Optimizing Tax potential in Ethiopia, *Rahel Jigi[1] Kitessa*

Abstract

In designing a tax policy, governments often face when and how to mobilize revenues. Crucial to those questions include, are we already collecting more revenue than the economy can produce or not? The current study has precisely addressed this question in the case of Ethiopia. Tax effort prediction is made via an error correction model. The finding shows that tax effort, theoretically measured as the difference between tax revenue collected and tax potential is extremely low in the country. This problem becomes more complicated when GDP shows as a rather inverse predictor of tax potential, indicating massive work of tax base identification to enable tax ratio moves with the speed of GDP growth.

Keywords: *Tax Policy; Tax effort, Public Finance, Economic Development, Tax ration, Tax Administration*

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Introduction

The tax system of a country is one of the key indicators of public sector administration. A good tax policy will ideally have relevant information to use taxation as an economic tool and method of raising optimal revenue. Among the key information for taxation is optimal revenue mobilization. Scholars in public finance have long identified optimal revenue as a key input for tax policy formulation and sustainable development among others (Stiglitz, 2000; Grubber, 2016). However, developing countries often face a problem of important input for designing tax policy in line with country-specific requirements (Bahl & Bird, 2008). Among these input data, the tax capacity of the country which is closely associated with tax potential and tax effort in literature are the major areas of interest (Moor et al, 2007; Besley and Perssin, 2013; Bird, 2014).

Various empirical works have assessed the determinants of government revenue to increase understanding of optimal taxation. Historically, since the first attempt to quantify the factors that affect a country's revenue share by Willimson (1961), two types of factors were identified as determinants; the stage of development and the size of foreign trade. The first study that utilized statistical results to analyze the tax effort was by Lotz and Morss (1967). Since then numerous studies were carried out in the arguing for broader determinants of tax capacity and tax effort there of (see Plasschaert, 1962; Hinrichs, 1966; Thorn, 1967; Weiss, 1969; Shin, 1969; Lotz and Morss, 1970).

More recently, literature has attempted to included various additional variables in the prediction of tax potential. Agbeyegbe et al. (2006) examined the

role of trade liberalization and exchange rate. This study has expanded the previous work of early literature that has focused on the role of the exchange rate to drive cross country and cross-region comparison of tax ratios. Bird et al (2008) included the role of citizens' perception of corruption and accountability in the country on the revenue of the country. Bird argued that in addition to studying the supply side of tax ration determinants it might also be crucial to add the demand-side variables. However, as we see it later, our model does not adopt Birds' argument of tax ratio predictors. Furthermore, Bird (2014), assessed to what extent societal institutions including rule of law affect revenue share.

Mansour (2014), has contributed an important milestone in providing tax revenue dataset for Sub-Saharan Africa that covers a period of 1980-2010. This has enabled the emergence of many tax-related studies that utilized the data for tax-ratio analysis in Sub Saharan region (Goujon and Yohou; Closset et al, 2016; Feindouno and Goujon, 2016; Pichard, 2016)

The effect of foreign aid on tax ratio is also widely studied within this literature (Knack, 2009; Prichard et al., 2013; Brun et al., 2011; Crivelli and Gupta; Yohou et al., 2016; Thornton, 2014).

Hence, literaturehas exerted efforts to come up with better predictors of countries' tax potential with a lion's share conducted at the regional level, especially in sub-Saharan countries. The aim was two folds; the first one is to contribute to the precise estimation of tax potential and tax effort in this region. The second is to give a glimpse of tax ratio in this region with the intention of promoting a strong tax system as a favorable tool to strengthen a region with a financial power.

However, governments often face, when and how to mobilize revenues. Crucial to those questions include, are we already collecting more revenue than the economy can produce or not? The current study precisely addressed this question. This paper addressed this question albeit contributing to the method of analysis by employing the error correction method to establish long-run relationship of tax ratio and classical structural variables. Specifically, this study seeks to answer two main research questions:

Question 1: What is the level of tax effort as compared to tax potential in Ethiopia?
Question 2: What are the determinants of tax effort in Ethiopia?

The objective of these questions is to create rigorous evidence of the estimated tax effort in Ethiopia. The study gives an insight into the potential of tax and relates it to the tax effort which helps to design important policy based on the current initial study while providing evidence and a stepping stone for consequent studies which can be developed in the current paper.

The Model and Data

Before specifications of the model are presented, it is important to provide a definition of important concepts that are central to this paper. In line with previous literature which has wielded considerable work on differentiating between tax capacity and tax effort, two of these terms are treated differently in this paper. Hence, tax capacity is the revenue that can be raised by a country as predicted by structural variables while tax effort is defined as a prediction that is believed to capture the extent to which the country's capacity is being utilized. Following this standard definition in literature, in this paper distinctions between terms are adopted. Hence, the definition of tax capacity or potential tax level is different from the tax effort. The potential tax level is the level of the tax collection, as predicted by the structural factors of an economy but are independent of authorities' willingness at least in the short run (Brun et al. 2011a; Goujon and Wagner, 2016).

These structural factors include trade openness, the level of development, and the sectoral composition of the economic variables. The tax effort measures the extent to which the actual level of tax revenues deviates from the potential tax as predicted by these structural factors. Tax effort in this study then is considered as the result of political will and policies, represented as follows. The general representation of this concept is presented as follows.

Tax ratio is assumed to be a function of taxable capacity and tax effort (E). Effort ration in a country is then

$$E = (T/Y)/(T^\wedge/Y)$$

$$E = T/T^\wedge \quad (1)$$

This can be rewritten in an econometric regression of the actual tax revenue at year t (TR_t) on the structural determinants of tax (X_t):

$$TR_t = \beta X_t + E_t \qquad (2)$$

The residual of the regression (E_t) derived from the regression represents the tax effort:

$$E_{it} = T_t - \beta X_t \qquad (3)$$

Tax effort is then considered as relatively low (high) if the observed tax is lower (higher) than the predicted tax β^Xt, resulting in a negative (positive) value of Et. Hence, tax effort measures revealed an estimate of the willingness and capacity in mobilizing and collecting tax above what was predicted by the structural variables .

The model that predict the revenue that the

$$TaxRevenuet = \beta o + \beta 1GDPpercapitat + \beta 2\ openesst + \beta 3\ Inflationt + \beta 4ManufacturSectort + \beta 5AgricultureRelatedt + \beta 6\ ExpenseofGDPt + \varepsilon_t \qquad (4)$$

The variables (independent variables) should be those elements on which revenue mobilization depends. One of these variables is a classical indicator of the country's income, which is, GDP. Income indicators such as GDP have been used in standard tax effort literature as a potential explaining variable of the country's tax generation capacity. Another indicator of tax capacity is the country's level of development as explained by sectoral composition. It is often the case that tax capacity is found to be correlated with the level of manufacturing and service industry achieved. Hence, manufacturing sectors and industrial sectors (manufacturing including construction sector) are expected to positively correlate with higher tax capacity while the agricultural sector is found to be negatively correlated with tax capacity. Therefore, the sectorial contribution of the industry and manufacturing sector is used as the explaining variables in our model. Inflation is used as a control variable to account for the change in consumer prices across years. The other classical element of tax capacity structure in the literature is openness to foreign trade. This is also included in the model to have a positive relationship with tax capacity.

One issue that was considered in this model is multicollinearity. For instance by taking GDP and other sectoral contributors such as the manufacturing sector might result in multicollinearity. To avoid this their percentage contribution to GDP was considered.

Hence, this study is designed to be analytical applying statistical analysis explained in detail in the next section. World Development Indicators (WDI) data

and the Ministry of Revenue (MOR) database were utilized. The data covered 33 years of data of revenue and other important data that are considered to be determinants of revenue. The primary data were also used for clarification and triangulation of the secondary data collected from different databases.

Method of Data Analysis

Econometric Analysis

In this study to estimate the level of tax effort and determinants of tax capacity, econometric analysis was used, while the long-run and short-run effect of structural variables on tax –ratio was examined.

This helps to capture the degree of impact and their level of significance of the structural variables on tax ratio, while estimating the tax effort needed.

Unit Root Test

Time series data have the problem of non-stationarity. Nonstationary time series has a time-varying mean, time-varying variance, or both. Therefore, for the purpose of forecasting, such nonstationary time series have little practicable value.

For testing the stationarity, i.e. to test for the existence of unit-roots of the variables Dickey-Fuller (DF)/Augmented Dickey-Fuller (ADF) was used in this study. Augmented Dicky-Fuller (ADF) test is one of the widely used approaches of unit root testing.

The simplest starting point for testing stationarity is an autoregressive model of order one, AR(1), of the form:

$$Y_t = \emptyset Y_{t-1} + t\,\cup_t \ldots\ldots (5)$$

What we need to examine here is whether Ø is equal to 1 (unity and hence unit root)

By subtracting Y_{t-1} from both sides of equation (7), we can obtain a more convenient version of the test:

$$Y_t - Y_{t-1} = \emptyset Y_{t-1} - Y_{t-1} + t\,\cup_t$$

$$\Delta Y_t = Y_{t-1}(\emptyset - 1) + t\,\cup_t$$

$$\Delta Y_t = \gamma Y_{t-1} + \cup_t \ldots\ldots (6)$$

Where $\gamma = (\emptyset - 1)$, the null hypothesis is H_0: $\gamma = 0$ and the alternative hypothesis is H_1: $\gamma \neq 0$, if $\gamma = 0$ then Y_t follows a random walk model.

As the error term is unlikely to white noise, Dickey and fuller extend their test procedure suggesting an augmented version of the test which includes extra lagged terms of the dependent variable in order to eliminate autocorrelation. The lag length on these extra terms is either determined by the Akaki information criterion or Schewartz Byyesian criterion or more usefully the lag length necessary to whiten the residuals. The three possible forms of the ADF test are given by the following equations:

$$\Delta Y_t = \gamma Y_{t-1} + \sum_{i=1} \beta_i \Delta Y_{t-i} + \cup_t \ldots\ldots (7)$$

$$\Delta Y_t = \alpha_0 + \gamma Y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta Y_{t-i} + \cup_t \ldots\ldots (8)$$

$$\Delta Y_t = \alpha_0 + \gamma Y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta Y_{t-i} + \alpha_1 t + \cup_t \ldots\ldots (9)$$

The difference between the three regressions again concerns the presence of the deterministic elements. Hence, due to the above advantages over DF test, the researcher has used the ADF test of stationarity. In addition, the lag-length of the ARDL model is determined by Akaike Information Criterion (AIC).

Co-integration and Error Correction Model

Co-integration offers a way of mitigating the problem of non-stationary series without loss of long-run relationships if any. For any non-stationary series (i.e.) series where p is the order of integration), if there exists a linear combination of the series that is stationary [I (0)], the series is referred to as co-integrated and the resulting regression is not spurious. There are different ways of testing the presence of co-integration between various series: Engle-Granger Procedure, Single Equation Error Correction Model, Johansen Procedure, and ARDL approach.

Engle-Granger Approach is one of the

widely used tests of Co-integration. It is a residual-based test of co-integration. In order to apply the Engle-Granger procedure, first, all the variables must be integrated in the same order. Once the variables are found to have the same order of integration, the next step is estimating the co-integrating parameter through OLS and test for co-integration. To do this, we have to calculate residuals from the estimated equation and test its stationarity, usually by ADF test if the residuals are stationary, which implies that the variables are co-integrated.

The second stage involves forming the error correction model, where the error correction term is the residual from the co-integrating relationship, lagged once. This term tells us the speed of adjustment to the long-run equilibrium. However, using the Engle-Granger method has some weaknesses. For instance, if we have more than two variables, there may be more than one co-integrating vector. But it can find out only one co-integrating vector. Second, a co-integration test may depend on the direction of the variable put on the left side of the co-integration. That means the method does not allow the variables on the right-hand side to be potentially endogenous.

Johansen maximum Likelihood (1988) co-integration method is one of the technique that solves the above shortcomings of the Engle-Granger procedure. Basically, it can estimate more than one co-integration relationship, if the data set contains two or more time series. However, since Johansen co-integration techniques require that all the variables in the system have equal order of integration, i.e the application of the Johansen technique will fail when the underlying regressors have different orders of integration, especially when some of the variables are I(0) (Pesaran, Shin, and Smith, 2001). That means the trace and maximum eigenvalue tests may lead to erroneous co-integrating relations with other variables in the model when *I*(0) variables are present in the system (Harris, 1999).

To overcome this problem, Pesaran and Shin developed a new Autoregressive Distributed Lag (ARDL) model which has more advantages than the Johnson cointegration approach. First, the ARDL approach can be applied irrespective of whether the regressors are I(1) and I(0). Second, while the Johansen co-integration techniques require large data samples for validity, the ARDL procedure provides statistically significant results in small samples. Therefore, due to the above-mentioned advantages, the study has used the ARDL method of co-integration

The ARDL approach involves two steps for estimating the long-run relationship. The first step is to examine the existence of a long-run relationship among all variables in an equation and the second step is to estimate the long-run and short-run coefficients of the model. We run the second step only if we find a co-integration relationship in the first step.

The generalized ARDL (p, q) model can be shown as follows:

$$\Delta Y_t = \theta + \sum_{i=1}^{p} \sigma i \Delta Y_{t-i} + \sum_{i=0}^{p} \rho i \Delta X_{t-i} + \pi ECT_{t-1} + v_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (11)$$

The above model is said “autoregressive” since it includes p lags of the dependent variable. At the same time, it is also a “distributed lag” model because it includes q lags of the explanatory variable. After testing the existence of a long-run relationship between the variables through the Bound Testing, an Error Correction Model (ECM) will be formed. If and are *I(1, 1),* the long-run model can then be reformulated into an error correction model (ECM) which integrates short- and long-run dynamics of the model.

An ECM takes the following form.

$$Y_t = C + \alpha_0 Y_{t-1} + \cdots + \alpha_p Y_{t-p} + \beta_0 X_t + \cdots + \beta_q X_{t-q} + V_t \ldots\ldots (10)$$

Where C, t and v are intercept, time trend and white noise error term respectively and Y_t and Xt are stationary variables.

Wher e_{ECTt-1} is one-period lag of the residual term (disequilibrium) from the long-run relationship, is a white noise error term, and are parameters. Equation (11) can be estimated by the usual OLS method since all its terms (in first differences) are I(0) and therefore standard hypothesis testing using *t*-ratios and related diagnostic tests can be conducted on the error term.

Theoretically, the coefficient of the one-period lag of the disequilibrium term should be negative (i.e. < 0) and significant if the disequilibrium is to be corrected in the subsequent period and long-run equilibrium restored. In this light, the coefficient of the error term represents the speed of adjustment to the long-run equilibrium.

Diagnostic Test

I. Heteroskedasticity Tests

The model procedure now provides two tests for heteroskedasticity of the errors: White's test and the modified Breusch-Pagan test. Both White's test and the Breusch-Pagan are based on the residuals of the fitted model. For systems of equations, these tests are computed separately for the residuals of each equation. The residuals of estimation are used to investigate the heteroskedasticity of the true disturbances.

Testing heteroskedasticity of the errors is a major challenge in high dimensional regressions where the number of covariates is large compared to the sample size. Traditional procedures such as the White and the Breusch-Pagan tests typically suffer from low sizes and powers (Zhaoyuan and Jianfeng, 2016).

Serial Correlation Test

Serial Correlation is a correlation among members of the series of error terms ordered in time. It is mainly caused by incorrect functional forms, autoregressions, manipulation of data, data conversion, and non-stationarity of the data (Wooldridge, 2009).

The problem of serial correlation can be detected using the graphical method, Geary test, Durbin- Watson *d* test and Breusch-Godfrey (BG) test. In this study, the BG test that is based on the Lagrange Multiplier principle is chosen since other tests have drawbacks that made the BG test to be chosen. Though the graphical method is powerful and suggestive, its detection power is more of a qualitative nature than others making it less preferred. The drawback of the Geary test is that it has no assumptions about the probability distribution from which the observations are drawn. Due to these reasons, the Breusch-Godfrey (BG) test of serial correlation is the best option at hand.

III. Normality test

In the literature, there are several tests for normality such as histogram of residuals normal probability plot (NPP), Anderson-Darling and Jarque-Bera tests. The Jarque-Bera test for normality is employed in this research.

Data Presentation and Analysis

This section presents data, along with descriptive and statistical analysis of the time series data and experimental data.

Descriptive Statistics

The tax revenue of the country and the tax ratio across the past 33 years is presented in Table 1 and Figure 1. The data indicates that the country's tax revenue was consistently increasing every year during the past three decades. The data analysis in this section is made by categorizing the timing into three, the first, the decade and the third decade.

the economy's openness to foreign trade which is a classical indicator of the country's tax capacity was minimal in the first and second decades of the target year. Here,openness to trade is calculated by summing the total exports and imports level of the country.

Table 1: Summary Statistics

	1990-2000	2001-2010	2011-2020
Tax revenue (% of GDP)	8.533	8.421	8.255
	(1.958)	(1.005)	(0.836)
Tax revenue in LCU	3.831	11.43	103.8
(In Billions)	(1.825)	(5.932)	(49.14)
Openness	2.054	6.753	22.50
(In Billions, US$)	(0.515)	(3.875)	(4.501)
Inflation, consumer prices (annual %)	7.531	11.04	13.44
	(11.35)	(14.28)	(8.336)
Industry (including construction), value	9.335	11.65	16.69
added (% of GDP)	(2.140)	(1.051)	(7.082)
Population	56.09	75.46	99.61
(In Millions)	(5.567)	(6.390)	(8.246)
Manufacturing, value added (% of GDP)	4.757	5.032	4.647
	(1.241)	(0.718)	(1.055)
Agriculture, forestry, and fishing, value	53.63	41.87	37.60
added (% of GDP)	(5.614)	(2.934)	(4.367)
National Income	7.340	11.03	41.95
(In Billions current US$)	(2.339)	(6.753)	(14.33)
GDP per capita (current US$)	168.7	192.2	598.3
	(55.54)	(95.24)	(180.9)
Observations	10	10	10

mean coefficients; sd in parentheses

The average yearly growth of tax revenue of the country was relatively low in the first two decades. For instance, the average revenue collected in the first decade was 3.83 billion ETB. In the second decade, the average revenue collected increased to 11. 43 ETB with relatively low annual growth. On the contrary, there was an interesting spike in revenue collected after 2010. In this time period increase in revenue showed exponential growth, with an average of 103.8 ETB. This result is interesting as the economy seemed to have ignored the international recession that took place in 2008. Moreover, this could be a priori indicator, as can be seen from Table 1, that

Similarly, with the increase in tax revenue and foreign trade, different indicators of the country's level of development such as per capita GDP and the national income showed a substantial increase in the economy of the country when compared across decades. For instance, in the first decade, the average national income was 7.43 Billion USD. In the second decade the national income showed an average increase of 11.03 USD, while the average increase in the third decade, i.e. 2010 it was 41.95 USD. Hence the percentage increase in the third decade is significantly greater than the average increase in the second decade from what was achieved in the first decade.

Even though both tax revenue and GDP per capita were visibly increasing, the average tax ratio across the three decades did not show an increasing trend. This first

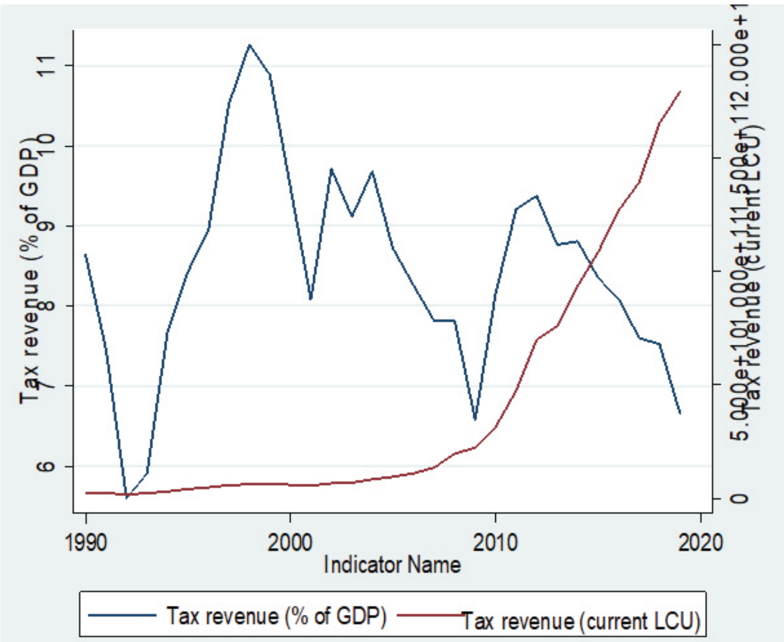


Figure 1: Tax revenue vs Tax ration

indicator of the country's inability to increase the tax ratio is clearly shown in Figure 1. Figure 1 shows a sharp spike in tax revenue, with no indication of an increase in tax-GDP ratio across the three-time periods. While figure two shows comparison of tax ratios, it actually indicated a decrease in tax ratio across the years.

This shows that in the past three decades, tax revenue was increasing but not at the same speed as the GDP. For a better understanding, the inferential statistics below has presented a detail statistical analysis of this issue.

Estimation of Tax effort

Estimation of tax effort follows the concept that the speed with which tax ratio was increasing in the country was not in line with increase with the country's tax capacity. Hence, estimating whether tax effort is positive or negative is the starting point for the policy for expanding the tax base and tax rates. The tax capacity is in turn explained with structural variables according to a prior justification of their relationship with tax capacity. A simplified model to present arguments prior to justification of tax capacity predictors are presented in the equation below.

$$\begin{aligned} TaxRevenuet &= \beta o + \beta 1 GDPpercapitat + \beta 2\ openesst + \beta 3\ Inflationt \\ &+ \beta 4 ManufacturSectort + \beta 5 AgricultureRelatedt \\ &+ \beta 6\ ExpenseofGDPt + \varepsilon_t \end{aligned}$$

Tax Effort Prediction via Error Correction Model

When two or more variables are individually non-stationary; but a linear combination of the variables are stationary, we can use the Error correction model to estimate long-run steady-state with error correction term. Error correction model takes advantage of co-integrating relationships. In line with the theoretical argument of Tax effort estimation in the methodology part, the Error correction model gives us the error correction term as shown in equation 5.

$$ECT\, t-1 = [(Yt-1) - (\hat{Y}t-1)]\mu \quad (12)$$

μ is the coefficient of ECT. μ is interpreted in such a way that if it is negative and less than 1, then ECT indicates that there will be long-run convergence of the model. This indicates that the predictors of tax ration included in the model will have long-run predicting power of the country's tax capacity. In addition, the current disequilibrium will be corrected given the estimated tax effort by the speed of adjustment term implemented by the government.

Furthermore, the error correction term is defined not as the time required to correct the deviation from disequilibrium. By definition, the error correction mechanism is asymptotic since it takes infinite time to adjust. This shows that it is not logical to associate μ with time. Hence, μ is interpreted as the speed of adjustment, as convergence takes infinite time.

This ECT is calculated following several steps. The first step was to verify that variables are integrated of order one, that non-stationary in levels but stationary in differences. Hence all variables of interest do meet the above criteria. This step was proceeded by calculations of optimal lag for each variable as allowed by ARDL model. The maximum optimal lag for all variables was 2. The second step was to examine the short-run relationship before co integrating or long-run relationships between the variables are examined. The result of this analysis is presented in Table 2 below. It verifies that there is a cointegrating relationship and finally estimation and interpretion of the error correction model as

$$Y_t = \gamma_{oj} + \sum_{i=1}^{p} \delta_j Y_{t-i} + \sum_{i=0}^{p} \beta' Xt - i + \varepsilon_{jt} \quad (13)$$

Short-Run Predictors Of Tax Capacity

Short-run relationship between variables is estimated using ARDL model

Where is a vector and the variables in are allowed to be purely I(0) or I(1) of cointegrated; □ and δ are coefficients; γ is constant; j=1, …k; p,q are optimal lag orders; is a vector of the error terms-unobserved zero-mean white noise vector process (serially uncorrelated or independent).

In our model

Y_t is Tax Revenue and

X' are $GDPpercapitat, Openess\ to\ trade, Inflation, Manufacturing\ secotr, Agricultural\ sector, Expense\ of\ government$

Hence the result of ARDL regression is presented in Table 2. The short-run relationship between tax ratio and its predictors is presented in Table 2 below.

The lag of tax ration is positively related to the current level of tax revenue, i.e. a percentage increase in tax revenue in the last period is related to 0.35 percent increase in tax ratio in the current period. On the current data and policy, we have the country's GDP per capita is negatively related to the tax ration. This means that the tax ratio is not increasing with an increase in per capita GDP, but rather seems to be decreasing with it. This shows whatever value is added via the economic activity that is being captured by GDP, the government is not raising revenue from it. Openness to foreign trade is positively and significantly related to the tax ratio. As classical predictors of tax capacity, this finding is in line with other findings in this literature as well (Fenochietto and Pessino, 2013; Pichard, et al., 2014; Yohou et al, 2016). The average inflation rate seems to be not related to the tax ration, however, the inflation that lagged in one year is related positively and significantly to the tax ration. This might be explained by the soundness of expansionary fiscal policy that could be implemented with the existence of inflation. The more inflation, the more the tax that

could be imposed to stabilize the economy.

Analysis of the role different economic sectors have on tax ratio is also interesting.

related to in tax ration. For instance, a one percent increase in value-added to GDP by the manufacturing sector will increase the tax ratio by 70 percent, while a one percent

Table 2: Short-Run Relationship

	Tax revenue (% of GDP)
L. Tax revenue (% of GDP)	0.350***
	(0.0634)
GDP per capita (current US$)	-0.0209***
	(0.00288)
L.GDP per capita (current US$)	-0.00501
	(0.00278)
Openness	4.04e-10***
	(7.63e-11)
L.openess	1.23e-10
	(7.06e-11)
L2.openess	2.44e-10**
	(7.90e-11)
Inflation, consumer prices (annual %)	-0.0109
	(0.00652)
L.Inflation, consumer prices (annual %)	0.0269**
	(0.00897)
Manufacturing, value added (% of GDP)	0.700***
	(0.161)
L.Manufacturing, value added (% of GDP)	0.680***
	(0.0993)
Agriculture, forestry, and fishing, value added (% of GDP)	0.133***
	(0.0344)
L.Agriculture, forestry, and fishing, value added (% of GDP)	-0.0296
	(0.0471)
L2.Agriculture, forestry, and fishing, value added (% of GDP)	0.131***
	(0.0210)
Expense (% of GDP)	0.110**
	(0.0336)
L.Expense (% of GDP)	-0.0721*
	(0.0378)
L2.Expense (% of GDP)	0.152***
	(0.0360)
Constant	-13.91***
	(2.356)
Observations	24
Adjusted R^2	0.980

Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

As can be seen in Table 2, both the manufacturing sector and Agriculture and related sectors increased value is positively

ncrease in value-added to GDP by the manufacturing sector with one lagged period, will increase the tax ratio by 68 percent. Similarly, an increase by one percent in value-added by agriculture, forestry, and fishing as measured by the percentage of GDP, will increase the tax ratio by 0.13 percent.

Correspondingly, an increase by one percent in the second lag of value added by the agriculture, forestry, and fishing sector will increase the tax ratio by 0.13 percent. Hence, the manufacturing sector is a strong predictor of tax capacity. The relationship between government expenditure and tax ratio is positive except in lag one where it indicates a negative relationship. The persistent positive relationship of government expenses and tax ratio might indicate the notion that tax resources are essential to finance public infrastructure. The negative relationship in lagged variables might be because of unexpected shocks or lack of proper planning from the government side.

Hence, from these findings, one can conclude that in the short run it seems that increasing foreign trade, via import and export activities, increasing economic activities in all sectors of the economy, but giving more emphasis on manufacturing sectors will increase the tax capacity of the country. The finding is in line with economic theory but some divergence is also observed. For instance, the agricultural sector was historically considered hard to the tax sector and usually indicates a negative relationship with the tax capacity of countries (see Yohou and Goujon, 2018; Chelliah et al., 1975; Leuthold, 1991; Tanzi, 1992; Stotsky and WoldeMariam, 1997). Furthermore tax ratio's positive relationship with lagged two of inflation may indicate that the government has been using an expansionary fiscal policy that takes inflation information as an input to increase taxes. The next step in our tax effort analysis is to examine if the above short-run relationship also holds in the long run. Hence the test of Cointegration bound to these variables is conducted. Table 3 below presents this test.

The ARDL bound test decision rule is to reject the null hypothesis of no existence of long-run relationship among dependent and independent variables if F statistics is higher than F critical values of (I, I) or first-order integration between series for all the variables. Since F-statistics is clearly higher for (I, 1) all series we reject the null hypothesis, establishing a long run between variables (*see Table 3)*.

With this result, we can proceed to predict the future correction to the disparity between tax ration and the potential of the country from regressors identified in our model. Table 4 presents the predicted tax effort-defined speed of adjustment of error in error correction models.

Table 4 shows the long-run prediction between the current tax ratio and regressors given the current economic policy that the country has. The speed of adjustment required to achieve long-run stable state is 0.65 percentage points. In the long run, value-added both in the manufacturing sector and agricultural related sectors, as well as general government need for expenses, are associated to tax ration in positive and significant manners.

The long-run relationship between GDP per capita shows negative and significant at a 1% significant level. That is one percent change in GDP per capita is associated with a 0.04 decrease in tax ratio. This might be because of three main reasons. The first might be a clear indication that the tax base identification and tax rate calculation of the current tax policy has ignored the economic activities that could increase the collection of the tax revenue. The second is that the negative relationship between tax ratio and per capita GDP might be because of exerting much effort on wrong tax bases. For instance, the majority of business

income taxpayers pay their taxes via a presumptive tax mechanism, the method that lacks the principle of certainty when

Table 3: Bound test of Co Integration among the Variables

Pesaran/Shin/Smith (2001) ARDL Bounds Test

H0: no levels relationship F = 35.540

t = -10.247

Critical Values (0.1-0.01), F-statistic, Case 3

	[I_0] L_1	[I_1] L_1	[I_0] L_05	[I_1] L_05	[I_0] L_025	[I_1] L_025	[I_0] L_01	[I_1] L_01
k_6	2.12	3.23	2.45	3.61	2.75	3.99	3.15	4.43

accept if F < critical value for I(0) regressors

reject if F > critical value for I(1) regressors

Critical Values (0.1-0.01), t-statistic, Case 3

	[I_0] L_1	[I_1] L_1	[I_0] L_05	[I_1] L_05	[I_0] L_025	[I_1] L_025	[I_0] L_01	[I_1] L_01
k_6	-2.57	-4.04	-2.86	-4.38	-3.13	-4.66	-3.43	-4.99

accept if t > critical value for I(0) regressors

reject if t < critical value for I(1) regressors

k: # of non-deterministic regressors in long-run relationship

Critical values from Pesaran/Shin/Smith (2001)

imposing taxes. The third is, such disparity can also be from the weakness of official GDP calculation/data to include the role of the contribution of the informal sector to the economy. However, a detailed answer to this question is left for further study

Furthermore, Figure 2 shows that obviously the predicted tax potential of the country and the current average collected tax GDP ratio have a great disparity; with collected tax revenue being incredibly smaller than the predicted tax potential of the country given the regressors.

Hence, analysis of our data shows that the country's tax system displays two major caveats. The first is its inability to collect taxes with the speed of economic growth. The second is, in line with the problem raised above, there is the low effort exerted on tax collection compared to the country's tax potential as indicated by structural variables (see Figure 2).

Test of Diagnostics

Serial Correlations

Test of autocorrelation or serial correlation is done using Durbin-Watson statistics. As can be seen, from Table 5 the Durbin-Watson statistics show no serial correlation among the variables. In the same way, the Breusch-Godfrey test for autocorrelation confirms that we cannot reject the null hypothesis of no serial correlation among the variables.

Table 4: Long run Determinant of Tax Revenue via Error Correction Model

	D.Tax revenue (% of GDP)
ADJ	
L.Tax revenue (% of GDP)	-0.650***
	(0.0634)
LR	
GDP per capita (current US$)	-0.0399***
	(0.00350)
Openess to foreign trade	1.19e-09***
	(1.06e-10)
Inflation, consumer prices (annual %)	0.0246
	(0.0196)
Manufacturing, value added (% of GDP)	2.124***
	(0.266)
Agriculture, forestry, and fishing, value added (% of GDP)	0.361***
	(0.0399)
Expense (% of GDP)	0.293***
	(0.0837)
Observations	24
Adjusted R^2	0.953

Standard errors in parentheses $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table 5: Test of Serial Correlation

Number of gaps in sample: 1

Durbin-Watson d-statistic(17, 24) = 2.120012

Number of gaps in sample: 1

Breusch-Godfrey LM test for autocorrelation

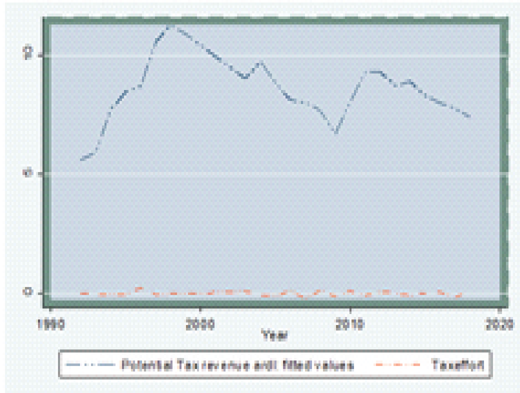
lags(p)	chi2	df	Prob > chi2
2	16.695	2	0.0002

H0: no serial correlation

Test of Homoskedasticity

Table 6 shows the White test of homoscedasticity for our model. Given the non-significance of P values for IM-statistics, we cannot reject the hypothesis of homoscedasticity of the variables in this model.

Figure 2: Tax Potential vs Tax ratio



Test of Normality

The test of normality is the test done using Jarque-Bera test. Jarque-Bera statistics for normality is 0.9145. Hence, we cannot reject the null hypothesis of normality of the model.

Hence, the results of our diagnostic tests show that our model can be taken seriously and inference from it can a useful input for the policy.

Conclusion

Tax policy is a crucial tool for development and other desirable social goals. Moreover, it is one of the valuable/most essential tools to strengthen a country with a financial power. However, governments often face challenges on when and how to mobilize revenues. The need for revenue mobilization makes it a requirement to examine whether or not optimal revenue that the economy can produce is not being already collected.

Hence, it is the aim of this study to precisely address the above-raised question, i.e. whether the potential to more tax collection exist and if enough effort is exerted to collect tax in line with the tax potential. Hence, the finding of this study indicates that tax effort, theoretically measured as the difference between tax revenue collected and tax potential is extremely low. This problem becomesmore complicated when GDP shows as a rather inverse predictor of tax potential, indicating massive work of tax base identification to enable tax ratio moves with the speed of GDP growth.

Hence this paper recommends that with the help of further study, increasing the tax base to allow revenue collection that also induces the GDP growth is crucial. For this, a further reshuffling of tax bases and refocusing on different bases for increased tax collection on different sources than previously identified might be needed.

Hence, analysis of our data shows that the country's tax system displays two major caveats. The first is its inability to collect taxes with the speed of economic growth. The second is, in line with the problem raised above, there is the low effort exerted on tax collection compared to the country's tax potential as indicated by structural variables.

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