Evolution of Tax capacity and Tax effort in 21 African Economies

Abstract

An effective tax system is an essential component for the economic growth and development of country. This paper aims to estimates Tax effort in selected African economies; of which findings of this study might help to discern whether a country is constrained in its revenue mobilization by a low capacity to generate tax or by indisposition to use the available tax capacity to fund public services. Furthermore, tax effort comparisons will provide a roadmap as to what is the proper mix of fiscal policy to embark on in the event of a budgetary imbalance and debt management strategy. This study analyzes taxable capacity and tax effort in 21 African economies for the period 2000-2015 using panel data analysis, and contrasts tax collection levels versus external debt growth in selected countries. Due to short time span with a large covariate, linear model estimates tend to produces bias and inconsistent estimates, the paper therefore make use of dynamic GMM to address these issues, together with possible endogeneity issue. The main findings of this paper are that GDP per capita, trade openness and corruption control are positive and significant determinant of tax revenue. Population also is positive but insignificant in determination of tax revenue. We found agriculture to be negative and significant in determination of tax revenue. When tax effort is constructed using total tax revenue as % of GDP, 10 countries out of 23 with comparable data have tax effort below one. Using direct tax to construct tax effort, 11 countries out of 22 with complete data are found to have tax effort below one. Estimation using indirect tax shows that 9 out of 20 countries have effort below 1. Furthermore, estimation of tax effort using corporate tax for countries with complete data set shows that 5 out of 12 countries have tax effort below 1. These findings suggest that improvement in governance; trade openness and output growth are desirable tools in revenue mobilization in African economies.

Key words: Tax effort, tax capacity, African economies and panel data analysis.

JEL(HO:H25, H26)

Introduction and background of the study

An efficient tax system is an essential factor for the economic development of a country. This paper provides the conceptual and empirical analysis of countries' taxable capacity and tax effort in 21 African economies for 2000-2015 periods. The paper contrasts tax collection levels versus external debt growth in selected countries. It employs a cross-country study from the above mentioned 21 countries for 2000-2015 periods.

There are two major approaches used in estimating tax effort: the first is a regression analysis approach, which uses regression analysis to explain variation across different entities, see (Lotz and Moore,1967), (Bahl,1971), (Chelliah,1971), (Reddy,1975),(Dwivedi,1980) and (Oommen,1987). The second approach is the representative tax system, which attempts to select potential bases of individual taxes, i.e. for each tax an appropriate base is identified and a representative set of tax rates is generated. See (Thimmaiah, 1979), (Chelliah and Sinha,1982).

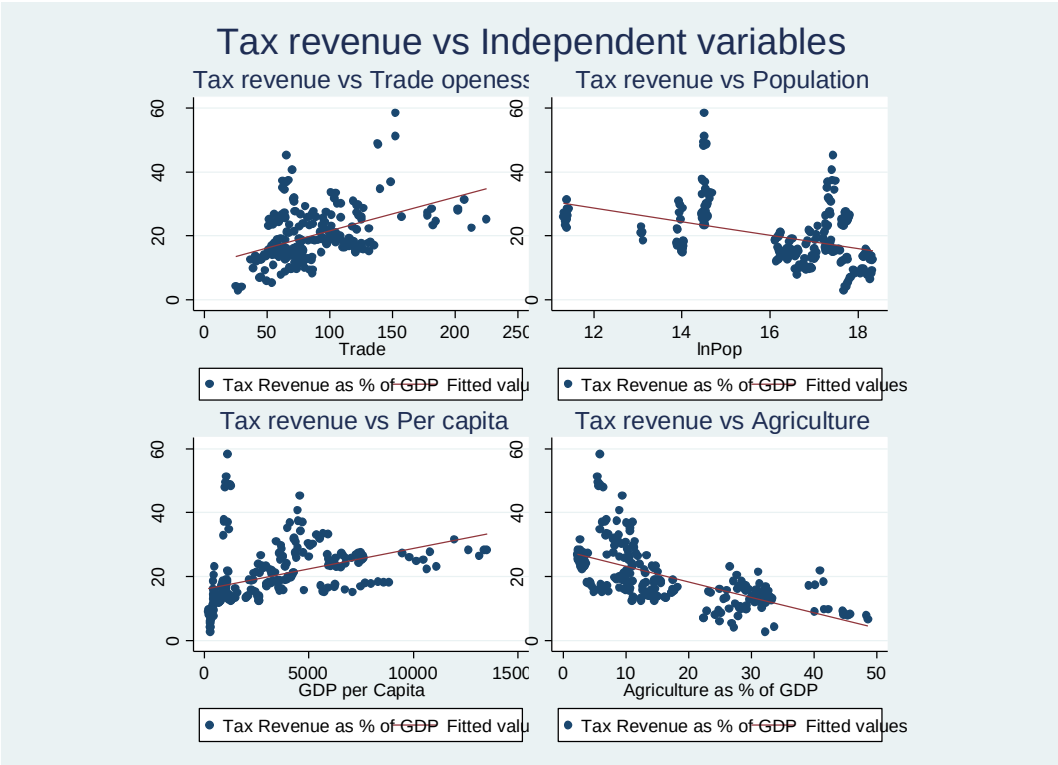
This paper adopts regression analysis for assessing the potential tax revenue of 21 African economies. The estimators obtained from regression analysis approach tend to be consistent and reliable; (Stotsky and Asegedech WoldeMariam, 1997).This study argues that tax collections in developing countries are under-capacity. The average tax revenue as a percentage of GDP for Malawi is 14.88, Mauritius is 16.91, Madagascar is 10.19, Kenya is 16.36, Zambia is 14.60 and DRC is 6.24, which are all below the UN stipulated level of at least 20% of GDP, and far afield from that of the developed countries' average of 40% of GDP. The tax index for a country is measured as the ratio between actual tax ratios to the predicted ratio (Bird, 2004). This study makes use of predicted tax ratio as a proxy for potential tax revenue. The estimated tax index mirrors the variance in the taxable capacity of a country. Tax effort is defined as an index of the ratio between the share of the actual tax collection in gross domestic product and taxable capacity, while taxable capacity refers to the predicted tax to gross domestic product ratio, which can be measured empirically by taking into account a country's specific macroeconomic, demographic and institutional features (Tual Minh Le, et al (2012)).

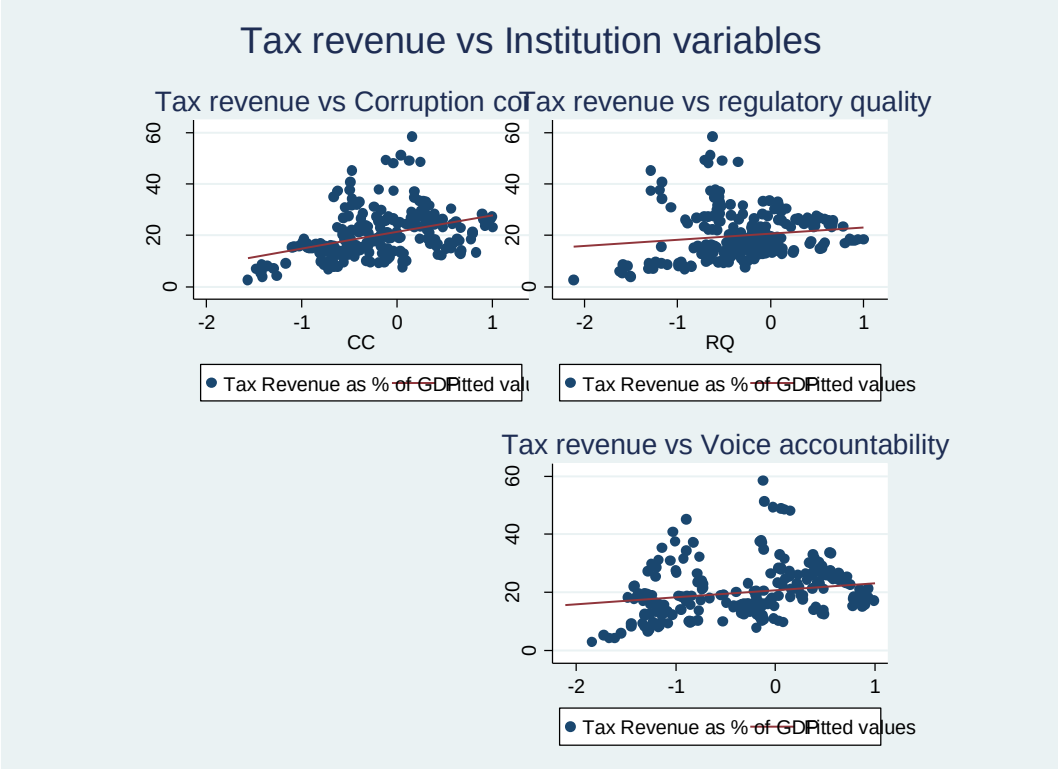
A high value of tax effort index shows that a particular country is collecting more tax than predicted, given its structure and prevailing economic and social conditions. This study aims to build on previous work by (Zestos et al, 2016 and Gupta, 2007), and to explain the main

determinants of differences in tax across countries with a main focus on Africa economies. Previous literature shows that tax effort and tax capacity are useful tools to judge whether reforms on tax collection should be carried out, accounting for disparity in income levels, demographics and institutional according to respective countries. There is a gap in the literature for tax capacity and tax effort for African economies. Most literatures about tax mobilization focus on colonial legacies and political institutions and ignore factors such as drought, dynamism of state in building other infrastructure necessary to increase tax mobilization. Leading discussions are focused on foreign aid role in development in Africa. Various literatures focused on tax mobilization problem in developed economies. The paper by (Ade, Rossouw and Gwatidzo, 2018), provide latest literature on tax mobilization in SADC region. They show that FDI inflow have substantial impact in tax collection in the region .Their analysis does not take into account the role of institutions in tax revenue mobilization. It further emphasizes the need of FDI as a way to increase tax revenue, but often FDI is made in search of high investment rate of returns, which often come with a condition of low taxes. Here, we devote effort in establishing the role political and institutional determinants plays in determination of tax capacity and tax effort in African economies. Our study acknowledges the role of corruption control, governance and regulatory quality in the process of revenue mobilization since such factors influence the ability of tax authorities to collect taxes. Furthermore, the current study introduces several control variables to the tax literature, namely: employment-population ratio and labour force participation, thereby investigating their potential effect on tax capacity. This approach is valuable because it will help to establish specifically under what tax sub-category government should put more effort in revenue mobilization.

The paper also tries to establish the link between the tax efforts, tax capacity and external debt in the group of countries studied. There is narrative that government inability to mobilize revenue is sources of many developing countries resorting to excessive borrowing, (Snider, 1990). Understanding the interaction between debt and revenue mobilization. First do countries with power tax revenue mobilization capacity rely more on external debt. Second can high levels of external debt signal a state inability to collect tax? These questions are also discussed here.

Figure 1: Graphs of Tax revenue as a % of GDP with independent variables.





From the graph above in figure 1, tax revenue as a % of GDP is expected to be positively related to trade openness, negative related with population, positive related with the per capita, negative related to agriculture. While all institution variables are positively related to tax revenue as a percentage of GDP. The study break-down estimation of tax effort to different tax sub-category of direct tax, indirect and corporate tax. The sub categorization of taxes is done to see whether, meaningful insight can be derived from it. The remainder of the study is organized as follows: Section 1.2 presents a survey of the existing literature, Section 1.3 presents the data collection and transformation and source of the data, Section 1.4 explains the econometric methodology for deriving the tax effort indices, Section 1.5 presents the multivariate technique used to estimate the tax capacity and tax effort, Section 1.6 presents the empirical interpretation of results, and Section 1.7 concludes the study.

1.2 Literature review

A series of studies have used the approach of calculating tax effort and tax capacity for developing and developed countries, combined and contrasted across countries based on income levels, demographics and institutional effect. Although these studies are useful in studying tax

trends across countries, they do not provide useful guidance for African economies specifically. Most African economies are still underdeveloped and over-dependent on factors such as aid and borrowing to finance their expenditure[1].Recent paper by Makate, Mahonye and Mandishara (2018) provides an extensive background of impact debt has on growth in Sub-Saharan Africa. (Pattillo et al, 2002) study of twenty countries found that external debt as a percentage of GDP is above the threshold of 35-40 per cent. , (Le, Moreno-Dodson and Rojchaichaninthirn, 2008) defined taxable capacity as the predicted tax-to-GDP ratio, calculated using estimated coefficients of a regression specification, taking into account country-specific effects. Tax effort index is the ratio between the share of actual collection to GDP and taxable capacity according to (Stotsky et al, 1997). A tax effort index greater than 1 show that a country is utilizing its tax base effectively, while a tax effort index less than 1 show that a nation has substantial scope to raise its tax revenue.

The tax effort approach was first used by (Lotz and Morss, 1970), who used the differences between actual and predicted tax ratios for the purpose of making inter-country tax effort comparisons. (Bahl, 1971) provides a detailed survey of further studies of tax effort. The authors argues that, among developing countries, differences in openness account for differences in tax collection revenue share at least as well as do differences in GDP per capita. (Chelliah, Baas and Kelly, 1975) developed a tax effort index using different combinations of explanatory variables. (Tait, Gratz and Eichengreen, 1979) also provide further estimation techniques of tax index. A discussion paper by (Piancastelli, 2001) looks at an estimation of tax effort in both developed and developing countries from 1985 to 1995. (Meda, 2015) uses various approaches to estimate the tax gap in South Africa by defining a tax gap as the difference between potential revenue inferred from macroeconomic data and actual tax collection. (Meda, 2015) found that the tax gap is a quantitative indicator of an efficient tax system; he concludes that the diagnosis and evaluation of efficiency in tax collection are key factors for the prioritization of scarce resources allocation.

[1] See table 2 in the appendix for external debt as a percentage of GDP in the countries in this study. Pattillo et al (2002) finds that the average impact of external debt on per capita GDP growth is negative for net present value of debt levels above 160-170 % of export and 35-40% of GDP.

By comparing the efficacy in revenue mobilization across countries in different income groups, (Tuan Minh Le, et al, 2012) show that the tax-to-GDP ratio tends to produce a misleading picture, as a result of differences in economic structures, institutional arrangements and demographic trends. (Le Moreno-Dodson and Rojchaininthorn, 2008) suggest that the tax system exerts a significant impact on investment decisions. Furthermore, higher tax revenues are important to lower aid dependency in low income countries. An effective tax system encourages good governance, strengthens state building and promotes government accountability. Using tax effort and tax capacity, (Tuan Minh Le, Blanca Moreno Dodson and Nihal Bayranktar, 2012) constructed a benchmark upon which they could rank different economies in four different groups, namely:

i. low tax collection, low tax effort
ii. high tax collection, high tax effort
iii. low tax collection, high tax effort
iv. high tax collection, low tax effort

A tax effort of 1 corresponds to an index of the ratio between the share of the actual tax collection in GDP and taxable capacity. A country can have a low tax collection, which will be reflected in it having a low tax effort index, or it could have a high tax collection, which will be reflected in it having a high tax effort index. Mixed results can be obtained as a result of measurement error or insufficient data points during estimation. The financial crisis of 2008-2009 led to increased budget deficits and forced governments to look for new ways to increase revenue to finance public expenditures and narrow the deficit with minimal adverse effect on economic activities. (Hinrichs, 1963) and (Musgrave, 1969) emphasize the importance of tax structural features such as import, which are relatively easy to tap for fiscal purposes. (Bird, 1989) cites the administrative capacity limitations imposed on taxation in developing countries.

(Kaldor, 1963) argues that one of the principal lessons attained from tax reform globally is that political will is a *sine qua non* of any successful tax reform. (Bird, 2004) goes further to argue that a country's tax system reflects its political institutions. An effective tax system thrives well in a country with strong institutions and a politically safe environment. A study by (Marcelo Piancastelli, 2001) concludes that corruption control and regulatory quality uncertainty are

dominant determinants of tax revenue across countries. Tax revenues tend to be lower when corruption controls are weaker. (Feger and Asafu-Adjaye, 2014) show that tax collection in sub-Sahara Africa only amounts to 15% of GDP. Table 1 presents synthesis of main literature on determinants of tax effort and capacity.

Table 1: Determinants of Tax capacity and Tax effort in empirical literature

Categories	Variables	Positive relation	Negative relation	Non- significant
		(Source's)	***(Source's)***	**Relation Inconclusive**
Macro-Economic	**Trade**	Hinrich (1965), Lotz and Morss (1967), Chelliah(1971), Tuan Minh Le, Blanca Moreno_Dodson, Nihal Bayraktar (2012), Munawer Sultan Khwaja and Indira Iyer (2014)		
	Per Capita	Hinrich (1965), Chelliah(1971), Tuan Minh Le, Blanca Moreno_Dodson, Nihal Bayraktar (2012).	Chelliah(1972/1976), Tait(1972/1976)	Lotz and Morss (1967)
	Agriculture	Chelliah(1), Bahl (1966/1968), Tuan Minh Le, Blanca Moreno_Dodson, Nihal Bayraktar (2012). Davoodi and Grigorian(2007)	Tait(1972/1976)	Chelliah(2) ,Tait (1972/1976), Khwaja and Indira Iyer (2014), Piancastelli (2001)
Demographic	**lnPOP**	Dragos, (2014); Zerriaa et al. (2017),	Tuan Minh Le, Blanca Moreno_Dodson, Nihal Bayraktar (2012).	

Historical Event	**Colonial policy**	Feger and Asafu-Adejiye (2014)		
Institutional Quality	**Corruption Control**	Khwaja and Indira Iyer (2014)	Tuan Minh Le, Blanca Moreno_Dodson, Nihal Bayraktar (2012). Tanzi and Davoodi (1997), Bird et al (2004)	
	Regulatory Quality	Torgler and Schneider (2007)		
	Voice accountability			

Summary of few prominent literature reviews on determinant of tax revenue

Author	**Year of Publication**	**Basic Results**
Janet G. Stotsky and Asegedech WoldeMAriam	1997	Used panel data for 43 sub-Saharan-Africa economies to construct tax effort for the period of 5 years, the main findings is that countries with high tax share tend to have a high index of tax effort, but there is no consistency across countries.
(Chelliah, Baas and Kelly),Tait, Gratz and Eichengreen	1975,1979	By relating tax share in GNP with few independent variables, they found that mining is positive related to tax share, while agriculture is negative and export is insignificant, with Tait el at. 1979 update, confirming the stability of the initial findings
Tanzi	1987	Use a sample of 86 developing countries to determine how the share of tax revenue is related to natural of per capita income, were founds a positive and significant relation between this variables.
Tony Addison and Jorgen Levin	2012	They found that tax to GDP ratio is high in more open

		economies and less agricultural dependent economies, less populous and peaceful countries.
Jean –Francois Brun and Maimouna Diakite	2016	Make use of stochastic frontier model to establish the overall tax effort. They found that low income countries have higher tax effort; they also argue that inefficiency in taxation can be attributed more to policy decisions than on tax management performance.
Gupta	2007	Confirms that factors such as per capita GDP, Trade openness foreign aid, institution factors such as political stability significantly affect revenue performance of an economy
Garikai	2009	Examines tax buoyancy in the SADC region and found that monetasation, external aid growth and growth of fiscal deficit adversely affects tax buoyancy in SADC.

1.3 Data:

All data used in this paper is collected from the World Bank's World Development Indicators (WDI). The data collected is based on data availability. The following data were collected: Tax revenue as a percentage of GDP, where tax revenue is defined as the revenues collected from taxes on income and profits, social security contributions, taxes levied on goods and services, payroll taxes, taxes on the ownership and transfer of property, and other taxes. Total tax revenue as a percentage of GDP indicates the share of a country's output that is collected by the government through taxes, Tax on goods and services (direct tax) is defined as all taxes levied on the production, extraction, sale, transfer, leasing or delivery of goods, and the rendering of services, or on the use of goods or permission to use goods or to perform activities.

They consist mainly of value added and sales taxes, Tax on corporate profits is defined as taxes levied on the net profits (gross income minus allowable tax reliefs) of enterprises, imports as a percentage of GDP, exports as a percentage of GDP, agricultural output as a percentage of GDP, and GDP per capita which is Log of per capita GDP PPP in constant US$. Population (lnPop) which is the natural logarithmic of population, it is either the growth rate of population between 15-64 years old, or the age dependency rate. We took the logarithm of population. Labour force participation rate and employment-to-population ratio were also collected to be used for a robust check of results estimates. Value Added in Agriculture, as a % of GDP which is value added of agriculture as a percentage of GDP Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs.

The data spans the years 2000 to 2015 for a total of 21 African countries. Due to problems of missing data, we use only countries with a complete dataset of variables in the period of the study. A trade variable is constructed by adding imports as a percentage of GDP to exports as a percentage of GDP. Institutional variable such as corruption control (CC) and regulatory quality (RQ) are used to determine the role of institutions in tax mobilization determination. The choice of countries' data is done randomly to avoid selectivity bias but also according to data availability. Correlation matrix does not show any strong positive or negative correlation between independent variables used in the estimation.

1.4 Methodology

The empirical specification used in this paper are adapted from (Le, Moreno- Dodson and Rojchaininthorn, 2008) and (Tuan Minh Le, et al, 2012), (Tanzi and Davoodi, 1997), (Bird, Vazquez and Torgler, 2004), (Tanzi and Zee's, 2000), (Feger and Asafu-Adejiye ,2014) with the aim of establishing tax effort trends in 21 Africa economies and further learn policy implications for fiscal reform in Africa. Using a stochastic model, where T represents Tax Revenue and Y represents GDP, we estimate the following regression to obtain results used in the estimation of tax effort: $\frac{T}{Y} = f(X_i \dots X_n, U)$. X_i represents independent variables expected to influence the tax ratio and U is the error term. Tax effort is measured by the ratio between the actual and the predicted value of T/Y. This paper adopts the approach used by (Zestos et al, 2016) and (Bird, Vazquez and Torgler, 2004) by using a multivariate regression model (shown below):

$$\frac{T_{it}}{Y_{it}} = \alpha_0 + \beta x'_{it} + \varepsilon_{it} \quad (1)$$

(1)

Where x_{it} is the vector of all explanatory variables used in empirical analysis going forward, as stated in the equation below, and ε_{it} is the error term.

$$\frac{T_{it}}{GDP_{it}} = \alpha_0 + \alpha_1 GDPPC_{it} + \alpha_2 lnPOP_{it} + \alpha_3 TRADE_{it} + \alpha_4 AGR_{it} + \alpha_5 Instit_{it} + \varepsilon_t \quad (2)$$

$\frac{T_{it}}{GDP_{it}}$ is total tax revenues collection as a percentage of GDP

As suggested by (Bahl, 1997), (Fox et.al. 2005), (Piancastelli, 2001), the income level of a country is expected to be significant in determining actual tax collection. Thus, we expect GDPPC to have a positive and significant impact on tax revenue collection. Higher population is expected to distort the tax revenue collection capacity of a nation, (Bird, et. al., 2004), therefore we expect the lnPop variable to be negative. Trade openness is also an important variable in determining tax revenue as suggested by (Rodrik, 1998); (Piancastelli, 2001); (Norregaard and Khan, 2007); (Aizenman and Jinjarak, 2009). Differences in trade openness are expected to have opposing effects on taxes; higher trade openness is expected to correspond with lower tax

collection due to free trade on imports and exports, thus it might have a negative impact on taxes. Conversely, high trade openness is often associated with high economic growth rates; we expect open economies to grow faster and as a result more taxes can be collected, thus increasing the tax base.

Due to the difficulty the state faces in taxing the agricultural sector, it is expected that as the share of agriculture value added as a percentage of GDP increases, collected taxes in percentage of GDP drop due to a smaller tax base: (Leuthold, 1991); (Tanzi, 1992); (Piancastelli, 2001), thus the expected sign of the agriculture value added variable is negative. The results of the agriculture variable will also depend on the state subsidy level – thus it might be positive or negative.

Institutional and governance quality are considered essential factors for determining the adequacy of tax collection, (Tanzi and Davoodi, 1997); (Ghura, 1998); (Bird, et al, 2004); (Gupta, 2007). Institutional governance quality or corruption control and regulatory indexes are expected to be positive and significant in determination of tax collection.

The challenge one faces when estimating using ordinary least squares (OLS) is that the estimators obtained exclude the effect of heterogeneity that may exist among countries. The uniqueness of countries is contained in the disturbance term (ε_{it}). The consequence of individual differences among countries being contained in the error term is that the disturbance term will be correlated with some of the independent variables included in the model, and, by implication, $cov(v_t, v_s) = \rho, t \neq s$, (Gujarati, 2008). The implication of the error term being correlated with other independent variables is that the coefficient estimated will be biased and inconsistent, due to a possible heterogeneity effect not captured in OLS. A panel data approach is used to estimate the coefficients, which corrects for the challenges mentioned above. (Clark et al ,2013,Woolridge, 2005) gives a detail discussion on whether one should use fixed effect or random effect models, and factors to account for in each choice.

The Panel data model uses both time series and cross sectional data[2]. Using both Fixed Effect (FE) and Random Effect (RE), (Wooldridge, 2005, Clarke et al, 2010) argue that the choice between fixed effect or random effect will solely depend on the aims of the research; they show, for example, that the choice of random effect provides biased but efficient estimators of the parameters, thus there is a trade-off between FE and RE. The advantage of using a fixed effects model is that it provides consistent estimates in the presence of countries' specific effects that are correlated with explanatory variables in the model, (Baltagi, 2005). The above equation (2) is modified to account for time effect and country effect.

$$\frac{T_{it}}{Y_{it}} = \alpha_0 + \alpha_1 + \gamma_t + \beta x_{it} + \varepsilon_{it} \quad (3)$$

The above model has an overall constant term (α_0) as well as a group effect for each country (α_1) and a time effect for each period (γ_t). The random effect model, also for a two ways estimate, is given by:

$$\frac{T_{it}}{Y_{it}} = \alpha + \beta x_{it} + u_i + w_t + \varepsilon_{it} \quad (4)$$

By first regressing tax ratio on per capita GDP and on the share of foreign trade in GDP for the whole sample of countries,(Bahl,1971) argues that trade trends are more relevant than per capita income in determining the tax ratio. Estimators are found using OLS, and then fixed effect and random effect models are estimated to obtain their estimators. One limitation of OLS and FE estimators will suffer from Nickell[3] bias when estimating dynamic panel which is done in the second part of results in this paper, due to short time series available and unobserved heterogeneity will not be corrected. We adopt both 2SLS and GMM approach to deal with inherent endogeneity[4] and the small sample problem[5]. The dynamic model will take the following form:

[2] (Arellano and Honore, 2001) and (Blundell, Bond and Windmeijer, 2000) provide a broad literature of panel estimators, both their benefits and their limits.

[3] (Nickell, 1981) provides literature with regard to dynamic models with fixed effects. FE dynamic panel is estimated and results are presented in table 6.

[4] Endogeneity problems tend to make least square based inferences (FE and RE) estimators to be biased and inconsistent, the paper make use of GMM which produces consistent parameters for a finite number of time periods and large cross-sectional dimension of covariate to address the endogeneity problem (Arellano and Bover, 1995, Blunder and Bond, 1998 and Arellano and Bond, 1991)

$$y_{it} = \alpha y_{it-1} + \beta x_{it} + n_i + \epsilon_{it}; i = 1, \dots N, t = 1, \dots T \quad (5)$$

Where y_{it} is tax revenue as percent of GDP, x_{it} is the vector of all explanatory variables in the model, n_i denotes unobserved time-invariant heterogeneity and ϵ_{it} is the idiosyncratic error term. Table 2 and 3 provide the summary statistics and estimations for the three estimating approaches. Table 2 presents the descriptive statistics, table 3 provides empirical results when corruption control is used as an institutional variable, table 4 provide results when the regulatory variable is used as an explanatory variable, while table 5 depicts the estimated results for actual tax revenue, fitted tax revenue (tax capacity) and GDP growth of the respective countries. Table 6 presents the all the results including system GMM, 2SLS estimates. We follow the 3 steps followed in (Feger and Asafu-Adejiye, 2014)[6] to construct the tax effort variable.

1.5 Table 3: Descriptive statistics

	(1)	(2)	(3)	(4)	(5)
VARIABLES	N	Mean	Sd	Min	Max
Time	400	2,008	4.616	2,000	2,015
Tax Revenue	257	20.13	8.982	2.752	58.47
GDP per capita	400	2,717	2,736	193.9	13,542
Agriculture	371	17.72	11.97	2.032	48.64
CC	375	-0.297	0.615	-1.566	1.250
Trade	380	83.95	33.90	25.04	225.0
lnPop	400	16.12	1.708	11.30	18.42
Number of ID	23	23	23	23	23

Note: Time is in years, Tax revenue is the % of GDP, GDP-capital is GDP per capita, Agriculture is as % of GDP, CC is corruption control, Trade is sum of import and export both as % of GDP, lnPop is logarithm of population of respective country. ID capture the number of countries used, only 21 results have sufficient observation and thus they are the only reported.

Table 2 provides a snapshot of the data used for empirical estimation in this paper. Mean, standard deviation, maximum and minimum of the variables used are presented: The ID variable is for the number of countries for which data is collected for the study. Three countries were dropped during estimation because they have an inadequate number of observations. As explained in the previous data section, all data has been collected from the World Bank database

[5] In a panel data analysis with a small number of time periods, we often ecounter inference problems such as small sample bias in coefficient estimation and hypothesis testing (Bun and Sarafidis, 2013)

[6] The steps followed to obtain tax effort are: (i) estimate the tax capacity using a sample of 21 developing countries. (ii) Use the beta estimates obtained in (i) to generate the tax capacity for each country. (iii) Calculate the tax effort by taking a ratio of the actual tax revenue for each country relative to tax capacity.

(World Development Indicators: WDI). All values are in unit forms and tax revenue, agriculture, and trade openness are all as a percentage of GDP, whereas population is the number of individuals ages 15-64 in the respective countries in logarithmic form. The choice of population between the ages of 15-64 years is informed by data availability. Labour participation rate and employment-to-population ratio are used as proxies for GDP per capita to check for results robustness (see table 3 and 4 in the appendix). The time scope is 2000 to 2015. The average tax revenue for the countries under study is 20.13, while agriculture as a percentage of GDP is 17.72. Corruption control per average is -0.297. Trade openness is 83.95 per average and population per average is 400, in logarithmic form.

Empirical Results (full sample 2000-2015)

Table 4: Regression Analysis Results

VARIABLES	(1) OLS	(2) FE	(3) GLS
GDP_Percapita	-0.001**	0.002***	-0.001***
	(3.810e-04)	(5.329e-04)	(2.630e-04)
Trade	0.122***	0.076***	0.122***
	(3.095e-02)	(2.271e-02)	(2.435e-02)
Agriculture	-0.567***	0.059	-0.567***
	(8.083e-02)	(1.442e-01)	(6.329e-02)
CC	6.064***	3.461**	6.064***
	(1.351e+00)	(1.601e+00)	(1.327e+00)
RQ	-6.719***	-3.927**	-6.719***
	(1.743e+00)	(1.563e+00)	(1.309e+00)
VA	2.813***	1.147	2.813***
	(7.439e-01)	(1.225e+00)	(8.422e-01)
lnPop	2.267***	-0.686	2.267***
	(5.648e-01)	(4.862e+00)	(5.333e-01)
Constant	-14.822	18.245	-14.822
	(1.050e+01)	(7.836e+01)	(1.037e+01)
Observations	223	223	223
R-squared	0.512	0.151	
N	223	223	223
F	31.76	4.897	.
r2	0.512	0.151	.
r2_a	0.496		
Number of ID		23	23
Country FE		YES	
Rho		0.854	.
chi2		.	233.9

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

*Note: all variables are in unit values form LM (country effects) represent the Breusch-Pagan Lagrange Multiplier statistic for assessing the appropriateness of FEM estimator,(Probability values in brackets), *** p<0.01, ** p<0.05,* p<0.1, FE indicates fixed country effects estimation.*

Table 4 reports the results as follows: when estimation is performed using Pooled Ordinary Least Squares (POLS), which assumes that all countries are the same, agriculture as a percent of output has a negative and significant impact on tax revenue collection[7]. A unit increase in agriculture

[7] Lack of robust infrastructure for tax collection and agriculture subsidies can be attributed to the negative sign between agriculture output and tax revenue (see Mkandawire, T, 2010)

production leads to a 0.567 decrease in tax revenue, and this is significant at a 1% level. For every unit change in trade openness, tax revenue increases by 0.122 units, which is also significant at a 1% level. GDP per capita is significant in explaining tax revenue when estimated using OLS, but has a negative sign[8]. For each unit increase in per capita income, tax revenue collection falls by 0.001 units. The logarithm of population is positive and significant in explaining tax revenue collection. The labour force participation rate in selected African countries is more than 50% on average, which could explain why growth in working age population has a positive impact on tax revenue (see table 3 in appendix). Each one percent change in population will cause tax revenue collection to increase by 2.267 units. Corruption control (CC) is positive and significant in determining tax revenue collection[9], which is consistent with our expectations (one would expect corruption control to have a positive influence on tax collection).[10] A unit change in corruption control will cause a 6.064 unit increase in tax revenue collection. Regulatory quality is negative and significant in explaining tax revenue. Each one unit improvement in regulatory quality seems to decrease tax revenue by 6.72 units. Voice accountability is positive and significant in explaining tax revenue mobilization. For each unit increase in voice accountability, tax revenue will increase by 2.813 units.51% of the model is explained by the variables used in estimation, as indicated by the R-square using OLS, while only 15% of tax revenue is explained by regressors when using FE model for estimation, this could be attributed to heterogeneity of cross sections. This is also expected since our data is more cross sectional dominant, than time dominant.

We use the Hausman test to decide between a fixed effect and random effect model, a fixed effect model is preferred to random effect. When panel model estimation is performed using fixed effect model, the assumption is that the intercept may vary across countries, but does not vary over time. Trade openness, per capita GDP, and corruption control are regulatory quality are significant in explaining tax revenue collection. Holding all else constant, a unit increase in GDP per capita will cause a 0.002 increase in tax revenue collection, while a unit increase in

[8] This could be attributed to tax evasion and tax collection cost which are prevalent in developing countries (Edwards and Tabellini, 1991)

9 Cukierman el at, (1989) emphasizes the role of political system in tax mobilization challenges faced by different countries.

[10]

trade will lead to a 0.076 increase in tax revenue, which is significant at a 1% level. Agriculture is positive but not significant in explaining tax revenue collection[11]. Based on 5% critical values, the contribution of corruption control (CC) is not only positive (3.461) but also statistically significant. The log of population (lnPop) is positive but not significant in explaining tax revenue when estimated using FE model. Estimating using generalized least square (GLS), both GDP per capita and trade openness are positive and significant in explaining tax revenue. A unit increase in GDP per capita will lead to a 0.001 unit decrease in tax revenue. At the same time, holding all else constant, a unit increase in trade will lead to a 0.122 units increase in tax revenue. Corruption control is positive and significant in explaining tax revenue. Each one unit change in corruption control will lead to a 6.064 unit increase in tax revenue. Furthermore agriculture is negative and significant in explaining tax revenue[12].The relationship between tax revenue and agriculture as a percentage of GDP is negative, perhaps because governments often have no specific infrastructure in place to tax agricultural output, which is seasonal and often unpredictable. Informality of agriculture sector makes it difficult for the state to tax. For every unit increase in agriculture output, tax revenue falls by 0.567 units. For voice accountability, which is positive and significant, each unit increase in voice accountability, will results in 2.823 units increase in tax revenue. The Hausman test confirms the choice of fixed effect (FE) is a better model than a random effect approach. The LM test[13] (Lagrange multiplier test for random effects) is used to choose between OLS and random effect. The LM test probability is below 5%, therefore OLS is used instead of RE when deciding between them, by keeping in mind that estimators obtained from RE estimation are likely to contain correlation between unobserved effects and the explanatory variables. The Hausman test[14] is performed to decide which of the two model approaches provides more consistent estimators. The Hausman test p-value obtained is below 5%, therefore one should reject the null hypothesis and use fixed effect for estimation i.e. FE provides more consistent estimators than the RE approach. The F-probability is 0.0002, thus the model is well fitted and all coefficients are not zero. The Wooldridge test for

[11] Tax revenue and tax revenue collection is used interchangeably.
[12] (Edward and Tabellini ,1991) argue that countries with a large agriculture sector are more susceptible to tax evasion than those with manufacturing industry
[13] LM test for var(u_i)=0
[14] The Hausman test, test for the null hypothesis of no correlation, i.e. there should be no differences between estimators.

autocorrelation in panel has an F-probability of 0.001 showing the presence of first order serial correction, and the Modified Wald test for group-wise heteroscedasticity in FE has a Chi-square probability of 0.000, again signaling heteroscedasticity presence in the error term. We perform the over-identifying restrictions; and we obtain the Sagan-Hansen statistic of 0.0007, which corrects for both cross-sectional dependence and the heteroscedasticity problem mentioned above. Panel estimation under fixed effect (FE) provides better results than those obtained using the OLS model or GLS model.

The most interesting finding from the above is that tax revenue drivers are significant despite the methodological differences in the estimation of results. This does not mean measurements of the results are free of measurement errors or specification error; it merely shows the strength of the variables used in determining tax revenues. (Bahl, 1997) and (Mertens, 2003) observed unstable statistical results, which are consistent with our estimation, as one moves from one model of estimation to another model. The dynamic modeling approach is performed to deal with sample size problem, the heterogeneity issues and also to see the role of adjustment variable in explaining tax revenue. Both GMM[15] and 2SLS models are estimated to obtain dynamic panel data results which are presented in the table 6. The next section presents the estimated Tax Effort Index, Actual Tax Ratio and economic growth of the respective countries.

Table 6: Results when System GMM and 2SLS method is used for estimation

[15] See (Anderson, T.W and C.Hsiao ,1982) and (Arellano M, and S. Bond ,1991) for both literatures of dynamic panel data estimation.

VARIABLES	(1) OLS	(2) FE	(3) 2SLS	(4) System GMM
L.Tax_Revenue	0.829***	0.279***	0.854***	0.271***
	(4.049e-02)	(7.597e-02)	(7.644e-02)	(0.073)
GDP_Percapita	-0.000	0.002**	0.001	0.002**
	(1.623e-04)	(6.185e-04)	(9.969e-04)	(0.001)
Trade	0.029*	0.062**	0.003	0.061**
	(1.622e-02)	(2.399e-02)	(4.017e-02)	(0.024)
Agriculture	-0.095**	0.017	0.064	0.008
	(4.489e-02)	(1.439e-01)	(2.082e-01)	(0.139)
CC	0.708	2.020	0.303	2.060
	(9.052e-01)	(1.716e+00)	(1.537e+00)	(1.695)
RQ	-0.455	-2.620	-1.136	-3.024*
	(7.695e-01)	(1.706e+00)	(1.050e+00)	(1.664)
lnPop	0.417	-4.353	0.300	-5.069
	(3.552e-01)	(5.364e+00)	(5.567e-01)	(5.140)
Constant	-3.540	73.649	-5.309	
	(6.675e+00)	(8.629e+01)	(9.148e+00)	
Observations	201	201	158	170
R-squared	0.839	0.214	0.788	
N	201	201	158	
F	143.2	6.638	.	
r2	0.839	0.214	0.788	
r2_a	0.833			
Number of ID		23		21
Country FE		YES		
Rho		0.931	.	
chi2		.	607.9	
Countries				21.000
No. of instruments				170.000
AR1 p-value				0.000
AR2 p-value				0.426
Sargan p-value				0.042

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

From table 6, when using OLS lag of tax revenue and trade openness are positive and significant in explaining tax revenue, while agriculture is negative and significant in explaining tax revenue. For every one unit change in previous tax revenue, current tax revenue will go up by 0.83 units. Tax revenue will go up by 0.03 units for a unit change in trade openness. Tax revenue falls by 0.095 units for every one unit increase in agriculture output. 89 % of variation in tax revenue is

explained by the variable in the model. Using FE model to estimate the model, trade openness, and per capita GDP and lag of tax revenue are positive and significant in explaining tax revenue. Each unit increase in GDP per capital will lead to a 0.02 units increase in tax revenue (similar results were obtained by Tanzi, 1987). For every one unit increase in the lag of tax revenue will results in 0.28 units in tax revenue. Tax revenue will increase by 0.062 units for each one unit increase in trade openness. When using 2SLS model approach for estimation; only the lag of tax revenue is significant in explaining current tax revenue. A dynamic approach to estimate the coefficient, system GMM results in lag of tax revenue, trade openness, per capita GDP are positive and significant in explain tax revenue.

Regulatory quality variable is negative and significant in explaining tax revenue. Each one unit increase in per capita GDP will result in tax revenue increasing by 0.002 units, while each unit increase in previous year tax revenue will lead to a 0.27 unit increase in current tax revenue. Tax revenue will go up by 0.061 units for every one unit increase in trade openness. For every one unit improvement in regulatory quality tax revenue decreases by 3.024 units. Sargan's – statistics is significant signifying that fewer instruments are used. We made use of lag of tax revenue as an instrument when estimating GMM. The results have become robust to the choice of transformation, with a slightly improvement estimates for the trade openness parameter when the GMM estimation is employed.

The FE and system GMM models estimates are consistently small than those of OLS and GLS, this is expected of since, FE cancels out the constants and the individual specific effect, whereas OLS estimators tend to be biased. The loss of power in GMM estimators is evidence compare to the FE estimators which can be attributed to heterogeneity problem.

Table 7: Tax Effort Indices (Tax effort constructed from total tax revenue as % of GDP)[16]

Country	N(Tax_eff~1)	mean(yhat_1)	mean(Tax_~1)	mean(Tax_~e)	mean(Growth)
Algeria	15	23.17	1.32	30.89	0.04
Botswana	8	26.63	0.97	25.70	0.05
Cabo Verde	3	25.86	0.78	20.20	0.06
DRC	10	14.30	0.44	6.24	0.04
Egypt	13	19.35	0.72	13.88	0.04
Ethiopia	1	5.75	1.60	9.21	0.11
Ghana	11	14.70	1.16	16.15	0.07
Kenya	12	9.95	1.73	16.24	0.04
Lesotho	6	36.06	1.29	46.48	0.05
Madagascar	14	15.67	0.66	10.19	0.02
Malawi	7	12.93	1.17	14.88	0.06
Mauritius	13	22.95	0.75	17.04	0.04
Morocco	11	20.34	1.06	21.56	0.05
Mozambique	4	17.02	1.15	19.58	0.07
Namibia	15	22.56	1.28	28.68	0.05
Rwanda	6	9.78	1.33	12.95	0.07
Senegal	6	20.85	0.86	17.81	0.04
Seychelles	11	28.78	0.93	26.50	0.05
South Africa	15	24.51	1.04	25.35	0.03
Swaziland	12	20.79	1.09	22.63	0.03
Tanzania	6	14.07	0.89	12.42	0.06
Tunisia	13	23.41	0.85	19.64	0.03
Zambia	11	16.77	0.89	14.60	0.07

yhat is the predicted tax revenue from regression

Note: The Tax Ratio, Tax Ratio fitted and Tax effort Index is all averages of data from 2000 to 2015.

From table 7 above, Kenya has the highest tax effort of 1.73, while Democratic Republic of Congo has the lowest tax effort of 0.44. Countries such as Namibia, Swaziland, Algeria, Morocco, Malawi, South Africa, Mozambique, Namibia, Lesotho, Rwanda, and Ghana all have tax effort indices above 1. Botswana, Madagascar, Mauritius, Seychelles, Senegal, Egypt, Cabo Verde, Tanzania, Tunisia, and Zambia all have tax effort below 1. A tax effort above 1 shows that governments are collecting tax revenue above their target, while those below still have scope to strengthen their tax collection, since their collection effort is below capacity. The results are

[16]To make it easier to compare the results, all countries are included.

consistent with those found by Gupta (2000). Our finding contradicts the findings of (Leuthold's, 1991) study with regard to Senegal having low tax effort.

Kenya and DRC are extreme cases, with Kenya having the largest tax effort index and DRC having the smallest. Democratic Republic of Congo is a war ridden country, which could explain its incapacity to collect tax effectively and hence a low tax effort index.

Overall, tax capacity and tax effort appear to have substantial power in explaining the variation in tax revenue trends in different African economies. Out of the sixteen countries studied, over 63% of them have a tax effort index below 1. This means there is still more rooms for tax reform in many African states[17], which will help bolster economic development in those economies. The results obtained are mixed: we see that even countries with very low tax effort still grew at a rate above 5%, e.g. DRC. On the other end of the spectrum there is Seychelles with a mean tax effort of 0.93 but mean growth of 3% within the same period. Only seven countries have a tax effort above 1. Developing economies have more scope to grow as different growth factors start to improve; improvements in education quality and improvements in the health sector contribute to increases in productivity, declines in conflict allow more productive activities, and maturity of institutions is also likely to have a positive effect in the growth of a country's economy. These improvements do not necessarily lead to improvements in the tax collection of the country, but they certainly contribute to growth.

To check robustness, two more variables were introduced in the model: employment-to-population ratio and labour force participation rate (see table 4 in the appendix). Both variables are significant but negative in explaining tax revenue. When the estimation is performed using 2GLS model, there are no significant improvements in results.

[17] (Edward and Tabellini, 1991) cites technological constraint and economic structure of a country as sources of under-capacity of tax collection mobilization in developing economies.

Table 9: Tax effort constructed from Direct tax revenue as a % of GDP

Country	N(Tax_eff~2)	mean(yhat_2)	mean(Tax_~2)	mean(Dire~x)	mean(Growth)
Algeria	15	39.24	0.71	28.91	0.04
Botswana	11	32.92	0.38	12.48	0.05
Cabo Verde	2	22.58	1.40	31.51	0.08
DRC	12	30.93	0.42	12.87	0.05
Egypt	14	33.98	0.68	23.06	0.04
Ethiopia	4	32.45	0.49	15.95	0.10
Ghana	12	23.09	0.63	14.58	0.07
Kenya	7	22.34	0.85	19.03	0.05
Lesotho	8	24.79	1.31	32.36	0.05
Madagascar	15	24.37	2.04	49.66	0.03
Malawi	8	22.29	1.45	32.36	0.06
Mauritius	15	31.27	1.61	50.59	0.04
Morocco	11	31.49	1.13	35.46	0.05
Mozambique	7	23.04	1.45	33.27	0.07
Namibia	14	28.78	0.77	22.04	0.05
Rwanda	3	28.25	0.96	26.98	0.07
Senegal	7	22.42	1.92	43.07	0.04
Seychelles	11	47.61	0.66	31.80	0.04
South Africa	14	37.30	0.91	33.89	0.03
Tunisia	13	34.82	1.00	34.61	0.04
Zambia	8	22.98	1.45	33.13	0.07
Zimbabwe	4	31.94	1.01	32.21	0.12

yhat is the predicted tax revenue from regression

When we construct tax effort using direct tax as a percentage of GDP, Madagascar has the highest tax effort of 2.04 followed by Senegal with tax effort of 1.92, Mauritius with tax effort of 1.61; Mozambique and Zambia tie at 1.45. Botswana has the least tax effort in this category, followed by DRC and Ethiopia. Other countries with tax effort below one are Algeria, Botswana, Egypt, Ghana, Kenya, Namibia, Rwanda Seychelles, and South Africa.

Other Cabo Verde, Lesotho, Madagascar, Malawi, Mauritius, Morocco, Mozambique, Senegal, Tunisia, Zambia and Zimbabwe all have tax effort index below one.

Table 10: Tax effort constructed from Indirect Tax as % of GDP

Country	N(Tax_eff~3)	mean(yhat_3)	mean(Tax_~3)	mean(Indi~x)	mean(Growth)
Algeria	12	34.56	1.32	45.40	0.04
Botswana	9	29.46	0.90	26.61	0.04
Cabo Verde	5	22.44	0.88	19.72	0.04
DRC	12	24.74	0.43	10.53	0.05
Egypt	13	33.13	0.77	25.35	0.04
Ethiopia	4	16.22	1.04	16.85	0.10
Lesotho	8	19.54	0.96	18.82	0.05
Madagascar	8	19.98	0.53	10.68	0.04
Malawi	8	20.98	1.53	32.17	0.06
Mauritius	15	29.01	0.56	16.23	0.04
Morocco	10	28.35	0.93	26.29	0.05
Mozambique	8	21.76	1.36	29.19	0.07
Namibia	15	26.43	1.36	35.77	0.05
Rwanda	3	10.97	1.90	20.81	0.07
Senegal	7	26.53	0.80	21.27	0.03
Seychelles	11	18.06	1.09	19.40	0.04
South Africa	15	47.05	1.08	50.56	0.03
Tunisia	13	24.03	1.05	25.00	0.04
Zambia	14	28.29	1.27	35.71	0.07
Zimbabwe	4	27.42	1.05	28.72	0.12

When tax effort is derived using indirect tax as % of GDP, Rwanda still has the highest tax effort of 1.90 followed by Malawi with tax effort of 1.53, Algeria with 1.32 and Mozambique with 1.36, Zambia with 1.27 and Namibia with 1.36.Botswana, Cabo Verde, DRC, Egypt, Lesotho, Madagascar, Mauritius, Morocco, Senegal all have tax effort below one, therefore can be considered to be under-capacity in tax mobilization through indirect tax collection.

Table 11: Tax effort for constructed from Corporate tax as % of total tax revenue

Country	N(Tax_eff~4)	mean(yhat_4)	mean(Tax_~4)	mean(Corp~x)	mean(Growth)
Cabo Verde	8	1.65	1.50	2.46	0.03
DRC	15	1.53	1.04	0.94	0.05
Egypt	14	3.75	1.32	5.01	0.04
Ghana	15	2.30	0.95	2.20	0.06
Kenya	15	2.16	1.06	2.29	0.05
Lesotho	8	2.42	1.16	2.81	0.05
Morocco	15	3.71	1.12	4.20	0.04
Rwanda	11	1.79	1.80	2.02	0.08
Senegal	15	2.35	0.68	1.58	0.04
South Africa	15	5.44	0.91	4.97	0.03
Swaziland	15	2.54	0.92	2.34	0.04
Tunisia	15	3.91	0.89	3.46	0.03

Only four countries out of twelve have tax effort below one for all set of countries with corporate tax data. Rwanda has the highest tax effort of 1.80 while Senegal has the lowest tax effort of 0.68. Other countries with tax effort below one are Tunisia (0.89), Swaziland (0.92), and South Africa with 0.91 and Ghana with tax effort of 0.95. The discernible conclusion is that tax effort from corporate tax is relatively higher for all the countries in the sample.

Table 12: Tax effort for total tax revenue, direct tax, indirect tax and corporate tax

Country	mean(Tax_ef~1)	mean(Tax_ef~2)	mean(Tax_ef~3)	mean(Tax_ef~4)
Algeria	1.323415	.7148383	1.317327	
Botswana	.9658526	.3804433	.9035932	
Cabo Verde	.780984	1.399627	.8785213	1.500129
DRC	.4391599	.4162695	.4321529	1.042621
Egypt	.7208502	.6789281	.7678192	1.31877
Ethiopia	1.60229	.4897902	1.040132	
Ghana	1.158701	.6300969	.9481468	
Kenya	1.73346	.8479888	1.06338	
Lesotho	1.287709	1.307845	.9625983	1.161942
Madagascar	.6590577	2.037817	.5268015	
Malawi	1.16641	1.451234	1.530397	
Mauritius	.7515024	1.614729	.5563425	
Morocco	1.0624	1.127639	.9283885	1.118605
Mozambique	1.15032	1.450168	1.357362	
Namibia	1.281181	.7740723	1.359467	
Rwanda	1.325808	.9560944	1.898121	1.804806
Senegal	.8622135	1.92184	.8018553	.676412
Seychelles	.9307286	.6601914	1.085065	
South Africa	1.035466	.9112156	1.076272	.9095188
Swaziland	1.088566		.920478	
Tanzania	.893248			
Tunisia	.8456839	.997117	1.052931	.8919035
Zambia	.8933678	1.450377	1.273811	
Zimbabwe	1.010834	1.046361		

Only Cabo Verde, DRC, Egypt, Lesotho, Morocco, Senegal, Rwanda, South Africa and Tunisia have complete data for the four different tax categories. For all these countries, tax effort is below one for at least one category. Cabo Verde, Egypt Senegal, Rwanda, South Africa have tax effort below one for two categories, while DRC, Cabo Verde and Tunisia have tax effort below one for three categories. Lesotho and Morocco both have tax capacity below one in one category.

1.6 Conclusion

Overall the analysis suggests four conclusions. First, macroeconomic effect, demographic effect, and institutional effect variables play a significant role in determining tax revenue collection in African economies. Second, among the six regression analyses performed, GDP per capita,

trade, and corruption control were all significant at a conventional level, with the exception of the logarithm of population, regulatory quality and agriculture as a percentage of GDP being either significant or insignificant across different estimation models. Third, the results fully support the findings of Bird, et al (2004). 11 countries out of 16 countries with comparable data set have tax effort below 1, signifying room for improvement in tax mobilization in the respective countries. The main finding of this analysis is that GDP per capita, trade openness and governance are positive and significant determinant of tax revenue. This finding suggest that improvement in governance, trade openness and output growth are desirable tools in revenue mobilization in African economies. These findings are noteworthy, since their sample period starts from 2000 to 2015, which is outside the examined period of previous, similar studies, and since the study uses OLS regression rather than panel data estimation. There is scope for additional work, focusing on establishing the role tax effort index plays in determining budget deficits in developing economies. The dynamic panel data estimations findings confirms that trade openness, per capita GDP, the lag of tax revenue and regulatory quality are all significant in explaining tax revenue .

1.7 References:

Addison, Tony and Levin Jorgen (2012)" The Determinant of tax Revenue in sub-Saharan Africa",Swedish Business School, Orebro University.

Anderson, T.W. and C.Hsiao (1982),"Formulation and estimation of dynamic models using panel data", *Journal of Econometrics 18, 47-82.*

Arellano, M. & S. Bond (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations, *Review of Economics Studies 58*.

Aizenman, Joshua and Yothin JinJarak (2009) "Globalization and Developing Countries-A Shrinking Tax Base?" Journal of Development Studies, Vol.45 No.5 pp.653-671 (May).

Arellano, M., & Honore, B., (2001), "Panel Data Models: Some recent developments" Chapter 53 in Handbook of Econometric,Vol.5,pp.3229-3296.

Arellano, M. and O.Bover (1995). Another look at the instrumental variable estimation of error-components model. *Journal of Econometrics* 68, 29-51

Bahl, R, W(1971). A regression approach to tax effort and tax ratio analysis. IMF Staff working Papers. N.18, p.570-607, 1971.

Baltagi, B, H, (2005), Econometric Analysis of Panel Data, 3rd Edition: Chapter 2. The one-way error component Regression model, pp. 11-28. John Wiley & Sons, Ltd.

Bird, Richard M., Jorge Martinez-Vazquez, and Benno Torgler (2004). "Societal Institutions and Tax Efforts in Developing Countries." Working Paper 04-06. Andrew Young School of Policy Studies, Georgia State University: Georgia, Atlanta

Bird, R.M. (2004) "Managing Tax Reform, "Bulletin for International Fiscal Document, 58:42-55.

Bird, R.M(1989) "The Administrative Dimension of Tax Reform in Developing Countries," in Malcolm Gills, ed., Tax Reform in Developing Countries (Durham:Duke University Press).

Blundell, R. and S. Bond (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics* 87, 115-143.

Blundell, R., Bond, S.,Windmeijer, F., (2000), "Estimation in Dynamic Panel Data Models: Improving on the Performance of the Standard GMM Estimators." No W00/12 IFS Working Paper from Institute for Fiscal Studies.

Bun,J.G.M, & Sarafidis, V., (2018), " Dynamic Panel Data Models", Amsterdam School of Economics, Department of Economics & Econometrics. The Netherlands.

Brun J.-F., Diakité M. (2016) "Tax Potential and Tax Effort: An Empirical Estimation for Non resource Tax Revenue and VAT's Revenue", Études *et Documents*, n° 10, CERDI. http://cerdi.org/production/show/id/1814/type_production_id/1

Chelliah, R.J. (1971), Trends in Taxation in developing countries. IMF Staff Papers, n.18. pp 254-331.

Chelliah, R.J., Baas, H. J,. Kelly, M. R. Tax ratios and Tax effort in developing countries, 1969-1971. IMF Staff Papers, n.187-205, 1975.

Chelliah , Raja J and Sinha (1982): Measurement of Tax Effort of State Governments (1973-76)' Somaiya Publication, Bombay.

Clark, Tom S and Drew A Linzer. 2013. "Should I use Fixed or Random Effects?".

Clarke, Paul, Claire Crawford, Fiona Steele and Anna Vignoles. 2010. "The Choice Between Fixed and Random Effects Models: Some Considerations for Educational Research". IZA Discussion Paper Series No. 5287.

Clements, B., Bhattacharya, R., and Nguyen, T.Q (2003). "External Debt, Public Investment, and Growth in Low-Income Countries." IMF Working Paper, Fiscal Affairs Department. WP/03/249.

Cukierman, A., S. Edwards and G. Tabellini,(1989)," Seigniorage and Political Instability, "NBER Working Paper No.3199.

Davoodi, Hamid R. and David A. Grigorian (2007) "Tax Potential vs Tax Effort: A cross Country Analysis of Armenia's Stubbornly Low Tax collection," IMF Working Paper No: WP/07/106 (May 2007).

Dwivedi, D N (1980): "Trends in Tax Effort of Indian State' mimeo, unpublished

Edward, S, & Tabellini, G, (1991), " Explaining fiscal policies and inflation in developing countries"*Journal of International Money and Finance*, 10, S16-S48.

Fox,William F. and Tami Gurley (2005) "An Exploration of Tax Patterns around the World." Tax Notes International: Special Reports, 37:9,pp.793-807.

Garikai , B.W.(2009) An empirical Analysis of the Determinants of Tax Buoyancy in Developing Nations. An experience from SADC Economies using Panel Data Analysis. Unpublished MSc Thesis, University of Zimbabwe: Department of Economics , Faculty of social Studies . University of Zimbabwe.

George K. Zestos, Travis K. Taylor and Ryan D. Patnode, Journal of Economic Integration. Vol.31, No. 4 (December 2016) . pp. 898-931.

Ghura, Dhaneshwar (1998) "Taz Revenue in Sub-Sahara Africa: Effects of Economic Policies and Curruption ," IMF Working Paper, No: WP/98/135 (September 1998)

Gupta, Abhijit Sen (2000) "Determinants of Tax Revenue Efforts in Developing Countries, "IMF Paper, No:WP/07/184 (July).

Gupta, S.A. (2007) .Determinants of Tax revenue Efforts in Developing Countries. IMF Working paper WP/07/184.Washington D.C.

Gujarati, D.N, Porter,D.C,(2008) " Chapter 16: Panel Data Regression Models" Basic Econometrics, Fifth Edition. Published by McGraw-Hill/Irwin.

Harley Hinrichs, "Determinants of Government Revenue Share among Less Developed Countries," Economic Journal, vol. 75 (September 1965). See also Hinrichs's book, A General Theory of Tax Structure Change during Economic Development (Cambridge, Mass.: Harvard Law School,1965.

Hinrichs,H.H.(1966) A general Theory of Tax Structure Change during Economic Development (Cambridge,MA: Harvard Law School International Tax Program).

Junji, Meda (2015), VAT GAP Analysis; IMF's approach and a case for South Africa.

Janet G. Stotsky and Asegedech WoldeMariam (1997), "Tax effort in Sub-Sahara Africa", IMF Working paper; WP/97/107. Fiscal Affairs Department.

Joergen R. Lotz and Elliott R. Morss, "Measuring Tax Effort in Developing Countries," International Monetary Fund Staff Papers, vol. 14 (November 1967).

Kaldor, N.(1963) Will Underdeveloped Counties Learn to Tax? Foreign Affairs, 41:410-19.

Khwaja, M. S., Iyer . I, (May, 2014) , "Revenue Potential , Tax Space, and Tax Gap: A Comparative Anaysis" Policy Research Working Paper 6868. World Bank.

Leuthold, Jane H.(1991) "Tax Shares in developing countries: A panel study," *Journal of Development Economics*, Vol.35, pp.173-185.

Leuthold, J.H.,1991. Tax shares in developing economies: a panel study.J.Dev. Econ 35 (1), 173-185.

Lotz,J.R., Moss, E. A theory of Tax level determinants for developing countries. Economic Development and Cultural Change, n.18, p.328-341, 1970.

Lotz, J.R & Morse. E.R., (1967): 'Measuring Tax effort in Developing countries', Staff Papers, Vol 14, No. 3.

Makate, M.,Mahonye, N., Mandishara, L (2018) " Economic Growth and External Debt in Selected Sub-Saharan Africa Countries." MEFMI Reseach and Policy Jounal: Issue 2. Pp24-45.

Mertens, J.B.,2003. Measuring tax effort in Central and Eastern Europe. Public Financ.Manaf.3(4), 530-564.

Michael, A., Rossouw , J., Gwatidzo, T., (2018), " Determinants of tax revenue performance in the Southern African Development Community (SADC), ERSA, working paper 762.

Thandika Mkandawire (2010), On Tax Efforts and Colonial Heritage in Africa, The Journal of Development Studies, 46:10, 167-1669, DOI: 10.1080/00220388.2010.500660.

Nickell,S., (1981), " Biases in Dynamic Models with Fixed Effects", Econometrica, Vol.49.No.6, pp.1471-1426.

Norregaarrd, John and Tehmina S. Khan (2007) "Tax Policy: Recent Trends and coming Challenges, " IMF Working Paper, No: WP/07/274 (December 2007).

Oommen, M. A, (1987):' Relative Tax Effort of States', Economic and Political Weekly, March 14.

Paul Carrillo, Dina Pomeranz and Monica Sighal (2017), Dodging the Taxman: Firms Misreporting and Limits to Tax Enforcement. *Journal of Applied Economics*, 9(2):144-164.

Pattillo, Catherine, Helene Poirson and Luca Ricci, 2002, "External Debt and Growth, IMF Working Paper 02/69 (Washington: International Monetary Fund).

Piancastelli, Marcelo (2001), Measuring Tax effort of developed and Developing countries: Cross country Panel Data Analysis -1985/95. Published by IPEA.

Purohit, C, Mahesh (2006). "Tax efforts and Taxable Capacity of Central governments", Economic and Political Weekly, Vol.41. No.8

Reddy, N K (1975): 'Inter-state Tax Effort,' Economic and Political Weekly, December 13.

Rodrik, Dani(1998) "Why Do More Open Economies Have Bigger Governments?" *Journal of Political Economy*, 106:5, pp.997-1032.

Schaffer, M.E.,Stillman, S. 2010. Xtoverid: stata module to calculate tests of overidentifying restrictions after xtreg,xtivreg, xtivreg2 and xthtylor: http://ideas.repec.org/c/boc/bocode/s456779.html.

Snider, L.W, (1990) , The Political Performance of Governments, External Debt Service, and Domestic Political Violence. International Political Science Review. Vol. 11, No.4, 403-422

Tait, A., Gratz, W.L.M.,Eichengreen, B.J. International comparisons of taxation for selected developing countries:1972-1976. IMF Staff Papers,n.26, p.123-156, 1979.

Tanzi, Vito (1992) "Quantitative Characteristics of the Tax Systems of Developing Countries: A Decade of Evidence," in Open Economies: Structural Adjustment and Agriculture. I Goldin and L.A.. Winters eds. Cambridge: Cambridge University Press, pp.267-81

Tanzi, V.,Zee, H., 2000. Tax policy for emerging markets: developing countries. International Monetary Fund Working Paper, Washington D.C.,00(35).

Tanzi, Vito and Hamid Davoodi. 1997 "Corruption, Public Investment and Growth." Working Paper /97/139, International Monetary Fund, Washington, DC.

Thuto Feger, John Asafu-Adjaye (2014)."Tax effort performance in sub-Sahara Africa and the role of colonialism." *Journal of Economic Modelling* 38. pp.163-174

Thiammaiah, G (1979): 'Revenue Potential and Revenue Efforts of Southern States, Oxford and IBH Publishing Co. New Delhi.

Torgler , B. And F. Schneider. 2007. "Shadow Economy, Tax Morale, Governance and Institutional Quality: A Panel Analysis." IZA Discussion Papers 2563, Institute for Study of labour (IZA).

Tuan,M.L, Dorson, B.M, Bayraktar (2012), Tax Capacity and Tax effort; Extended Cross Country Analysis: 1994-2004. Policy working Paper 6252. The World Bank, Investment Climate Department.

Wooldridge, J.M, 2005. Fixed Effects and Related Estimators for Correlated Random-Coefficient and Treatment-Effect Panel data Models. Review of Economics and Statistics. Vol 87; Issue 2, pp. 385-390

Zee, H.H. Empirics of cross country tax revenue comparisons. World Development, n. 24, p.1.659-1.671, 1996.

Appendix

Table 12: Tax revenue as a percentage of GDP for the countries in the study.

Country	Number of Observation	Average Tax Revenue as % of GDP
Algeria	16	29.93
Angola	12	22.78
Botswana	8	25.70
Cape Verde	5	20.89
DRC	10	6.24
Egypt	13	13.88
Ethiopia	11	8.47
Ghana	11	16.15
Kenya	13	16.36
Lesotho	11	44.04
Madagascar	14	10.19
Malawi	7	14.88
Mauritius	14	16.91
Morocco	11	21.56
Mozambique	4	19.58
Namibia	15	28.68
Rwanda	6	12.95
Senegal	6	17.81
Seychelles	12	26.65
South Africa	16	25.22
Swaziland	12	22.63
Tanzania	6	12.42
Tunisia	13	19.64
Zambia	11	14.60

Table 14: External Debt as a % of GDP for the countries in the study

Country	Number of Observation	Average External Debt as % of GDP
Algeria	16	25.63
Angola	16	44.37
Botswana	16	13.24
Cape Verde	15	84.22
DRC	16	60.84
Egypt	16	79.70
Ethiopia	16	67.42
Ghana	16	58.16
Kenya	16	47.88
Lesotho	16	60.83
Madagascar	16	57.98
Malawi	15	82.28
Mauritius	16	51.56
Morocco	16	58.21
Mozambique	16	62.87
Namibia	16	23.34
Rwanda	16	51.99
Senegal	16	46.55
Seychelles	16	126.35
South Africa	16	37.12
Swaziland	12	15.75
Tanzania	6	42.01
Tunisia	13	50.65
Zambia	11	69.68

Table 15: Average Tax effort, Population and Labour participation rate[18]

Country	N(Tax_effort)	mean(Tax_ef~t)	mean(lnPop)	mean(Labour~e)
Algeria	15	1.43	17.37	75.45
Botswana	8	1.18	14.48	73.18
Cabo Verde	3	1.71	13.09	77.56
DRC	10	0.41	17.90	73.67
Egypt	13	0.66	18.20	77.41
Ghana	11	0.71	16.95	78.81
Kenya	12	0.95	17.47	70.94
Lesotho	6	3.20	14.51	77.35
Madagascar	14	0.57	16.79	90.63
Malawi	7	0.92	16.46	80.90
Mauritius	13	0.80	14.03	81.27
Morocco	11	1.04	17.27	79.48
Mozambique	4	1.01	16.93	79.90
Namibia	15	1.62	14.57	65.63
Rwanda	6	0.72	16.08	88.71
Senegal	6	1.16	16.31	71.98
South Africa	15	0.89	17.72	64.20
Tanzania	6	0.56	17.57	85.34
Tunisia	13	0.93	16.16	75.11
Zambia	11	1.13	16.38	83.69

[18] The table gives the average of tax effort, logarithmic of population, and labour participation rate

Table 16: Tax revenue as a percent of GDP (Source of data: WDI)

Country	N(Tax_Rev~e)	mean(Tax_~e)	sd(Tax_Re~e)	max(Tax_R~e)	min(Tax_R~e)
Algeria	16	29.93	9.60	45.25	15.52
Angola	12	22.78	4.79	29.31	16.87
Botswana	8	25.70	1.53	27.37	23.17
Cabo Verde	5	20.89	1.56	22.74	18.42
DRC	10	6.24	2.16	9.24	2.75
Egypt	13	13.88	1.10	15.83	12.38
Ethiopia	11	8.47	0.94	9.71	6.58
Ghana	11	16.15	3.31	21.75	12.61
Kenya	13	16.36	1.08	18.67	15.14
Lesotho	11	44.04	8.30	58.47	32.97
Madagascar	14	10.19	1.17	12.98	7.67
Malawi	7	14.88	0.85	15.93	13.56
Mauritius	14	16.91	1.24	18.51	14.96
Morocco	11	21.56	2.68	26.49	17.94
Mozambique	4	19.58	2.94	23.13	16.12
Namibia	15	28.68	3.37	33.58	23.18
Rwanda	6	12.95	0.72	14.01	12.10
Senegal	6	17.81	1.36	19.00	16.12
Seychelles	12	26.65	2.53	31.49	22.37
South Africa	16	25.22	1.41	27.60	23.04
Swaziland	12	22.63	5.61	30.98	16.00
Tanzania	6	12.42	0.52	13.23	11.74
Tunisia	13	19.64	0.91	21.19	18.51
Zambia	11	14.60	1.23	16.54	12.50

Table 17: Direct Tax as percent of GDP (Source of data:WDI)

Country	N(Direct_~x)	mean(Dire~x)	sd(Direct~x)	max(Direc~x)	min(Direc~x)
Algeria	16	27.37	22.65	64.12	3.75
Angola	13	7.08	4.86	21.08	3.09
Botswana	11	12.48	2.08	15.39	8.83
Cabo Verde	6	33.03	4.82	41.09	27.33
DRC	12	12.87	1.50	14.78	9.42
Egypt	14	23.06	2.85	27.61	19.40
Ethiopia	14	13.67	3.63	21.67	9.25
Ghana	12	14.58	2.02	17.00	10.96
Kenya	8	19.22	3.85	24.48	11.91
Lesotho	9	32.52	3.56	36.71	25.27
Madagascar	16	50.09	5.98	58.48	41.82
Malawi	9	32.52	3.56	36.71	25.27
Mauritius	16	50.09	5.98	58.48	41.82
Morocco	11	35.46	2.40	39.66	32.54
Mozambique	7	33.27	2.20	36.39	31.06
Namibia	15	22.01	2.82	27.68	18.06
Rwanda	3	26.98	2.20	29.46	25.27
Senegal	7	43.07	1.84	44.99	40.68
Seychelles	12	33.21	13.95	48.69	5.16
South Africa	15	33.84	1.36	36.19	31.35
Swaziland	1	34.60	34.60	34.60	
Tunisia	14	34.90	3.06	38.56	28.72
Zambia	9	34.33	5.51	43.89	26.21
Zimbabwe	4	32.21	3.06	35.81	28.96

Tax on goods and services is defined as all taxes levied on the production, extraction, sale, transfer, leasing or delivery of goods, and the rendering of services, or on the use of goods or permission to use goods or to perform activities. They consist mainly of value added and sales taxes. This covers: multi-stage cumulative taxes; general sales taxes - whether levied at manufacture/production, wholesale or retail level; value-added taxes; excises; taxes levied on the import and export of goods; taxes levied in respect of the use of goods and taxes on permission to use goods, or perform certain activities; taxes on the extraction, processing or production of minerals and other products. This indicator relates to government as a whole (all government levels) and is measured in percentage both of GDP and of total taxation: Source (OECD)

Table 18: Indirect Tax as % of GDP (source: WDI)

Country	N(Indirec~x)	mean(Indi~x)	sd(Indire~x)	max(Indir~x)	min(Indir~x)
Algeria	13	48.03	26.79	79.54	5.39
Angola	16	40.93	9.25	55.98	27.61
Botswana	9	26.61	2.46	29.40	22.23
Cabo Verde	6	19.49	2.26	24.06	18.16
DRC	12	10.53	2.74	15.72	4.81
Egypt	13	25.35	3.39	29.67	19.12
Ethiopia	14	14.87	3.85	21.44	9.40
Lesotho	12	19.57	2.93	24.88	14.98
Madagascar	8	10.68	4.03	18.22	6.21
Malawi	9	32.88	5.55	38.74	24.82
Mauritius	16	15.93	3.48	22.16	11.41
Morocco	10	26.29	2.53	31.79	22.40
Mozambique	8	29.19	5.74	35.50	20.71
Namibia	16	35.76	3.40	42.44	31.79
Rwanda	3	20.81	1.72	22.43	19.00
Senegal	8	21.27	1.50	23.33	18.91
Seychelles	12	19.06	6.21	31.46	12.72
South Africa	16	50.63	1.93	54.45	47.40
Tunisia	14	24.68	3.06	27.95	19.09
Zambia	15	35.64	4.80	44.04	25.90
Zimbabwe	4	28.72	4.65	32.14	21.87

Tax on corporate profits is defined as taxes levied on the net profits (gross income minus allowable tax reliefs) of enterprises. It also covers taxes levied on the capital gains of enterprises. This indicator relates to government as a whole (all government levels) and is measured in percentage both of GDP and of total taxation. (Source OECD)

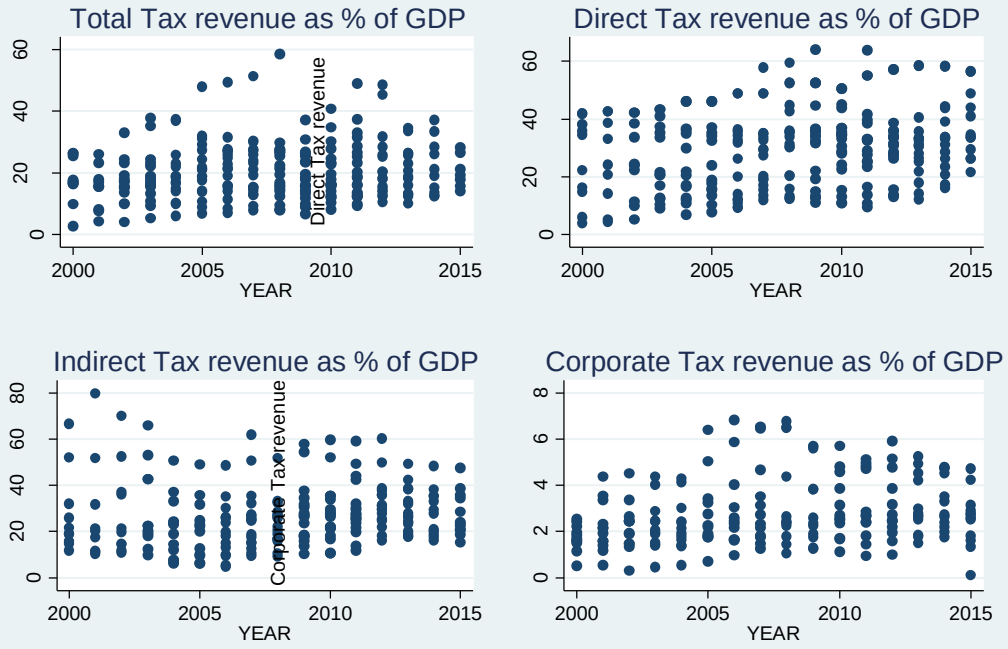
Table 19: Corporate Tax as a % of GDP and of total taxation (Source: OECD)

Country	N(Corpora~x)	mean(Corp~x)	sd(Corpor~x)	max(Corpo~x)	min(Corpo~x)
Cabo Verde	15	2.55	0.36	3.53	1.78
DRC	16	0.97	0.45	1.99	0.29
Egypt	15	4.90	1.73	6.82	0.12
Ghana	16	2.16	0.68	3.52	1.46
Kenya	16	2.25	0.39	3.13	1.57
Lesotho	16	2.24	0.78	3.81	1.16
Morocco	16	4.08	1.24	6.50	2.21
Rwanda	16	1.99	0.36	2.60	1.39
Senegal	16	1.57	0.17	1.85	1.29
South Africa	16	4.93	0.98	6.76	2.54
Swaziland	16	2.37	0.42	3.30	1.84
Tunisia	16	3.38	0.91	4.77	1.95
Zambia	1	1.60	1.60	1.60	

Table: Average of total tax revenue, direct tax, indirect tax and corporate tax

Country	mean(Tax_Re~e)	mean(Direct~x)	mean(Indire~x)	mean(Corpor~x)
Algeria	29.931716	27.369949	48.026121	
Botswana	25.701025	12.476541	26.610218	
Cabo Verde	20.886524	33.031986	19.49034	2.5516
DRC	6.2351726	12.872757	10.530936	.9681875
Egypt	13.878161	23.059558	25.345852	4.8968
Ethiopia	8.4690253	13.672771	14.868438	
Ghana	16.153205	14.576247	2.156375	
Kenya	16.359438	19.21618	2.2474375	
Lesotho	44.036622	32.518707	19.571469	2.2365
Madagascar	10.192119	50.092099	10.680505	
Malawi	14.879008	32.518707	32.883256	
Mauritius	16.91267	50.092099	15.932193	
Morocco	21.561138	35.462396	26.287106	4.07825
Mozambique	19.579591	33.274904	29.190565	
Namibia	28.677649	22.00926	35.756496	
Rwanda	12.954275	26.984973	20.80696	1.988
Senegal	17.814953	43.074823	21.268885	1.573125
Seychelles	26.65115	33.210706	19.055101	
South Africa	25.221192	33.838001	50.633126	4.931625
Swaziland	22.631557	34.603686	2.3735	
Tanzania	12.417594			
Tunisia	19.639707	34.895418	24.676055	3.3768125
Zambia	14.603951	34.325314	35.638372	1.604
Zimbabwe	32.210319	28.723338		

FIGURE 1:Mean of Tax by Tax type as % of GDP



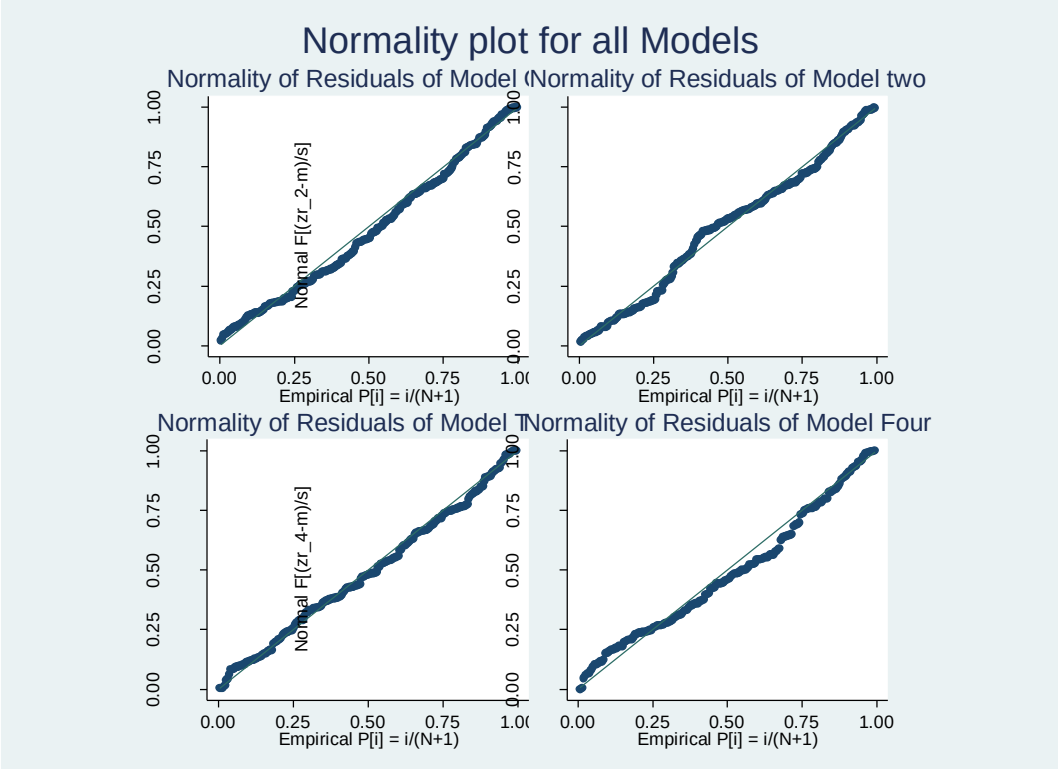

Normality plot for all Models
Normality of Residuals of Model one
Normality of Residuals of Model two
Normality of Residuals of Model Three
Normality of Residuals of Model Four
Normal F[(zr_2-m)/s]
Normal F[(zr_4-m)/s]
Empirical P[i] = i/(N+1)
0.00
0.25
0.50
0.75
1.00

Table 4: Robust check Estimates

VARIABLES	(1) OLS_1	(2) OLS_2	(3) OLS_3	(4) FE_1	(5) FE_2	(6) FE_3
GDP_Percapita	-0.001*			0.002***		
	(3.808e-04)			(6.278e-04)		
Trade	0.157***	0.147***	0.167***	0.091***	0.093***	0.098***
	(2.873e-02)	(2.747e-02)	(2.724e-02)	(2.382e-02)	(2.437e-02)	(2.418e-02)
Agriculture	-0.484***	-0.084	-0.229***	0.208	0.183	0.181
	(8.109e-02)	(7.960e-02)	(5.748e-02)	(1.316e-01)	(1.341e-01)	(1.337e-01)
CC	2.553*	2.630**	2.015*	3.971**	4.055**	3.635**
	(1.319e+00)	(1.163e+00)	(1.139e+00)	(1.554e+00)	(1.584e+00)	(1.611e+00)
lnPop	1.866***	1.136*	1.527**	3.786	8.317**	8.089*
	(6.467e-01)	(6.231e-01)	(6.077e-01)	(4.409e+00)	(4.155e+00)	(4.151e+00)
Employment_populationRatio		-0.196***			0.101	
		(4.131e-02)			(1.151e-01)	
Labourparcticipationrate			-0.360***			-0.241
			(7.115e-02)			(1.932e-01)
Constant	-13.078	-1.503	13.306	-57.434	-130.623*	-105.055
	(1.215e+01)	(1.187e+01)	(1.272e+01)	(7.285e+01)	(6.943e+01)	(7.164e+01)
Observations	199	199	199	199	199	199
R-squared	0.452	0.502	0.509	0.157	0.125	0.129
N	199	199	199	199	199	199
r2	0.452	0.502	0.509	0.157	0.125	0.129
F	31.84	38.95	40.05	6.492	4.973	5.152
Rho	.	.	.	0.897	0.961	0.953
chi2	.	.	.	.	.	.
Number of ID				20	20	20

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

Table 5: Further robust check estimates

VARIABLES	(1) OLS_1	(2) OLS_2	(3) OLS_3	(4) FE_1	(5) FE_2	(6) FE_3
GDP_Percapita	0.000			0.002***		
	(3.935e-04)			(6.352e-04)		
Trade	0.147***	0.136***	0.154***	0.082***	0.085***	0.091***
	(2.833e-02)	(2.724e-02)	(2.664e-02)	(2.367e-02)	(2.433e-02)	(2.408e-02)
Agriculture	-0.422***	-0.204***	-0.313***	0.015	0.005	0.012
	(8.128e-02)	(7.706e-02)	(5.571e-02)	(1.409e-01)	(1.440e-01)	(1.431e-01)
RQ	-3.290***	-2.682***	-3.079***	-2.909*	-2.479	-2.444
	(1.195e+00)	(1.001e+00)	(9.799e-01)	(1.584e+00)	(1.618e+00)	(1.606e+00)
lnPop	0.700	0.002	0.397	-2.309	2.950	3.014
	(5.610e-01)	(5.622e-01)	(5.301e-01)	(4.714e+00)	(4.445e+00)	(4.418e+00)
Employment_population ratio		-0.172***			0.083	
		(4.054e-02)			(1.167e-01)	
Labour participation rate			-0.356***			-0.314
			(6.983e-02)			(1.911e-01)
Constant	2.342	18.119*	32.939***	45.166	-39.212	-13.730
	(1.102e+01)	(1.096e+01)	(1.174e+01)	(7.789e+01)	(7.436e+01)	(7.496e+01)
Observations	199	199	199	199	199	199
R-squared	0.462	0.507	0.526	0.142	0.104	0.115
N	199	199	199	199	199	199
r2	0.462	0.507	0.526	0.142	0.104	0.115
F	33.21	39.76	42.75	5.770	4.045	4.534
Rho	.	.	.	0.835	0.917	0.893
chi2	.	.	.	.	.	.
Number of ID				20	20	20

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