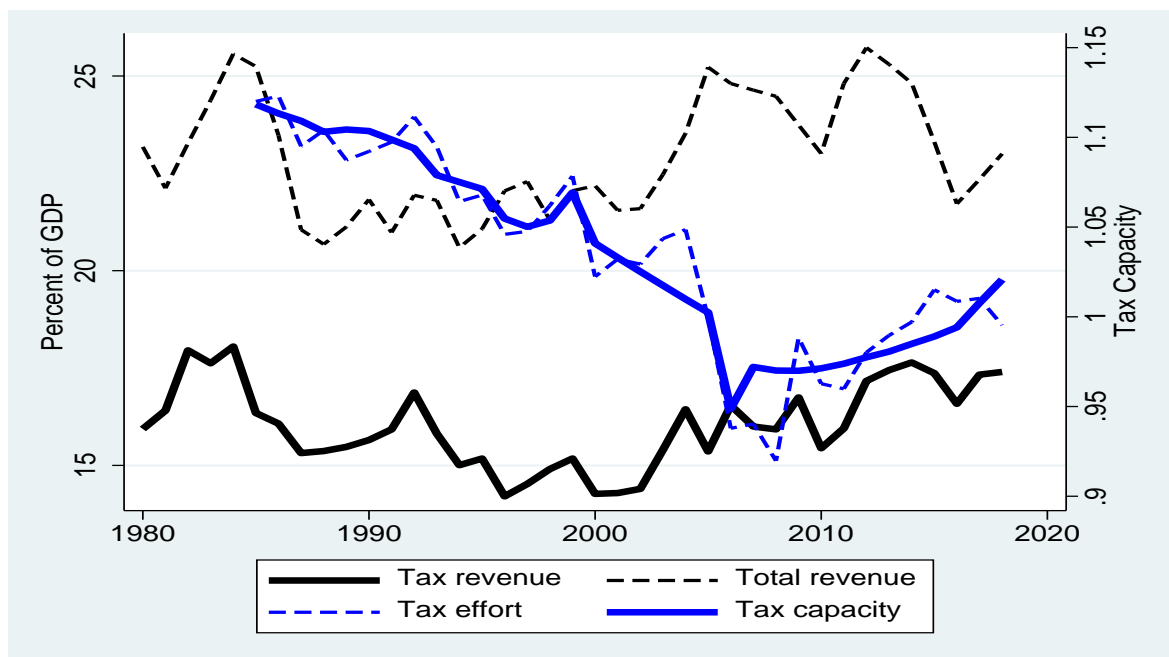
Figure A4: Average revenue/GDP ratio, tax/GDP ratio and tax capacity trend in resource-rich countries, SSA 1980–2018
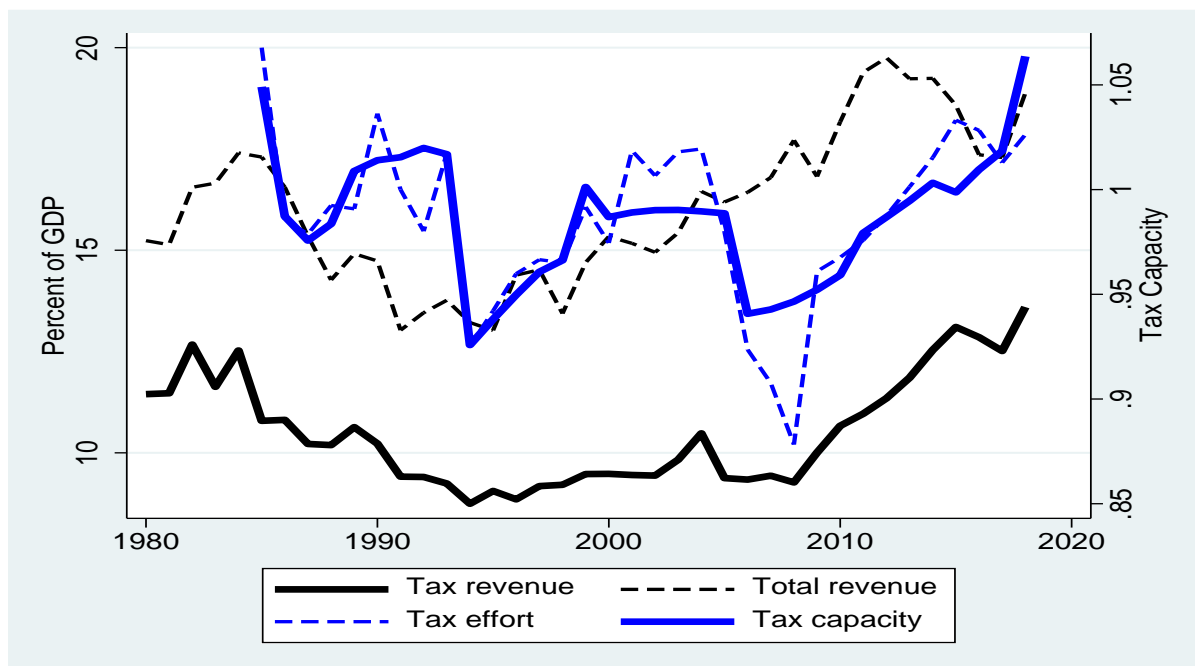
Figure A5: Average revenue/GDP ratio, tax/GDP ratio and tax capacity trend in non-resource-rich countries, SSA 1980–2018
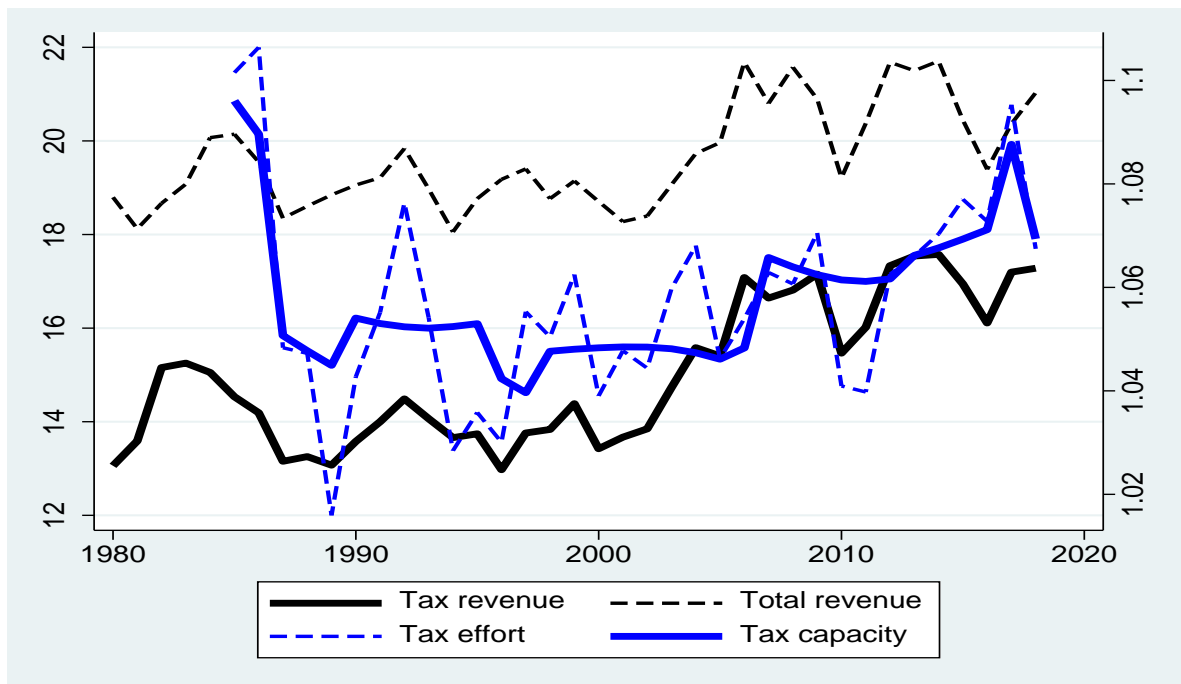
Source (all figures): authors' construction.

Appendix B: Evolution of performance and capacity ratios

This Appendix elaborates on Figures A1-A3 by reporting the trends in means of tax/GDP, total revenue/GDP, C and E for the 39 countries since 1980 (1985 for of C and E) and illustrating the variation using three-year and five-year box and whiskers plots. Separate trends are provided comparing LICs and non-LICs, and for resource rich (RR) and non-RR countries.

Figure B1 (three-year averages, and B11 for five-year averages) shows that average tax and revenue, both as shares of GDP, declined until the early 2000s, then increased so that the mean level of the early 1980s was not exceeded until after 2010. On average, revenue was only slightly greater than tax, but more variable (across countries over time). Figure B2 (B12) shows that Capacity on average was above 1.0 but variable over time (lowest in early 90s and around 2009) with no clear trend. Figure B3 (B13) shows that trends in E follow similar patterns.

Figure B3 (B13) shows that tax is lower in LICs but has been gradually improving, whereas for non-LICs tax moves around 15% of GDP, so that the gap declined from around 10 percentage points in the early 1980s to about five percentage points by 2015. Figure B4 (B14) shows a similar pattern for total revenue, except that the level for non-LICs is higher (moves around 20% on average). Figure B5 (B15) shows that for LICs C was below 1.0 until the mid-1990s and greater than 1.0 since the late 90s, whereas for non-LICs C was greater than 1.0 until the early 2000s and around 1.0 thereafter (rising by 2015). Figure B6 (B16) shows the pattern for efficiency was similar.

Figure B7 (B17) shows that RR had lower tax than non-RR countries although the gap declined slightly: for RR, tax varies around 10% of GDP, declining until the mid-1990s and above 10% since about 2010; for non-RR, tax was variable above 10% and has been over 15% since around 2010. Figure B8 (B18) shows that total revenue is slightly lower for RR, but the gap is small and non-RR is more variable, and both groups exhibit a fairly flat U-shaped trend. Figure B9 (B19) shows that RR have lower C, generally around 1.0 until about 2010, whereas for non-RR it is above 1.0 but with an irregular downward trend. Figure B10 (B20) demonstrates the same pattern for efficiency.

Three-year averages

Figure B1: Tax and Total Revenue Ratios, 1985-2018
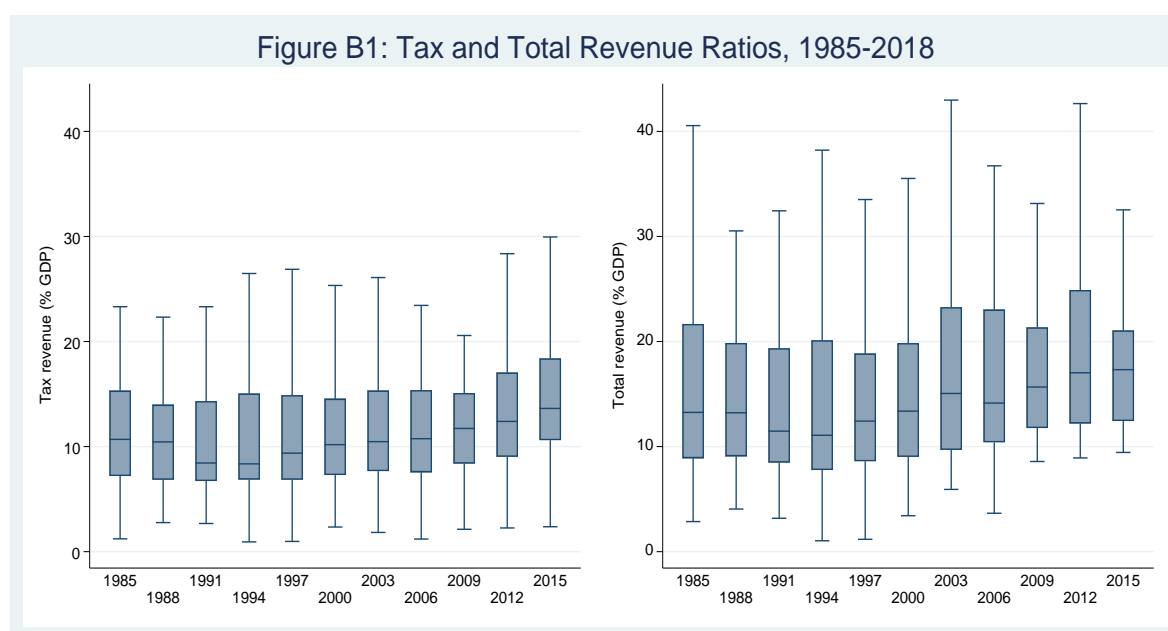
Figure B2: Tax Capacity Indicators, 1985-2018

Tax Efficiency
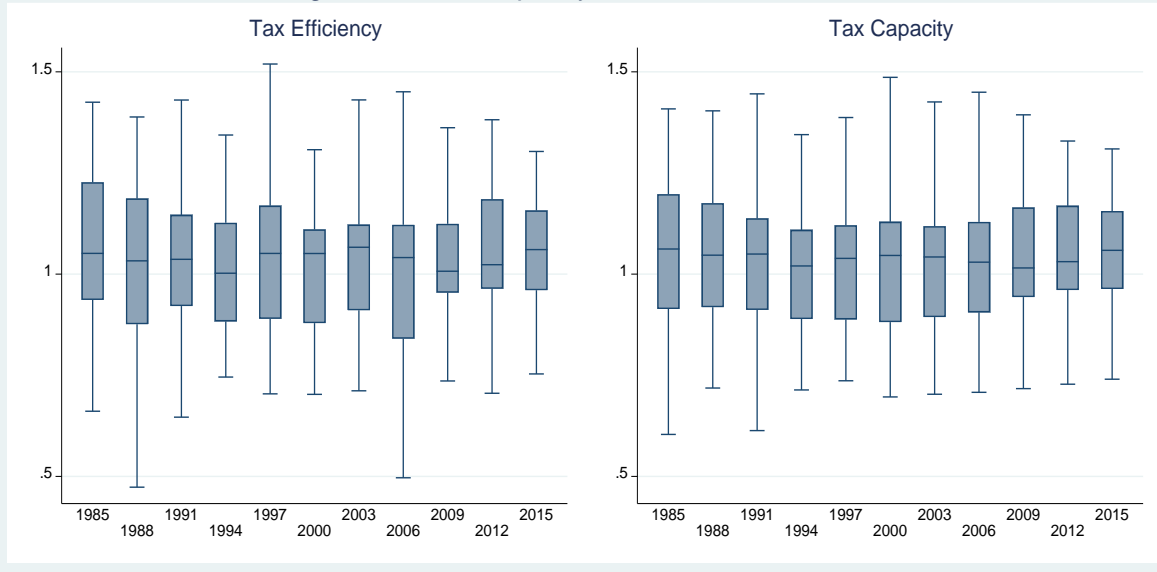
Tax Capacity

Figure B3: Tax Performance by Level of Development, 1985-2018

LICs

Non-LICs

15
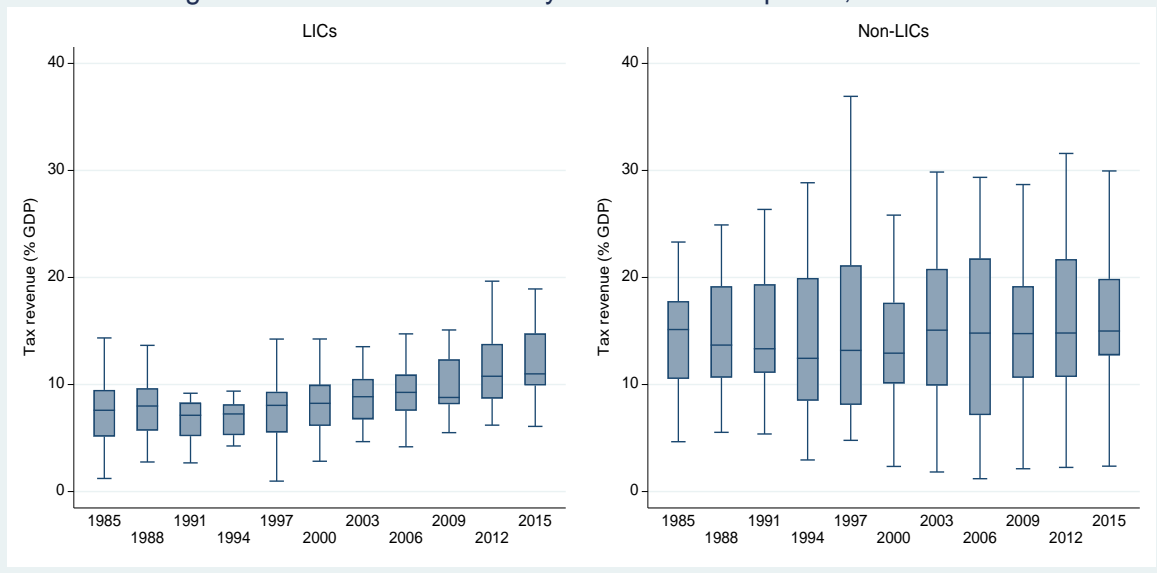
Figure B4: Revenue Performance by Level of Development, 1985-2018
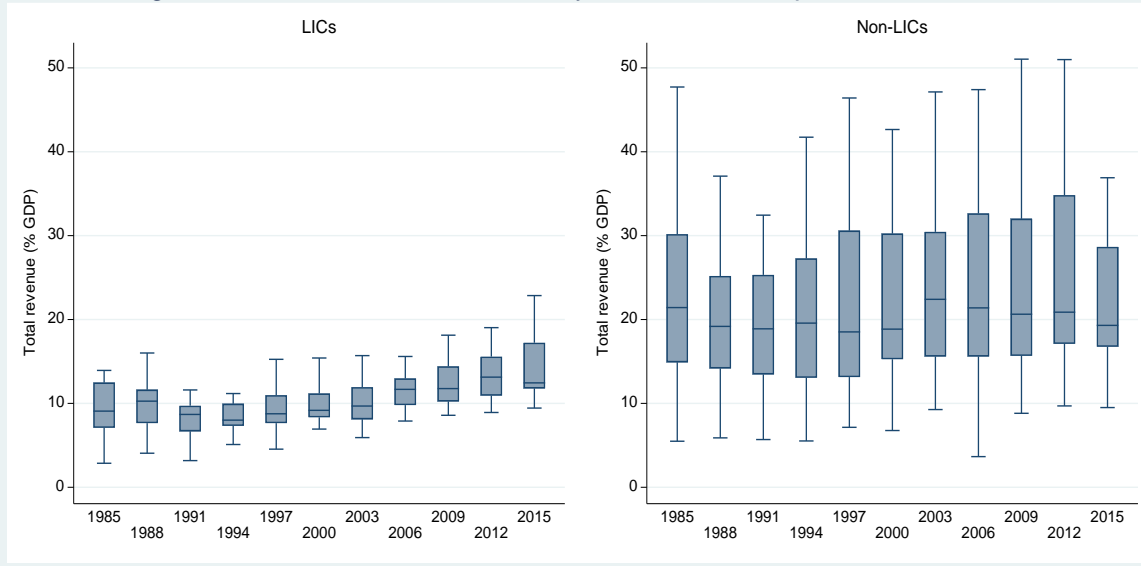
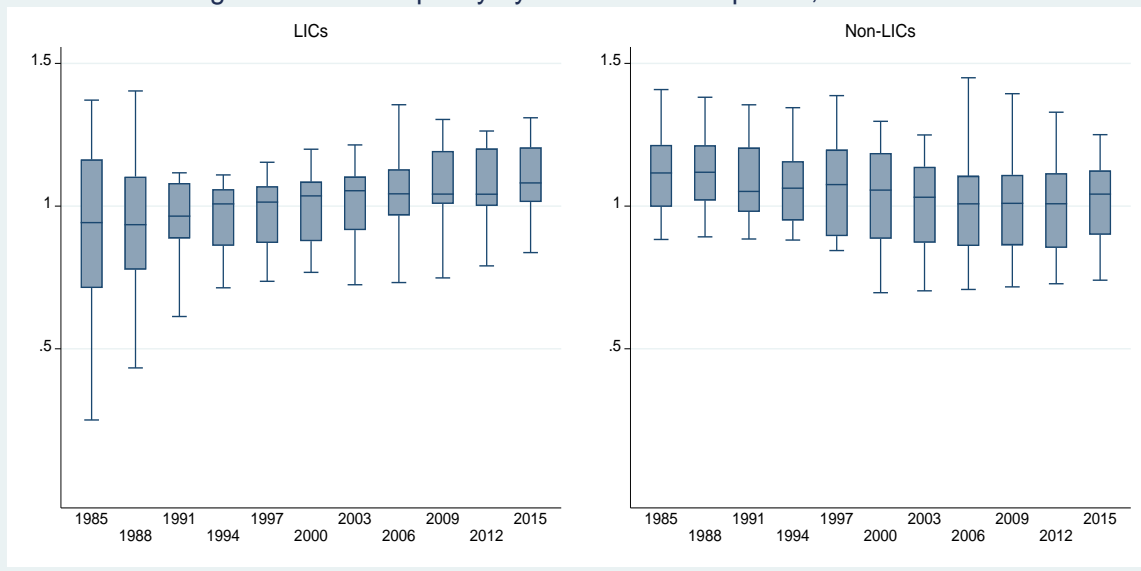Figure B5: Tax Capacity by Level of Development, 1985-2018

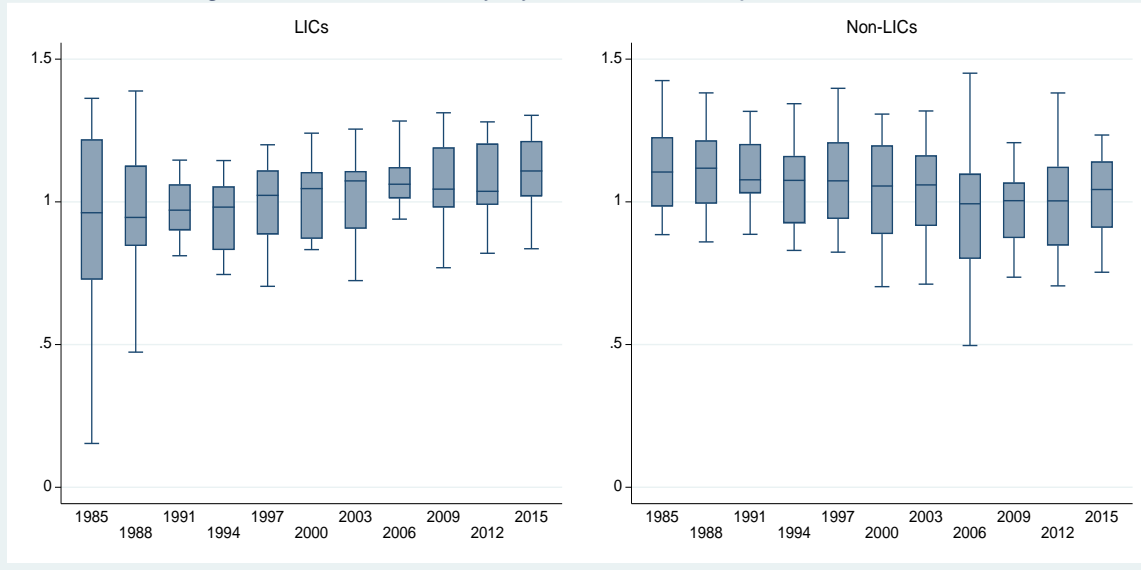Figure B6: Tax Efficiency by Level of Development, 1985-2018

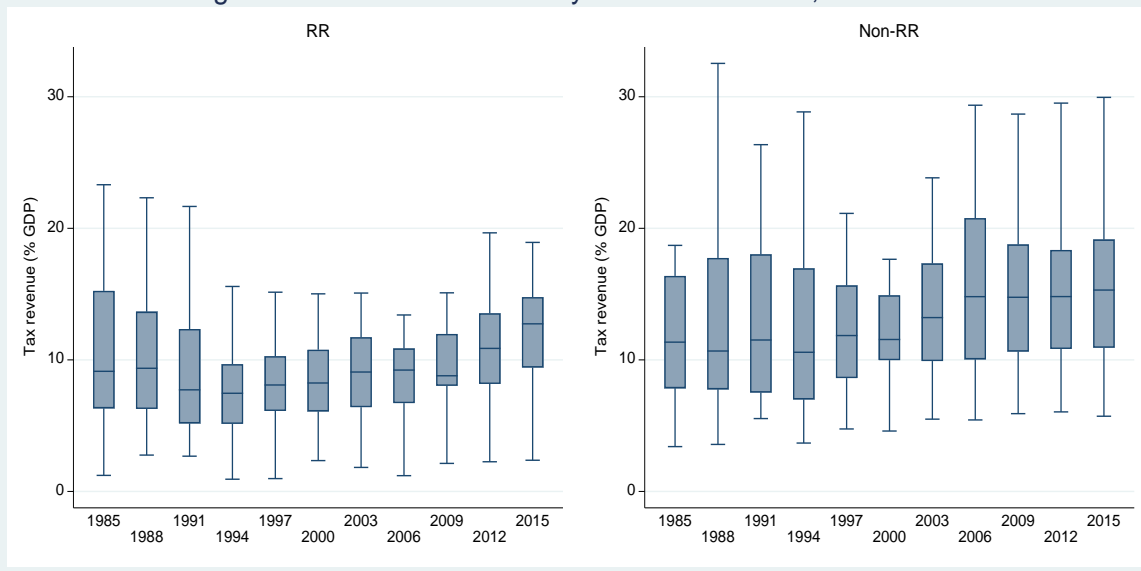Figure B7: Tax Performance by Resource Wealth, 1985-2018
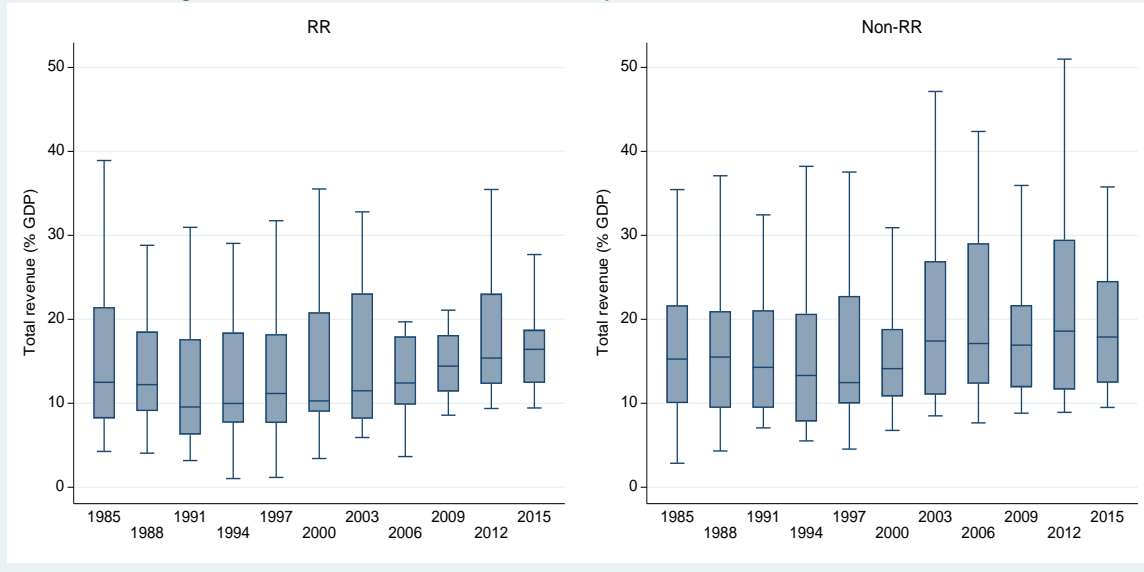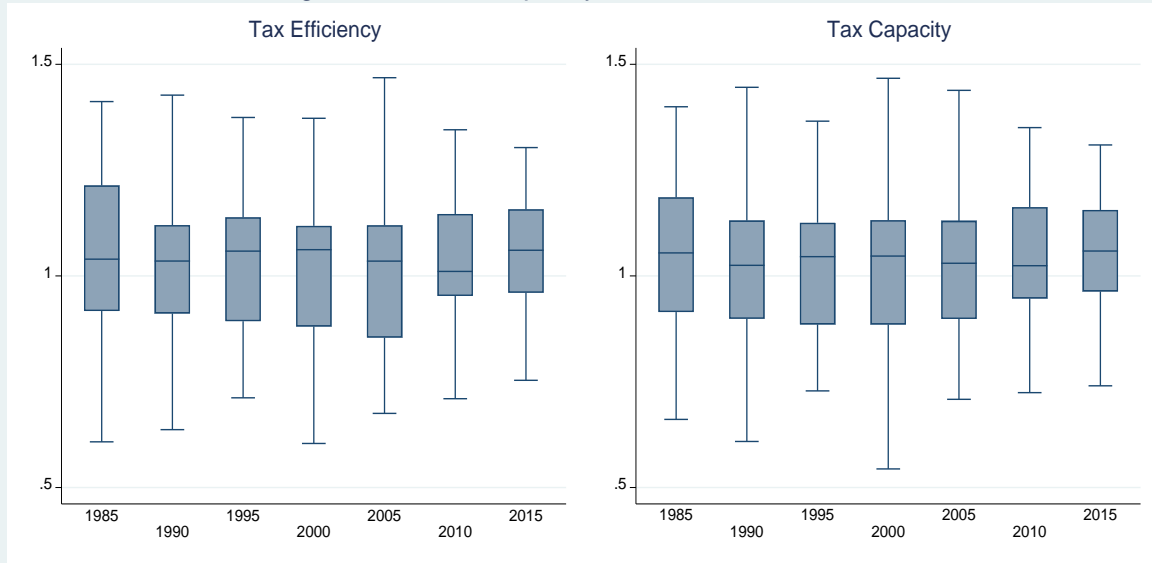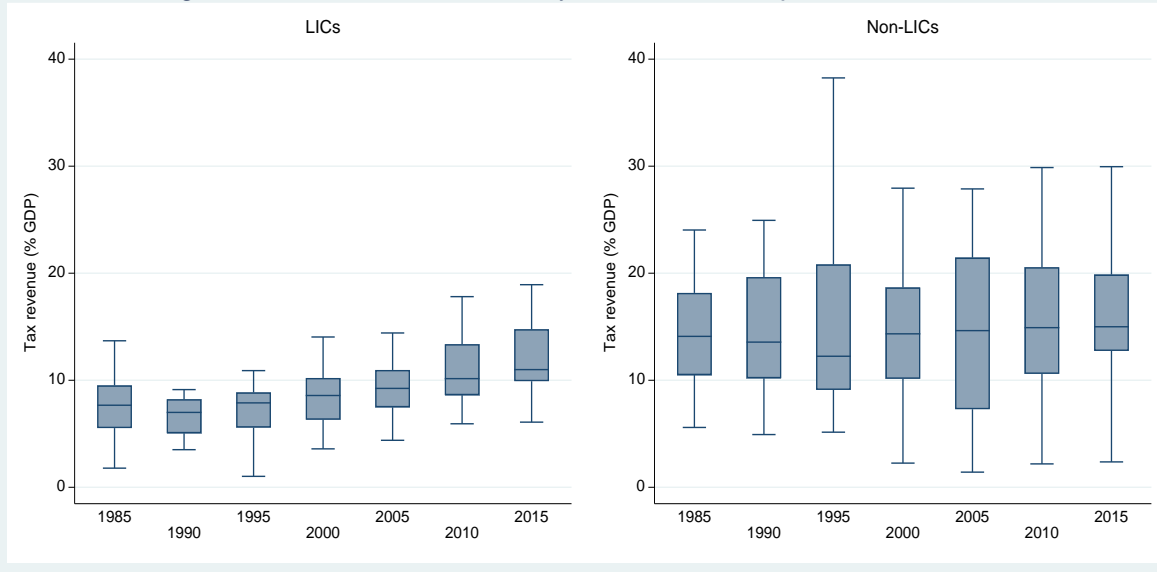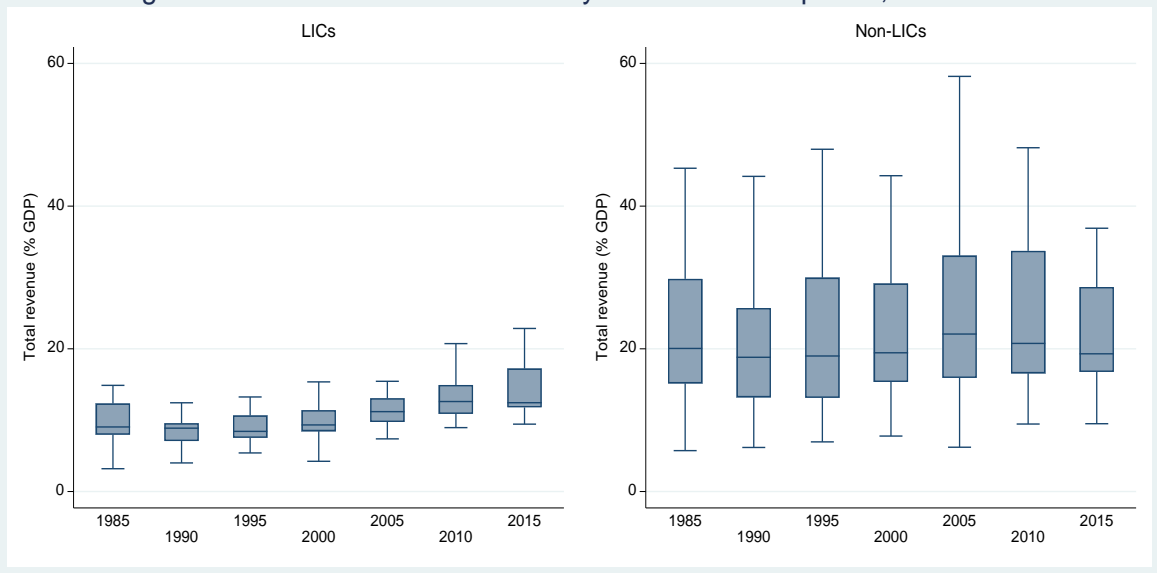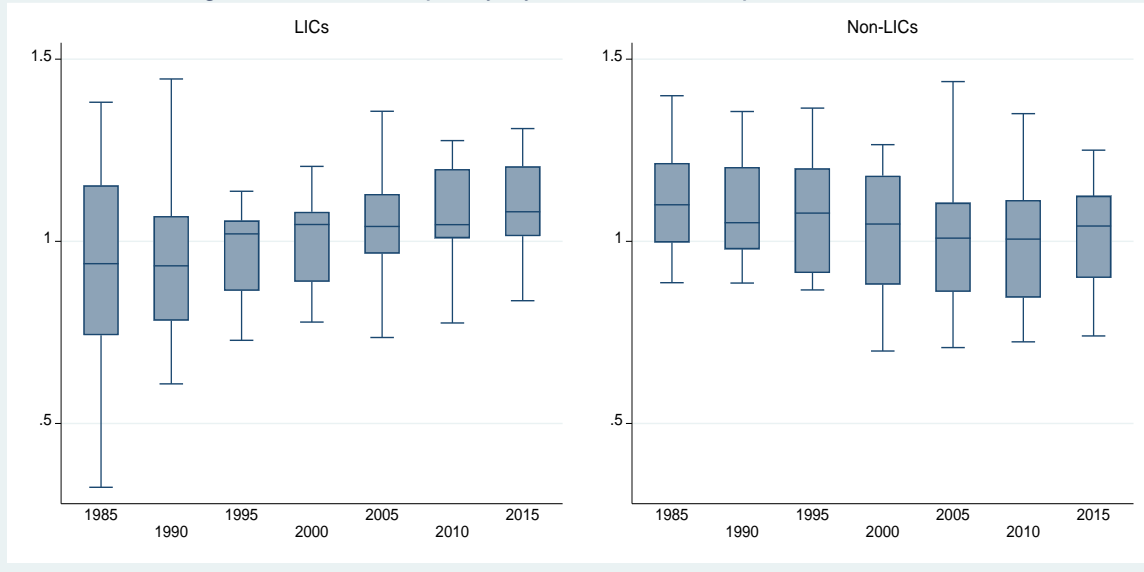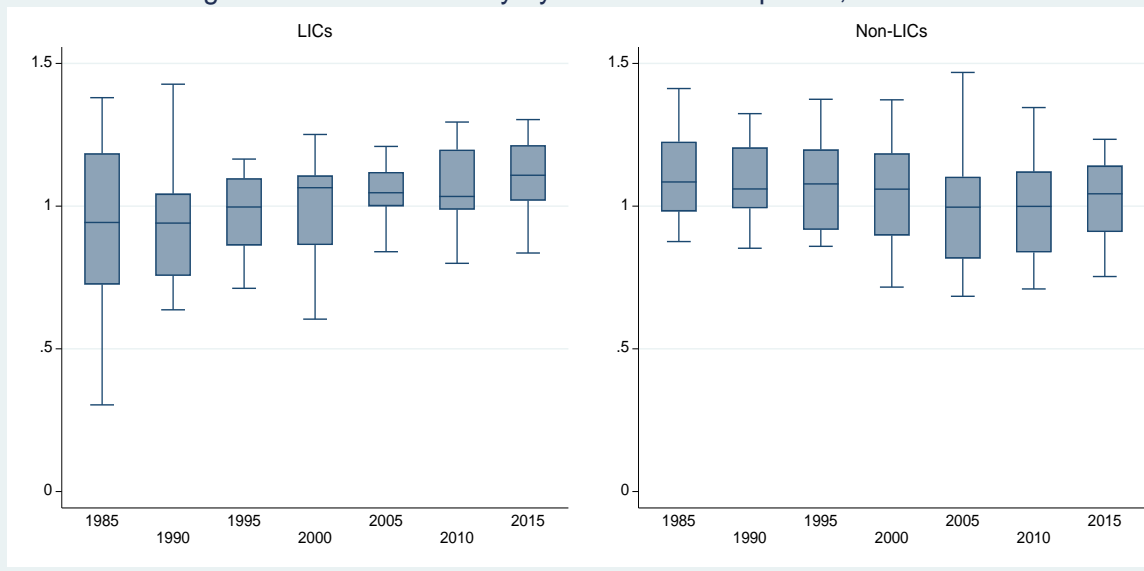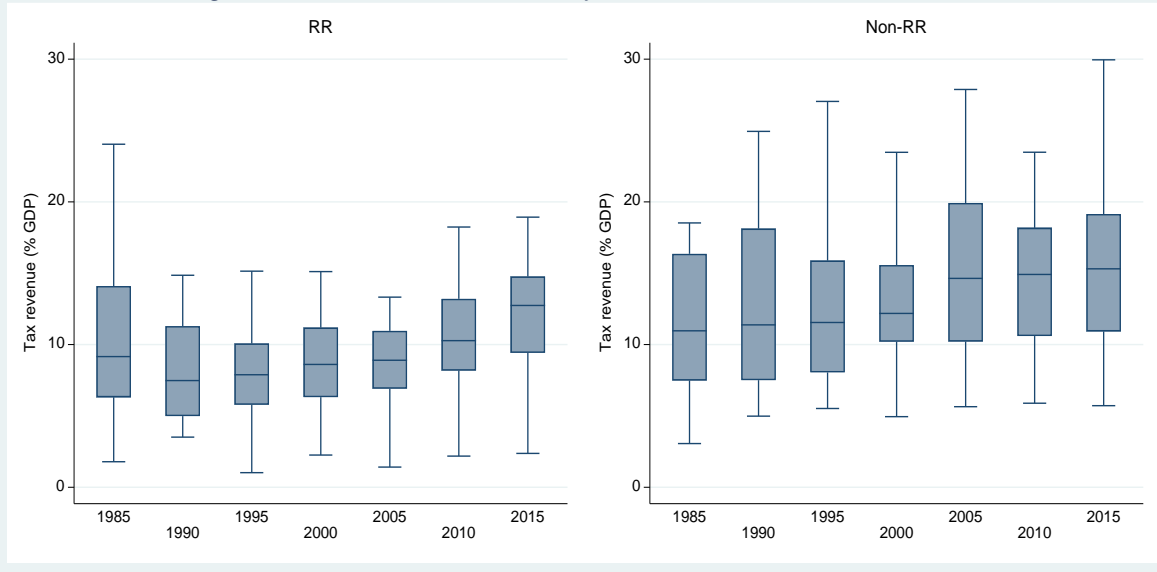
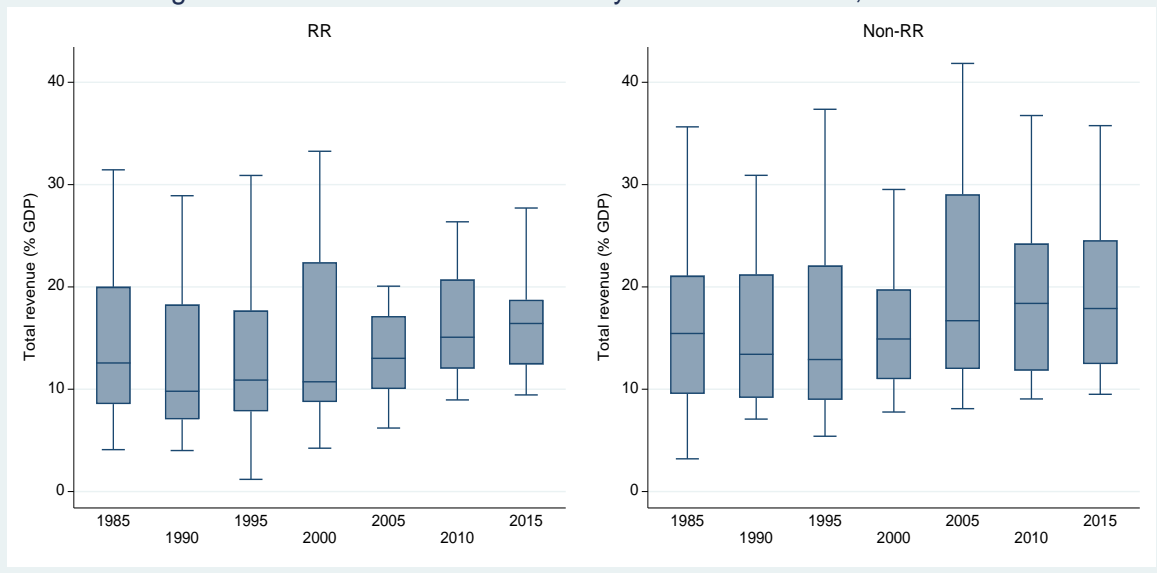Figure B8: Revenue Performance by Resource Wealth, 1985-2018

Figure B9: Tax Capacity by Resource Wealth, 1985-2018

18
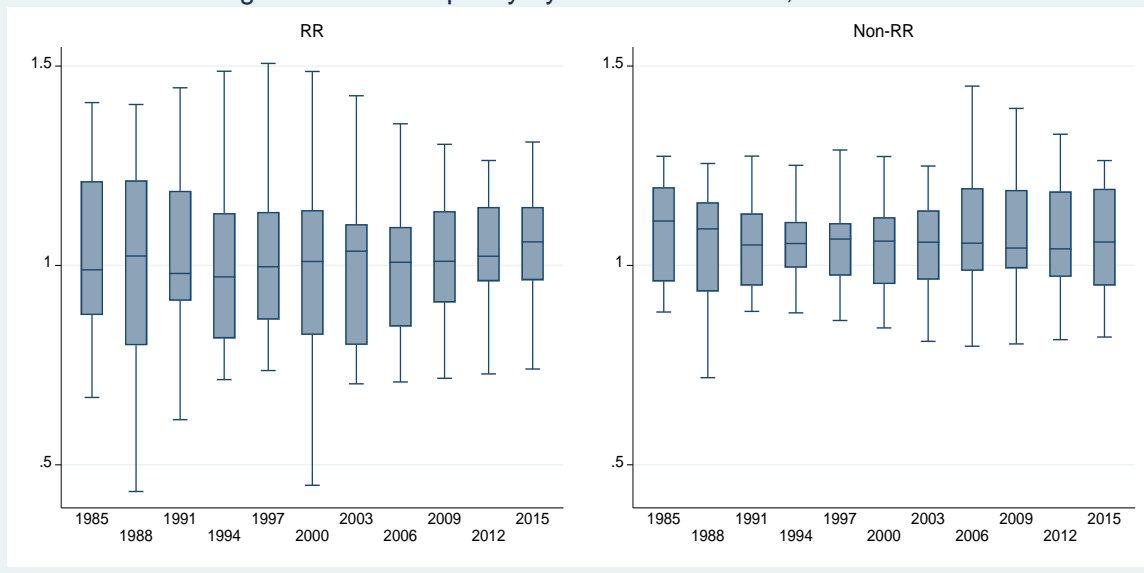
Figure B10: Tax Efficiency by Resource Wealth, 1985-2018
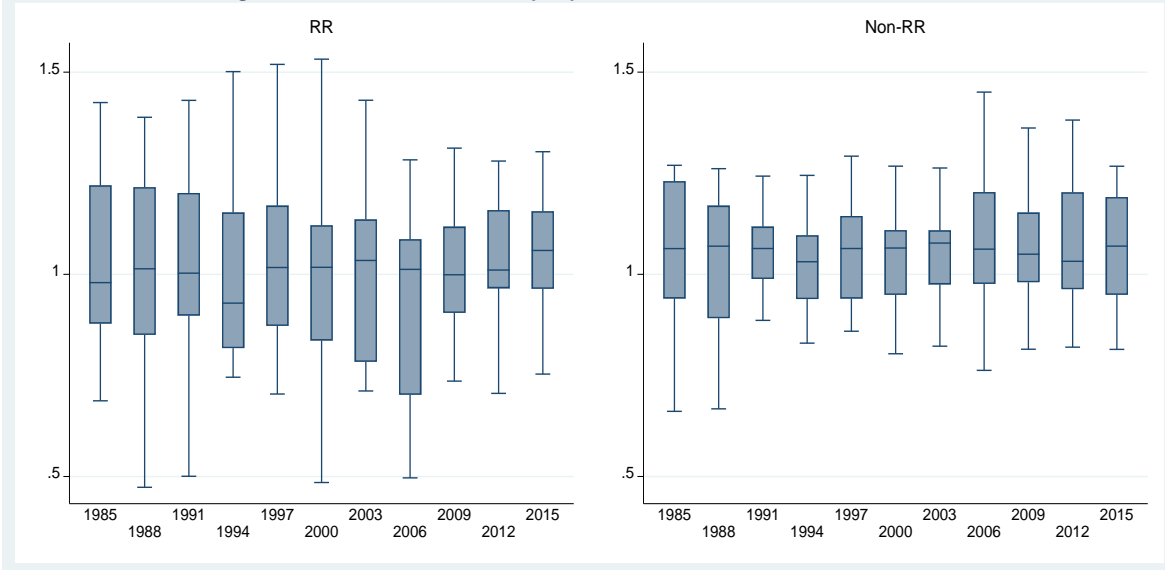
Source (all figures): authors' construction.

Five-year averages

Figure B11: Tax and Total Revenue Ratios, 1985-2018
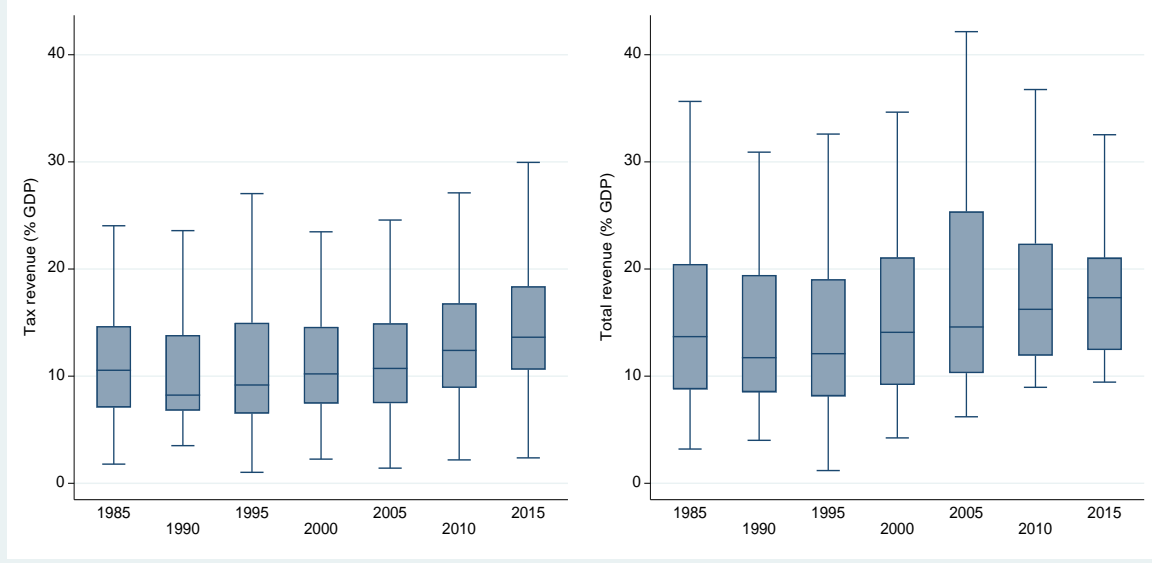
Figure B12: Tax Capacity Indicators, 1985-2018

Figure B13: Tax Performance by Level of Development, 1985-2018

Figure B14: Revenue Performance by Level of Development, 1985-2018

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Figure B15: Tax Capacity by Level of Development, 1985-2018

LICs

Non-LICs

Figure B16: Tax Efficiency by Level of Development, 1985-2018

LICs

Non-LICs

Figure B17: Tax Performance by Resource Wealth, 1985-2018

Figure B18: Revenue Performance by Resource Wealth, 1985-2018

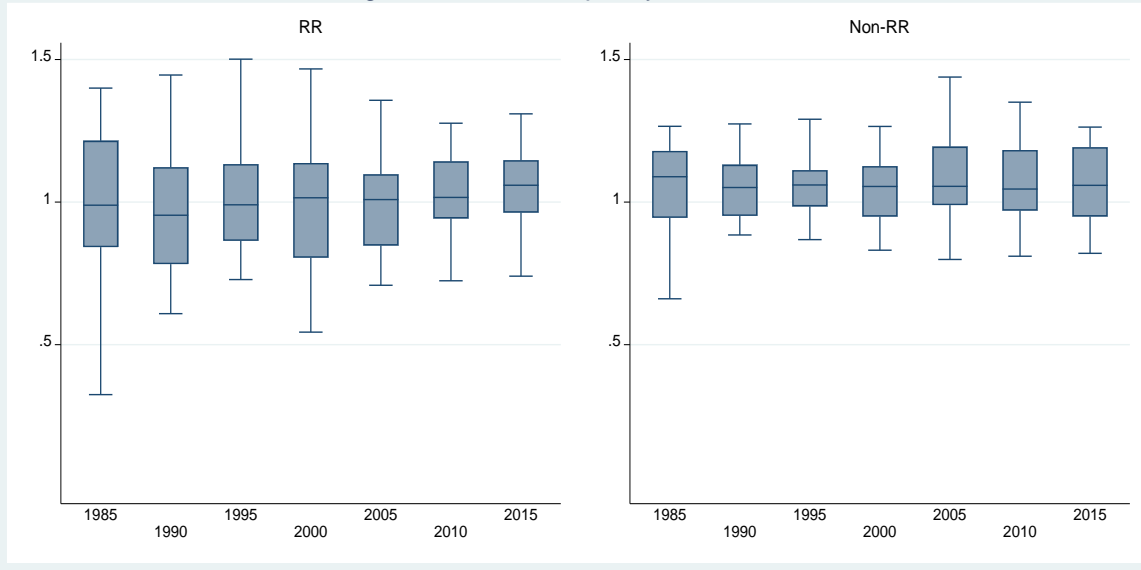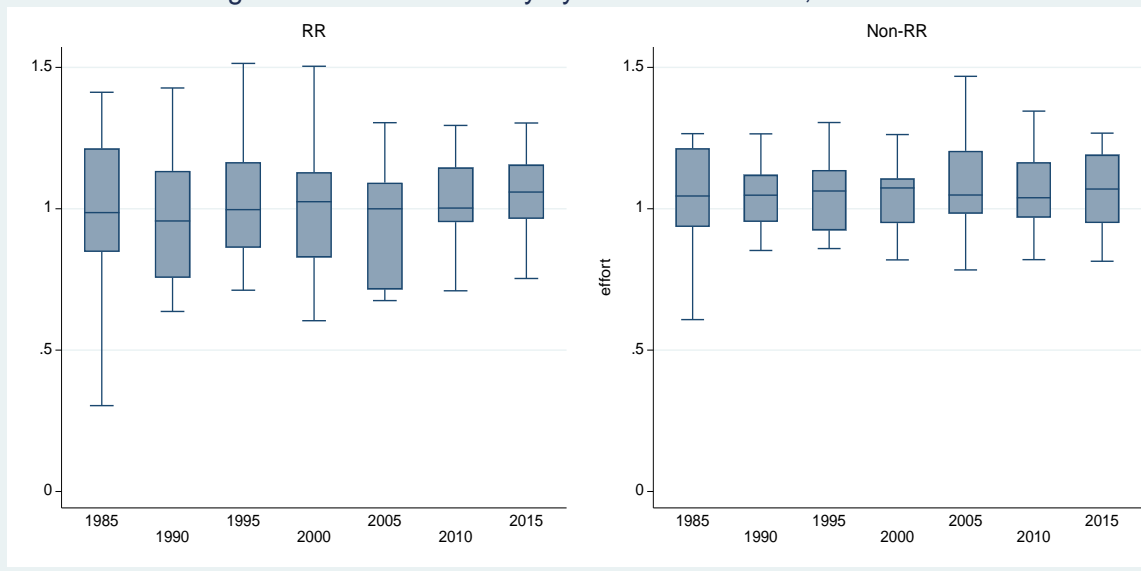Figure B19: Tax Capacity, 1985-2018

Figure B20: Tax Efficiency by Resource Wealth, 1985-2018

Source (all figures): authors' construction.

References

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

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. Sundtröm, 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

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).

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

Tagem, A.M.E, and O. Morrissey (2021). 'What Are the Drivers of Tax Capacity in Sub-Saharan Africa?' WIDER Working Paper 2021/161. Helsinki: UNU-WIDER. https://doi.org/10.35188/UNU-WIDER/2021/101-3

UNU-WIDER (2020). 'Government Revenue Dataset'. Version 2020. Helsinki: UNU-WIDER. Newest version: https://doi.org/10.35188/UNU-WIDER/GRD-2021

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