

# Estimating Ghana's Tax Capacity and Effort

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# Contents

List of tables

Abstract

1.	Introduction	1
2.	Stylised facts about the Ghanaian economy	4
3.	Literature review	6
4.	Conceptual issues and theoretical framework	9
5.	Empirical model	12
6.	Empirical results and interpretation	18
7.	Conclusion and recommendations	30
	References	34
	Appendix	37

## List of tables

1.	Tax revenues (% of GDP) – annual averages	4
2.	Variables and data sources	17
3.	Determinants of potential tax revenue (real values, natural log)	19
4.	Determinants of potential tax revenue (direct taxes) <sup>A</sup> [real values, natural logarithms]	21
5.	Determinants of potential tax revenue (indirect taxes) <sup>B</sup> [real values, natural logarithms]	22
6.	Explaining inefficiency in the tax system (by OLS)	25
7.	Descriptive statistics: Level of efficiency of tax system (%)	26
8.	Descriptive statistics: Level of efficiency of tax system (%)	27
9.	Tax-GDP ratios (actual and potential) and tax effort indicators	28
10.	Estimated tax effort	29
11.	Pairwise correlation coefficients	29
A1.	Definitions and measures of tax base and economic structure	37
A2.	Tax institutional reforms	38

# Abstract

The main objective of the study is to estimate and analyse Ghana's tax potential and effort and to determine how much more tax the country could generate based on its desired expenditure needs. To achieve this objective, a stochastic tax frontier model has been analysed using annual secondary data, covering the period 1985 to 2014. The analyses indicate that an increase in the taxable base and institutional improvements help to increase Ghana's optimum tax potential. The study also reveals that political institutional improvement reduces inefficiency in Ghana's tax system. In addition, the study finds that Ghana has enough of a tax gap to be exploited to meet its rising expenditure needs.

Key words: Tax revenue shares, tax capacity, tax effort.

# 1. Introduction

## Background to study and research problem

The international development community acknowledges the central role played by an effective tax system in the economic development of nations worldwide. As a result the international donor community, including multilateral institutions and the Group of Twenty (G-20) would want to ensure that the assistance they offer to developing countries to develop and strengthen their tax systems achieve the intended purpose. In addition, low-income countries perceive higher tax revenue mobilisation as a means to reduce their overreliance on foreign aid and influence the decisions of international investors (United Nations, 2002; World Bank 2005 and 1997).

Ghana has been experiencing persistent fiscal budget deficits since 1992, with the highest deficits, expressed as percentage of gross domestic product (GDP), recorded in 1997 (8.2%), in 2000 (8.62%), in 2008 (11.2%) and in 2012 (11.8%). These recorded government budget deficits have been the result of rising public expenditure that had not been matched by a growth in revenue and have prompted government to search for possible ways to increase tax revenues in tandem with measures aimed at expenditure rationalisation. Successive governments have taken measures to increase revenue mobilisation, particularly through a number of tax initiatives, but have also been mindful of the need to ensure that such measures do not distort economic activities. (Ministry of Finance and Economic Planning, Government of Ghana's Annual Budget Statements, 2006–2007 and 2011 to 2014). However, government will only be successful if the decision to increase revenue mobilisation is adequately informed by the extent to which the country has successfully harnessed its true tax potential. This means that an assessment of the extent to which the country has collected tax compared to what could be reasonably expected given its economic potential would inform effective tax policy in the country.

Nevertheless, no country-specific study has been found on Ghana's tax potential and extent to which the country has harnessed its tax potential. Studies on tax revenue in Ghana that has been identified include: Twerefou, Fumey, Osei-Assibey and Asmah (2010), Brafu-Insaidoo and Obeng (2008), and Kusi (1998). Twerefou et al. (2010) analyzed the buoyancy and elasticity of Ghana's tax system from 1970 to 2007 and found that the overall tax system was buoyant and elastic in the long run, but not buoyant in the short run. In addition, they found that tax revenue responds

more to the taxable base than the taxable base responds to income. Conversely, Brafu-Insaidoo and Obeng (2008) did not find import tariff revenue to be buoyant or elastic in Ghana in their study on the impact of import liberalisation on import tariff revenue in Ghana covering the period from 1965 to 2003. Kusi (1998) also analysed the revenue productivity of Ghana's overall tax system by estimating the tax buoyancy and elasticity covering the period from 1983 to 1993. He found that tax reform, successive devaluations of the exchange rate and import liberalisation contributed to an improvement in the revenue productivity of Ghana's overall tax system.

However, the use of the buoyancy and elasticity method of measuring a country's tax effort does not directly assess the impact of economic structure and characteristics of the country in influencing government tax collection. Their role is implicitly assumed in the framework adopted. The public finance literature suggests that the taxable capacity of a country does not only depend on its taxable base, but also on its peculiar economic conditions and characteristics.

A large number of identified empirical studies on estimating tax potential and tax effort that used the conventional "international tax comparison" method are cross-country and panel-data studies. Such studies include Stotsky and WoldeMariam (1997), Bothole (2010), Minh Le et al. (2012) Davoodi and Grigorian (2007), Fenochietto and Pessino (2013), Steenekamp (2007) and Abdalaziz (2012). Also, some recent studies on tax capacity have used stochastic frontier analysis (SFA). Examples of such studies are Langford and Ohlenburg (2015) and Ndiaye and Korsu (2011) for a cross section of countries over time, and Alfirman (2003) and Garg et al. (2014) at the sub-national level for Indonesia and Mexico, respectively. The use of the SFA is growing very fast: it has been employed for sub-national tax capacity and effort analysis (Jha et al., 1999 for India; Alfirman, 2003 for Indonesia; and Castañeda and Pardinias, 2012 for Mexico); and tax capacity analysis across countries (Fenochietto and Pessino, 2013; Cyan et al., 2013; Langford and Ohlenburg, 2015). The stochastic frontier approach affords the authors the opportunity to predict technical inefficiency in revenue collection and then investigate its determinants. In addition, the SFA has been used in country-specific studies to estimate the tax capacity and effort of specific countries, among which are Alfirman (2003) for Indonesia, Garg et al. (2014) for India, and Castañeda and Pardinias (2012) for Mexico. The country-specific studies used datasets consisting of panel data.

This study fills the research gap by estimating Ghana's maximum tax potential, which is the estimated stochastic tax frontier, and determines how well the country has performed in tax collection relative to its true maximum potential. By using the stochastic frontier analysis (SFA) technique, it answers the question of how much potential tax revenue is being lost, and it provides a potentially more policy-relevant measure of tax potential (capacity) and effort. In addition to the provision of more policy-relevant estimates of the size of tax effort, the SFA technique allows for the analysis of the determinants of the tax effort. Hence, the use of the SFA technique improves the identification of the tax effort and of factors that lead to higher levels of tax effort. In addition, the study attempts to unearth the country's performance in terms of tax collection relative to what could be reasonably expected considering



its economic potential, and to identify factors that best explain the tax collection performance of the country over time. The study covers the period 1985 to 2014.

The following are the key research questions answered in the study: What is the likely impact of increases in the taxable base and institutional improvements in Ghana's tax potential?; What impact does political institutional improvement have on inefficiencies in the country's tax system?; What is the country's maximum tax potential, and how well has the country performed in relation to its tax potential?; To what extent has the country exploited its tax potential to finance its desired public expenditure?; and, How much more revenue could potentially be had from economy? The first question is posed premised on the fact that both theory and empirical studies fail to make any conclusive argument about or provide a definite answer to the above question. Some studies, such as Minh Le et al. (2012), Kusi (1998) and Twerefou et al. (2010), suggest that an expansion in the taxable base and institutional improvements would cause an increase in tax revenues, whilst other studies, including those by Gorodnichenko et al. (2009), Kloeden (2011), and Zake (2011) show that in countries such as Russia and Brazil, tax reforms and a broadening of the base have not been accompanied by increased tax revenues. The second question is posed premised on the theoretical argument that governments that are democratic and have greater constraints on the powers of the executive tend to have a greater bargaining position vis-à-vis their citizens and are more capable of enhancing the efficiency of their tax system (Rakner, 2011). The third and fourth questions are answered in the study to fill an existing research gap in studies on Ghana's tax system.

## Objectives of the study

The overall objective of the study is to estimate Ghana's tax potential and to determine its tax performance in terms of the level of efficiency and effort in the tax system.

The specific objectives of the study are to:

- explain and estimate the maximum tax potential in Ghana;
- determine the level of inefficiency in Ghana's tax system;
- identify basic causes of inefficiency in the tax system;
- measure Ghana's tax effort; and
- compare the estimated tax effort with the expenditure-revenue gap of the country.

## 2. Stylised facts about the Ghanaian economy

Tax collection accounts for more than 80% of domestic revenue mobilisation in Ghana. The performance in tax collection varies between different types of taxes. For some types of tax, such as personal income tax, the average annual share of revenues in GDP has increased substantially and steadily over time. For other types of tax, including excise duties and export duties, the average annual share of revenues in GDP have declined steadily over time (see Table 1). The decline in international trade tax could be attributed to the implementation of trade liberalisation measures such as reductions in the levels and range of statutory rates.

Table 1: Tax revenues (% of GDP) – annual averages

	1985– 1990	1991– 1996	1997– 2002	2003– 2008	2009– 2014
1. Income and property	3.02	3.12	4.93	4.61	6.73
Personal (PAYE)	0.57	0.83	1.61	2.06	2.48
Self-employed	0.39	0.21	0.28	0.28	0.21
Companies	1.89	1.73	2.31	2.29	2.52
Others	0.16	0.35	0.72	0.73	1.33
2. Domestic goods and services	3.44	5.38	4.33	4.65	2.99
Excise duty	1.62	1.07	0.79	0.51	0.21
Sales tax/domestic VAT	0.93	1.08	1.51	1.55	1.50
Petroleum tax	0.89	3.23	2.03	2.59	0.66
3. International trade	5.15	5.58	4.69	3.63	2.86
Imports	2.68	3.83	3.42	2.96	2.40
Import duty	2.64	3.50	2.43	2.68	2.40
Sales tax on imports	0.00	0.25	0.51	0.00	0.00
Special tax	0.00	0.02	0.08	0.00	0.00
Other taxes	0.05	0.07	0.39	0.27	0.00
Export	2.47	1.75	1.27	0.67	0.13
Cocoa duty	2.47	1.75	1.25	0.65	0.13
Lumber	0.00	0.00	0.01	0.02	0.00
4. External VAT	0.00	0.00	2.09	2.77	2.27
Total tax revenue	11.61	14.07	16.03	15.66	14.52

The year 1998 also witnessed the successful replacement of sales tax on domestic goods and services, the value-added tax (VAT). The annual average share of VAT (external and domestic) revenue in GDP has so far been higher than the annual average share of sales tax revenue in GDP, indicating that the introduction of VAT has improved domestic revenue mobilisation. The annual average share of petroleum taxes in GDP has been unstable, whilst the annual average share of total tax revenues in GDP has been declining steadily since after 2002. The decline in total tax share after 2002 prompts a revisit to factors that drive tax revenues in Ghana.

In attempting to measure tax performance, it has become necessary to compare actual tax collected to the true maximum tax potential of the country under the existing tax codes. This will help to determine how well the country has performed and how much more could be done to harness the remaining tax potential of the country. This should be done by taking into consideration the country's economic structure, level of income, and institutional, demographic and fiscal characteristics. The public finance literature, including works by Minh Le, Morenno-Dadson and Bayraktar (2012), Davoodi and Grigorian (2007), and Fenchietto and Pessino (2013) suggest that measuring and explaining a country's tax effort must be based on true information about the taxable capacity of the country. The taxable capacity of a country depends on the specific characteristics of the country, namely the economic structure, and fiscal, demographic and institutional characteristics of the country. This study measures Ghana's tax potential and estimates its tax effort based on the estimated tax capacity as a means of explaining its performance in tax revenue mobilisation.

### 3. Literature review

A large number of empirical studies on estimating tax capacity and tax effort that were identified used the conventional “international tax comparison”, are cross-country and panel data studies. Such studies include Stotsky and WoldeMariam (1997), Botlhole (2010), Minh Le et al. (2012) Davoodi and Grigorian (2007), Fenchietto and Pessino (2013), Steenekamp (2007) and Abdalaziz (2012). For instance, Stotsky and WoldeMariam (1997) measured the tax capacity of 30 Sub-Saharan African countries and indicated that Ghana is among the countries that experienced a high tax effort (with an index value greater than 1) and that Ghana’s tax effort increased over time from 1990 to 1995. Botlhole (2010) used a similar regression method to estimate the tax capacity and tax effort of 46 Sub-Saharan African countries for the period 1990 to 2006. He found that for most of the countries studied, actual tax revenues typically fell short of their potential. The measure of tax potential based on the conventional approach produces a given average for a given set of potential determinants instead of providing an accurate indicator of true maximum potential. Essentially, this approach does not provide a precise measure of the magnitude of additional tax revenues that a country may be able to raise.

Some recent studies on tax capacity have employed stochastic frontier analysis. Examples of such studies are Langford and Ohlenburg (2015) and Ndiaye and Korsu (2011) for a cross section of countries over time, and Alfirmán (2003) and Garg, Goyal and Pal (2014) at the sub-national level for Indonesia and Mexico, respectively. The use of the stochastic frontier analysis (SFA) technique in this study is justified in that unlike the traditional approach that predicts the tax potential from an estimated regression and expresses the obtained actual tax-to-GDP collection over the potential to determine effort, the SFA can be used to generate a stochastic tax frontier, which defines an estimated maximum potential tax-to-GDP ratio for a given set of determinants and environmental factors. Thus, while the traditional approach treats tax potential as an average figure achieved for a given set of determinants, the SFA provides an indication of the true maximum potential. In addition, the SFA provides a measure of the extent to which a country may be able to raise additional revenues, which is very relevant for policy purposes. Also, the use of SFA is growing very fast: it has been employed for sub-national tax capacity and effort analysis (Jha, Mohanty, Chatterjee and Chitkara, 1999, for India; Alfirmán, 2003, for Indonesia; and Castañeda and Pardinas, 2012, for Mexico), and tax capacity analysis across

countries (Fenochietto and Pessino, 2013; Cyan et al., 2013, and Langford and Ohlenburg, 2015).

For a cross-country application of the SFA, Cyan et al. (2013) employed three different methodologies and a panel dataset of 94 countries over the period 1970–2009 to estimate tax potential and, therefore, the tax effort of the sampled countries. The methodologies employed are the traditional regression approach, the stochastic frontier approach and the calculation of tax effort indicators, and then comparing them to the expenditure-revenue gap of countries. The results obtained from the traditional regression and the stochastic frontier approaches were similar. In addition, the stochastic frontier approach afforded the authors the opportunity to predict technical inefficiency in revenue collection and then to investigate its determinants. The results showed that corruption, complexity of the tax system, government debt, and tax morale were significant factors in explaining inefficiency in revenue collection. The results of the third approach show that for most countries, the level of revenue collection was below their potential and was below the level needed to fully finance their expenditures.

In a related study, Langford and Ohlenburg (2015) used the stochastic frontier technique and a 27-year panel dataset of 85 non-resource-rich countries to estimate their tax capacities. In this study, the parameters of the stochastic frontier and the inefficiency model were estimated simultaneously to avoid bias (Wang and Schmidt, 2002, cited in Langford and Ohlenburg, 2015), using the maximum likelihood method. The results show that the average estimated tax effort across countries and time was 0.63 with a range from a low of 0.13 to a high of 0.97. On the determinants of tax capacity, industrial structure, education, trade and age dependency, inflation and imports were found to be significant, but the level of GDP per capita was not found to be significant once the level of education was included. In the case of tax effort, corruption, law and order and democratic accountability were found to be significant determinants.

In their study of tax capacity and tax effort of Economic Community of West African States (ECOWAS) countries, Ndiaye and Korsu (2011) estimated stochastic frontier tax functions for direct tax, indirect tax, trade tax and total tax (with and without natural resource related tax) for all ECOWAS countries and five non-ECOWAS Sub-Saharan African countries over the period 2000 to 2010. The results of the stochastic frontier tax functions show that literacy rate has a positive effect on all the categories of tax considered, financial depth has a positive effect on indirect tax and trade tax, agricultural share of GDP has a negative effect on direct and indirect tax, and openness of the economies to import and GDP per capita have positive effects on trade tax. The results of the tax effort estimation show that all ECOWAS countries are below their tax capacities, although with differences in magnitude across tax type and countries. The study identified indirect tax and trade tax as potential sources from which ECOWAS countries could raise tax revenue.

In yet another cross-country study, Fenochietto and Pessino (2013) employed the stochastic frontier model to estimate the tax effort and tax capacity of 113 countries.

The results and the model allow a clear determination of which countries are near their tax capacity and which are some way from it, and therefore, could increase their tax revenue. The authors also found that tax capacity depends on the level of development, trade, education, inflation, income distribution, corruption, and ease of tax collection.

The SFA method has also been used to estimate the tax capacity and effort of specific countries, including studies by Alfirman (2003), Garg, et al. (2014), and Jha et al. (1999). Using the stochastic frontier regression method, Alfirman (2003) estimated the tax potential of two sources of revenue for local governments in Indonesia. The dataset was a panel of local taxes and property tax of the 26 local governments in Indonesia for the period 1996 to 1999. The results show that none of the local governments had maximised their tax potential. The results further indicated that if all local governments were able to utilise their tax potential to the full, they would raise very substantial additional tax revenues of 0.10% of GDP from local taxes and 0.20% of GDP from property tax. The study recommends that local governments should increase their revenue collection efficiency by reducing tax evasion, mostly through decreasing corruption. It further recommends that central government should support local governments through the granting of subsidies.

Garg et al. (2014) measured the tax capacity and tax effort of 14 major Indian states from 1992–1993 to 2010–2011 using SFA. The results showed large variation in the tax effort index across states, which seems to be increasing over time. Econometric analysis suggests that per capita gross state domestic product has a positive effect on states' own tax revenue, but the relative size of the agriculture sector of a state has adverse effect on its own tax revenue. The evidence on tax efficiency suggests that while higher inter-governmental transfers, outstanding liabilities and expenditure on debt repayment reduced tax efficiency, the enactment of the Fiscal Responsibility and Budget Management Act and higher political competition inside a state, represented by an effective number of parties, improved the tax efficiency.

Castañeda and Pardinás (2012) also estimated potential Mexican sub-national tax revenues using a stochastic frontier model. The results indicated that states are exploiting their current tax bases, particularly the payroll tax, appropriately. Mexican municipalities, however, have a low rate of tax collection compared to their potential, especially in relation to property tax, which is their most important source of revenue and relatively simple to collect. Empirical evidence further suggests that tax collection efforts are strongly related to GDP per capita, and political affiliation.

No study on the determination of the maximum tax potential of Ghana has been identified. This study contributes to research and knowledge by focusing on estimating Ghana's maximum tax potential and tax effort conditional on the prevailing economic, institutional, demographic and fiscal characteristics of the country. In particular, the study takes into consideration the contributions of various elements of the tax bases, institutional reforms, economic policies and demography.

## 4. Conceptual issues and theoretical framework

### Concepts and definitions

A country's tax capacity has been universally defined as the most favourable tax burden that the country can bear, given its national income and ability to meet the tax revenue needs of government. The concept of tax capacity can be grouped into two categories: namely, absolute tax capacity and relative tax capacity (Dalton, 1961). Absolute tax capacity could be defined as the share of a country's income that the government can take from residents without having adverse consequences on total production in the country. It therefore refers to the maximum tax potential of an economy or country at large, or a region. Conversely, relative tax capacity is defined in reference to the share in a number of countries or regions within a country, and is consequently used to refer to the share of the contribution of a country or region within the country in relation to the capacity of other countries or regions within the countries (Gupta, 2007).

In spite of the difficulty in accurately measuring and conceptualising the absolute tax capacity of a country, the concept is very useful in devising public finance policy. In this study, the concept of absolute tax capacity will be adopted by proposing to use SFA to estimate the stochastic tax frontier that defines an estimated maximum potential tax-to-GDP ratio for a given set of determinants.

In the public finance literature, tax effort is defined as the share of society's tax capacity that is exploited by the country. In simple language, it can be defined as the effort made by a country to collect tax, given its potential to generate tax revenue. It reflects the extent to which a country is exploiting its optimum tax potential and points to the choice of policy (in terms of tax rates, bases and exemptions) and inefficiency in the execution of policy (Van der Hoek, 2008). Policy decisions are also revealed in the form of collective preferences for public expenditure, which may also include an intention not to work towards the attainment of the maximum potential tax (Langford and Ohlenburg, 2015). Our measure of tax effort will be generated from the estimated SFA model and will thus provide a more accurate measure of effort that can be best interpreted as "yet-to-be exploited tax potential" and is an integrated measure of choice and enforcement of policy. It therefore provides a more accurate measure of the extent to which a country can raise additional tax revenues.

## Theoretical Considerations

We adopt the theoretical stochastic frontier framework of Aigner, Lovell and Schmidt (1977) and Meeusen and Broeck (1977) in explaining tax capacity. It starts by assuming that in an ideal world, tax administration in a country collects tax revenues.

$$T_{it} = f(\chi_t, \beta) \quad (1)$$

where  $T_{it}$  = total tax revenue collection (output)

$\chi_t$  = inputs of revenue collection, that is, per capita GDP, level of education, etc.

$\beta$  = parameters to be estimated.

However, the stochastic frontier method contends that the tax administration potentially collects less revenue due to inefficiency as shown in Equation 2.

$$T_t = f(\chi_t, \beta)\psi_t \quad (2)$$

where  $\psi_t = (0, 1)$  is the level of inefficiency in its revenue collection. If  $\psi_t = 1$ , the tax administration is collecting the optimal amount of tax revenue using the available inputs  $\chi_t$  defining the tax bases, and the production function  $f(\chi_t, \beta)$ . When  $\psi_t < 1$ , the tax administration is not making the most of the available inputs  $\chi$ . As tax collection  $T$  is assumed to be strictly positive ( $T_t > 0$ ), the degree of technical inefficiency is also assumed to be strictly positive ( $\psi_t > 0$ ).

Tax revenue collection  $T_t$  is also assumed to be subject to random shocks, implying that:

$$T_t = f(\chi_t, \beta)\psi_t \exp(v_t) \quad (3)$$

Taking the natural log of Equation 3 yields:

$$\ln(T_t) = \ln[f(\chi_t, \beta)] + \ln(\psi_t) + v_t \quad (4)$$

Assuming that function  $f(\chi_t, \beta)$  is linear in logs, that there are  $k$  inputs defining the country's tax base, and defining  $u_t = -\ln(\psi_t)$  yields:



$$\ln(T_t) = \beta_0 + \sum_{j=1}^k \beta_j \ln(\chi_t) + v_t - u_t \quad (5)$$

where  $T_t$  represents a ratio of total revenue to GDP, while  $\chi_t$  represents a matrix of variables affecting the country's potential revenue.

We assume that the idiosyncratic error component,  $v_t$ , is independently  $N(0, \sigma_v)$  distributed over the observations. Since  $\psi_t = (0, 1)$ , it implies that  $\ln(\psi_t) \lesssim 0$  and, therefore,  $u_t \geq 0$ . In other words, the inefficiency effect  $u$  lowers the tax collection from its potential level. We assume two alternative specifications of the inefficiency term,  $u_t$ . In the first,  $u_t$  is independently half-normally  $N^+(0, \sigma_u^2)$  distributed, and in the second,  $u_t$  is independently exponentially distributed with variance  $\sigma_u^2$ .

Employing the definition of tax effort as the ratio between actual tax revenue and the stochastic frontier tax revenue, we are able to measure inefficiency as follows:

$$TE = [\ln(T_t) = \beta_0 + \sum_{j=1}^k \beta_j \ln(\chi_t) + v_t - u_t] / [\beta_0 + \sum_{j=1}^k \beta_j \ln(\chi_t) + v_t] = -u_t \quad (6)$$

where  $u_t$  has a value between zero and one.

## 5. Empirical model

To answer the first question identified in the Introduction of how much potential tax revenue is being lost, we propose to use the SFA technique to generate a stochastic tax frontier, which more accurately defines an estimated maximum potential tax ratio for a given set of determinants. The added advantage of the use of the SFA technique is that it improves the identification of tax effort and allows for the examination of key potential determinants that support higher levels of tax effort.

We use a panel dataset of eleven taxes for Ghana for the period 1985 to 2014 for the study. The empirical model is expressed as:

$$\ln(T_{it}) = \beta_0 + \sum_{j=1}^k \beta_j \ln(\chi_{it}) + v_{it} - u_{it} \quad (7)$$

where  $T_{it}$  represents a ratio of total revenue to GDP, while  $\chi_{it}$  represents a matrix of a number of explanatory variables including economic, demographic and social characteristics, and  $\ln$  denotes natural logarithm. The explanatory variables used for the analysis are measurable indicators for the tax base, institutional reforms, foreign grants, net foreign loans, government current and capital expenditures, inflation rates and urbanization.

A number of indicators are used for the tax bases of the different tax types (see Table A1). The elements of the tax base used in our analysis are GDP per capita, industry and services value added, manufacturing value added, value of imports net of non-processed agriculture and agricultural inputs, final consumption expenditure, value of exports and total trade.

A large number of studies, including those by Castro and Camarillo (2014) and Karogoz (2013), have suggested and indicated the important role of the availability of tax bases to the capacity of a country to raise tax revenue. In these studies, an increase in the availability of different types of tax bases enhances a country's tax capacity. For example, changes in the economic structure tending towards higher shares of industry and services or non-agriculture and a rise in the level of income, increase the availability of tax bases, which in turn improves a country's tax capacity and collection rate. However, there is also a vast array of literature that points to the fact that increasing the availability of certain tax bases has not contributed to a rise in the

tax revenue generated in a number of countries. Among such studies is Gorodnichenko et al. (2009) who investigated the effects of Russia's 2001 flat rate income tax reform on the tax base and government revenue. Employing household panel data for the period 1998–2004 and difference-in-difference and regression-discontinuity-type approaches, the authors found that the flat tax rate led to a rise in the tax base as people complied with the tax requirement but government revenue reduced.

The main reason for the series of tax-related institutional/administrative reforms has been to improve revenue mobilisation in the countries that reform. In most instances, it is assumed that revenue agencies and institutions must find ways to enhance revenue collections by implementing a number of reforms programmes without due consideration of other non-revenue indicators that have a long-term impact on revenue performance (Kloeden, 2011). However, a number of studies have shown that countries that reform their tax system experience an improvement in revenue collection on condition of good macroeconomic performance and a robust economy.

Institutional reforms are measured by an index, which we constructed based on information on the different tax-related institutional reforms that have taken place in the country since 1985, obtained from Osei and Quartey (2005) and Terkper (1994). For the purpose of constructing an index, tax institutional reforms that occurred during the period of investigation (1985 to 2014) can be broadly categorized into eight main types, based on eight key indicators. These are: granting of autonomy, tariff system reforms, replacement of sales tax with a VAT system, introduction of new incentives for staff of tax collection agencies, functional/organizational restructuring, automation, set-up of a large taxpayers' unit and a system of taxpayers' ID numbers, and integration and merger. We considered eight indicators for tax institutional reforms and assigned a value of 1 for each year in which the respective reform was carried out, and zero otherwise. The average score for each year was then computed to determine the extent and intensity of reforms overtime. The formula for the computation of the reforms index is as follows:

$Z_1 =$  autonomy

$Z_2 =$  tariff system reform

$Z_3 =$  replacement of sales tax with a VAT system

$Z_4 =$  new incentives for staff of tax collection agencies

$Z_5 =$  functional/organisational restructuring

$Z_6 =$  automation

$Z_7 =$  set-up of a large taxpayers' unit and system of taxpayers' ID numbers

$Z_8 =$  integration and merger

Institution reform index = average score = 
$$\frac{Z_1 + Z_2 + Z_3 + Z_4 + Z_5 + Z_6 + Z_7 + Z_8}{8}$$

Also see Table A2 in the Appendix for detailed information on reforms and the years in which they were implemented.

The inclusion of tariff reform in the construction of an index for tax institutional reform is based on the fact that tariff reform, in addition to the introduction of VAT, is a very important and influential policy development within the country's tax system. It forms a key motivation or stimulus for the all-encompassing tax revenue administration reforms that have taken place in the country (Kloeden, 2011). Tariff reform has basically been in the form of a simplification of and reduction in customs duties and is expected to improve efficiency and rate of collection of customs revenues. One basic channel through which tariff reform is expected to improve efficiency and the rate of collection is a reduction in the possibility of misclassifying imported goods, which in turn leaves little room for corrupt practices by tax officials (with the connivance of taxpayers). A reduction in the range of duty rates also reduces the scope of widespread use of discretionary exemptions and, consequently, is expected to improve efficiency and collection rate (Kloeden, 2011; Brafu-Insaidoo and Obeng, 2008).

The effect of foreign grants and loans on tax revenue cannot be determined a priori. One strand of the public finance literature suggests that governments in developing countries normally view external financing as an alternative to increasing domestic revenue mobilisation (Ghura, 1998). However, aid could also impact positively on a country's revenue if it is spent on public goods and to finance pro-growth projects, consequently expanding the taxable base (Besley and Persson, 2013). Data on foreign grants and loans as well as government's current and capital expenditures are obtained from the government's annual budget statements published by the Ministry of Finance and Economic Planning.

The visible impact of government investment expenditure is usually reflected in the development of capital goods such as social and economic infrastructure, and improvements in human capital that taxpayers can easily see as benefits of their tax payments. Ghura (1998) suggests that the visibility of the impact of this component of government expenditure is expected to increase the willingness of tax payers to pay taxes. Conversely, government consumption expenditure has been associated with increased corruption in a number of developing economies. Part of the planned consumption expenditures does not reach its final destination because of corruption (Ghura, 1998). Consequently, tax revenue shares are expected to increase with increases in government investment expenditures and reduce with increases in government consumption expenditures.

In addition to the discussions on potential determinants of fiscal or tax capacity based on the framework by Besley and Persson (2013), the public finance literature also mentions the quality of economic policies as an important factor that influences a country's taxable capacity. Good economic policies refer to policies that ensure a stable and conducive macroeconomic environment, including stable domestic and external prices, and generate incentives for production. High rates of inflation reduce the real (true) value of tax obligations in the case of actual tax payments with time lags, and shrink the tax base due to changes made by economic agents to their asset portfolios in favour of non-taxable assets. Economic agents may change their asset portfolio by holding more assets that would normally not attract higher taxes in order to protect the real value of their wealth. Consequently, lower inflation rates improve

the tax base and lead to higher tax revenues. This study used the inflation rate as a proxy for a successful macroeconomic stabilisation policy.

We also include a measure of urbanisation as a control variable to capture the contribution of demographic characteristics. An increase in urbanisation is assumed to reduce informality and improve on the tax net, thereby impacting positively on the country's taxable base and capacity (Langford and Ohlenburg, 2015).

## Technical Inefficiency

Stochastic frontier analysis allows us to estimate the level of technical inefficiency and its determinants in a country's revenue collection system.

After estimating Equation 7, we predict the technical inefficiency term,  $\overline{u_{it}}$ , and then estimate the following Equation 8:

$$\overline{u_{it}} = \sum_{j=1}^k \delta_j \pi_{it} + \eta_{it} + \tau_{it} \quad (8)$$

where  $\pi_{it}$  represents a set of variables that may explain technical inefficiency in revenue collection, including type or strength of political institutions, complexity of the tax system, population growth, government debt levels and changes in monetary base, while  $\pi_i$  is the time effect. Strength of political institution is represented by executive constraints or political cohesion. Executive constraint or political cohesion is expected to reduce corruption and hence reduce technical inefficiency in the tax system by ensuring political stability. We also represent type of political institution with an index for institutionalized democracy. Tax systems are normally more efficient in democratic countries because democracies are associated with better representation of the citizenry and enhanced efficiency in the delivery of services (Cyan et al., 2013).

Complexity of the tax system is measured by the Herfindahl index of a country's revenue system. The simpler the tax system, the easier it is for the taxpayers to perceive the real cost of government, and it is more likely that the government would have lower expenditure and, therefore, lower revenue. In other words, more complex tax systems lead to larger government and greater expenditures and, therefore, higher revenues for their financing and, in turn, higher efficiency in revenue collection. We intend to use the different types of taxes to compute the Herfindahl index. Higher values of the index are associated with a less complex tax system.

Population growth rate is associated with higher inefficiency in the tax system because it is difficult to administer a rapidly rising population. Conversely, government or public debt has a positive effect on government efficiency in collecting taxes because it will need to repay the debt in the future.

Seignorage revenue, proxied by an increase in the monetary base, may discourage governments from collecting taxes. To account for a lag in the effect of debt on efficiency in collecting revenues, we use the previous year's value of government debt.

## Estimation strategy

This study uses the maximum likelihood estimation technique for the stochastic frontier analysis for the reason that it is unique when the ordinary least squares (OLS) residuals have the appropriate skewness. It is a well-known statistical technique used for fitting a mathematical model to reflect real world data. The maximum likelihood estimate of an unknown parameter can be described as the value of the parameter that maximises the prospects of randomly representing a specific sample of observations. The maximisation of the likelihood function involves an iterative optimisation procedure entailing the selection of starting values for the unknown parameters and comprehensively upgrading and revising them until the values that maximise the log-likelihood function are identified. A routine solution for the stochastic frontier estimates emerges that differs from, and is better than, OLS estimates. The estimation technique for the stochastic frontier provides superior estimates of efficiency because it helps to examine changes in technical efficiencies over time in addition to underlying tax potential.

## Comparing tax effort indicator with expenditure – Revenue gap

To answer the second question in the study of how much more revenue could potentially be had from the economy, this study moves to another stage of analysis by estimating the expenditure-revenue gap and comparing the estimates with the estimated tax effort of the economy. Secondly, the discussion of tax effort without reference to what the revenue will be used for diminishes the policy relevance of the exercise. This is because a country may have a high tax effort but if the level is not high enough to enable it to meet its expenditure, then the effort cannot be said to be high. In that case, policy recommendations will be required to increase the effort. Similarly, a low tax effort must be discussed in relation to the revenue requirements (expenditure) of the country. If the low tax effort raises enough revenue to enable the country to meet its expenditure then, even though the tax effort may be low, there may not be the need to recommend improvements in the tax effort. To capture this essential bit of the analysis in the study, we compute the ratio of total revenue and total expenditure and compare that with the tax efforts estimated from the stochastic frontier.

## The data

Annual secondary time series data for all variables were obtained from various sources. The study relies on qualitative information on changes in direct quantitative restrictions on international trade and the series of institutional tax administration reforms obtained from the Ghana Revenue Authority and Osei and Quartey (2005). The study period is from 1985 to 2014. Table 2 contains details of the specific variables for which data and information were collected, and their respective data sources.

Table 2: Variables and data sources

	Variables	Measures	Source
1.	Tax revenues (disaggregated by type)		Ministry of Finance and Economic Planning website and Ghana Revenue Authority
2.	GDP per capita		World Development Indicators database
3.	GDP (at current/market price)		Ghana Statistical Service
4.	Industry and services value added		Ghana Statistical Service
5.	Manufacturing value added		Ghana Statistical Service
6.	Imports and exports of goods and services		Ghana Statistical Service
7.	Imported non-processed agriculture and agricultural inputs		Ghana Statistical Service
8.	Non-processed agriculture		Ghana Statistical Service
9.	Gross final consumption expenditure		Ghana Statistical Service
10.	Executive constraint index		Polity IV database
11.	Tax institutional reform index	Constructed using information on reforms to tax administration and collection system since 1985	Ghana Revenue Authority and Osei and Quartey (2005)
12.	Institutionalised democracy index		African Development Indicators database
13.	Government recurrent and capital expenditure		Ghana Statistical Service
14.	Foreign grants and loans		External Mobilisation Division of the Ministry of Finance and Economic Planning
15.	Share of working and urban population		World Development Indicators database
16.	Inflation rates		World Development Indicators database
17.	Population growth (%)		World Development Indicators database
18.	Public debt		Bank of Ghana and World Development Indicators database
19.	Monetary base		Bank of Ghana

## 6. Empirical results and interpretation

In this chapter, findings from the regression analyses and estimation of the tax potential and efforts are presented and discussed. The first sub-section focuses on investigating the determinants of potential tax revenue for each tax type, using the stochastic frontier model. The second sub-section of the chapter involves the identification of the key factors that explain the level of inefficiencies in Ghana's tax system whilst the third sub-section of the chapter presents a summary of statistics for the level of inefficiency in the tax system. The fourth part of the chapter compares the estimated tax effort indicators with the public expenditure-revenue gap.

### Determinants of potential tax revenues

This study used the stochastic frontier model to first investigate the determinants of potential tax revenues in Ghana. The analysis assumed two alternative specifications of the inefficiency term,  $u_i$ , that is a model assuming the half-normal distribution of  $u_i$ , and a specification assuming an exponential distribution of  $u_i$ , as well as a third specification known as the time-varying decay model. The use of alternative specifications of the stochastic frontier analysis is to guarantee robustness of the analysis.

Again, to deal with estimation biases emanating from the existence of high multicollinearity, some of the earlier mentioned potential determinants were dropped to obtain more acceptable and parsimonious estimation results. Table 3 presents the results from estimating the three alternative specifications for analysing the determinants of Ghana's potential tax shares. This analysis depended on the use of a one-period lagged value for government, current and capital expenditures in the specifications, to partly account for the problem of a possible reverse causality due to the difficulty with identifying an appropriate instrument to resolve the issue. Measures for taxable bases in relation to the different tax types used in the analysis are presented in tables 4 and 5.

In most cases, the estimated results are robust to changes in specifications. In addition, the signs and significance of the estimated coefficients are consistent across the different specifications. All the estimated coefficients have the expected signs. The estimation results show that factors that lead to improvement in tax revenue shares in Ghana are increases in the values of the respective taxable bases, tax-related institutional reforms, increases in foreign loans, government current and capital expenditures (one year lag), and reductions in foreign grants and rate of inflation.



Table 3: Determinants of potential tax revenue (real values, natural log)

Variable	Time invariant model	Time-varying decay model	Half-normal distribution of $u_i$	Exponential distribution of $u_i$
Tax base (real values, natural log)	0.032 (1.31)	0.082*** (2.66)	0.016 (2.44)**	0.013*** (2.30)
Institutional reforms index	2.800*** (8.20)	3.750*** (8.47)	2.650*** (7.25)	1.913*** (4.30)
Foreign grants (real values, natural log)	-0.530*** (-5.99)	-0.633*** (-6.91)	-0.331*** (-3.53)	-0.231*** (-2.59)
Foreign loans (real values, natural log)	0.116** (2.40)	0.105** (2.26)	0.072** (2.08)	0.068** (2.09)
Government current expenditure (real values, natural log) – one-year lag	0.416*** (3.10)	0.587*** (4.00)	0.646*** (5.04)	0.826*** (6.36)
Government capital expenditure (real values, natural log) – one-year lag	0.987*** (6.44)	0.980*** (6.54)	0.733*** (4.06)	0.752*** (4.25)
Inflation rates	-3.058*** (-3.59)	-3.794*** (-4.46)	-3.550*** (-3.90)	-2.942*** (-3.35)
Constant	6.362*** (9.08)	5.316*** (8.32)	6.580*** (10.00)	7.119*** (11.34)
Sigma ( $u$ ) $\sigma_{ui}^2$	1.646 (0.69)	4.746 (0.63)	1.672*** (18.86)	1.225*** (13.53)
Sigma ( $v$ ) $\sigma_{vi}^2$	0.495*** (10.54)	0.461*** (10.39)	0.145*** (3.38)	0.168*** (4.58)
Eta		-0.047*** (-4.15)		
Gamma	0.769*** (2.99)	0.911 (7.14)***		
Lambda	0.769*** (2.98)		11.560*** (105.37)	7.301*** (68.35)
Number of observations	232	232	232	232
Log likelihood	264.06	257.38	303.01	307.16

\* p<0.1; \*\* p<0.05; \*\*\* p<0.01 Z-statistic in parentheses

Note: Real values suggest nominal values deflated by the consumer price index.

The estimated results for the tax base are consistent with empirical findings from Cyan et al. (2013) and confirm the hypothesis that a country that has an efficient tax system experiences an increase in potential tax revenues, with an expansion in its taxable base. The estimated results also show that institutional tax reforms had been beneficial. The statistically significant and positive coefficient for the institutional reforms index suggests an improvement in tax collection as a result of the reforms.

The statistically significant and negative coefficient for foreign grants points to an increase in tax collection as a result of a reduction in foreign grants. The finding seems to confirm Ghura's (1998) assertion that governments in developing countries regard aid as an alternative to domestic revenue mobilisation. On the contrary, the coefficient for net foreign loans has a positive sign and is also statistically significant. This may suggest that loans are used to finance activities that directly and indirectly improve the country's tax revenue. It could also mean that government would normally increase tax effort in the current period to be able to service part of its external debt in the future.

The positive sign of the coefficients for government recurrent and capital expenditures may suggest that when government increases its expenditures in the current period, it follows up by increasing revenue collections in the next period to enable it to service any debt that might have arisen as a result of borrowing to finance its budget deficits. The estimation results for government capital expenditure may also confirm the assertion that taxpayers decide to pay tax based on the condition that residents can easily identify the economic benefits from public investment expenditure.

The estimated coefficient for inflation also has a negative sign and is statistically significant, which could be interpreted as a revenue enhancing effect of reduced inflation rates. The results indicate that a stable macroeconomic environment is important for efforts aimed at improving domestic revenue mobilisation. The log likelihood ratio test statistic and the estimated parameters for Sigma (u) and Sigma (v) are statistically significant, suggesting the existence of technical inefficiency in the model.

In addition to running a regression on a panel dataset for the 11 tax types, we also run a regression for each of the individual tax types. The results of the estimation exercise are presented in tables 4 and 5. Table 4 shows estimation results for the individual direct tax types. The results show that with the exception of personal tax, the tax base has not been important in explaining any of the direct tax types. Even with personal tax, the estimated coefficient for the tax base has a negative sign although it is statistically significant at 1%. The results show that increasing the tax bases for individual direct taxes has not led to an increase in the country's direct tax potential. This finding suggests the existence of inefficiencies in the collection of direct taxes, which may be manifested in the form of corrupt practices and revenue leakages, such as tax evasion. This is consistent with the suggestion by Gorodnichenko et al. (2009) for Russia that the existence of tax evasion does not allow for the realisation of a positive impact of an expansion of tax bases for direct taxes.

Table 4: Determinants of potential tax revenue (direct taxes)<sup>A</sup> [real values, natural logarithms]

Variable	PAYE	Self-employed	Company tax	Other direct tax
Tax base	-4.023*** (5.96)	0.921 (1.01)	-0.083 (-0.35)	-2.569 (-1.32)
Institutional reforms index	0.851** (2.24)	1.586*** (3.85)	1.477*** (2.90)	1.821** (2.09)
Foreign grants (real values, natural log)	-0.213*** (-3.09)	-0.093 (-1.22)	-0.219** (-2.22)	-0.576*** (-3.55)
Foreign loans (real values, natural log)	0.117*** (4.44)	0.059** (2.06)	0.061 (1.50)	0.033 (0.53)
Government current expenditure (real values, natural log) – one-year lag	0.902*** (7.37)	-0.347 (-1.22)	0.216 (0.57)	-0.013 (-0.02)
Government capital expenditure (real values, natural log) – one-year lag	0.194* (1.71)	0.076 (0.54)	0.195 (0.94)	0.479 (1.55)
Inflation rates	-0.354 (-0.67)	-0.022 (-0.04)	-0.712 (-0.85)	-0.157 (-0.12)
Urban population (% of total)	4.278*** (4.91)	2.954*** (5.90)	3.102*** (4.05)	7.144*** (6.68)
Constant	13.461*** (3.90)	-17.812** (-2.51)	-6.964 (-1.03)	-12.888 (-0.85)
Sigma ( $u$ ) $\sigma_{ui}$	0.002 (0.01)	0.031 (0.01)	0.003 (0.01)	0.002 (0.02)
Sigma ( $v$ ) $\sigma_{vi}$	0.120*** (6.75)	0.127*** (6.69)	0.182*** (6.76)	0.272*** (6.76)
Lambda	0.016 (0.06)	0.024 (0.07)	0.014 (0.03)	0.01 (0.01)
Number of observations	23	23	23	23
Log likelihood	16.12	14.82	10.51	12.64

\*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$  Z-statistic in parentheses <sup>A</sup> Estimation done by assuming half-normal distribution of  $u_i$

The estimated coefficients for the institutional reforms index, foreign loans and urbanisation are statistically significant and have a positive sign. The results show that institutional reforms, increases in foreign loans and urbanisation have contributed to growth in the country's direct tax potentials. Urbanisation reduces informality and makes it easier for government to identify businesses for the purpose of tax collection. The estimated coefficient for foreign grants has a negative sign. The results suggest that government considers foreign grants as an alternative to direct tax collections.

Table 5 shows the regression results for indirect taxes. The estimated coefficients for the tax bases for domestic indirect taxes have a negative sign although they are statistically significant, whilst the estimated coefficients for the tax bases for international trade taxes have a positive sign. The estimated coefficient for the institutional reforms index has a positive sign and points to the fact that institutional tax reforms have had the desired and expected impact on indirect tax collection in Ghana. The estimated coefficient for foreign grants has a negative sign and confirms the earlier suggestion that government regards foreign grants as an alternative to indirect tax revenue collection. The positive sign for the estimated coefficients for foreign loans in the specifications for domestic sales tax/domestic VAT, petroleum tax and import duty, as well as for the estimated coefficients for government current and capital expenditures, points to the fact that an increase in foreign loans inflows and government expenditures have contributed to growth in indirect tax collections in the country. The estimated coefficient for inflation has the expected sign in the specifications for domestic excise tax, petroleum tax and import duty, whilst the estimated coefficient for urbanisation is positive in all the specifications except in the specification for imports sales tax/ import VAT.

Table 5: Determinants of potential tax revenue (indirect taxes)<sup>B</sup> [real values, natural logarithms]

Variable	Domestic excise tax	Domestic sales tax / domestic VAT	Imports sales tax / import VAT	Petroleum tax	Import duty	Export duty
Tax base	-0.238*** (-6.45)	-0.013*** (-9.53)	1.950*** (3.50)	-1.211*** (-6.21)	0.723*** (5.10)	1.523*** (2.60)
Institutional reforms index	0.839*** (4.80)	-0.252*** (-6.68)	1.220*** (4.50)	1.899** (2.04)	1.103** (2.60)	2.639** (1.90)
Foreign grants (real values, natural log)	-0.278*** (-11.04)	-0.660*** (-8.97)	0.160*** (2.80)	-0.113*** (-9.21)	-0.105*** (-6.42)	-0.556*** (-9.21)
Foreign loans (real values, natural log)	0.081 (7.40)	0.423*** (6.63)	0.170 (2.50)	0.034** (2.20)	0.313** (2.40)	0.662 (1.00)

continued next page

Table 5 Continued

Variable	Domestic excise tax	Domestic sales tax / domestic VAT	Imports sales tax / import VAT	Petroleum tax	Import duty	Export duty
Gov. current exp. (real values, natural log) [one-year lag]	0.754*** (14.04)	0.128*** (4.54)	0.180*** (5.65)	0.231*** (9.40)	0.329*** (7.90)	2.558*** (3.00)
Gov. capital exp. (real values, natural log) [one-year lag]	0.302*** (11.04)	0.112*** (7.93)	-0.010*** (-7.42)	0.275*** (4.40)	0.244** (2.40)	0.187*** (7.30)
Inflation rates	-0.471*** (-6.04)	0.272 (7.71)	0.363*** (3.07)	-5.661*** (-3.70)	-1.410*** (3.01)	0.999*** (4.00)
Urban population (% of total)	15.832*** (5.30)	3.708*** (6.60)	-12.96 (-1.50)	2.890*** (5.40)	9.479*** (2.70)	
Constant	2.216*** (3.22)	-1.098*** (-3.04)	-2.553*** (-3.20)	5.577*** (5.05)	-1.182*** (3.50)	-1.907*** (6.21)
Sigma ( $u$ ) $\sigma_{ui}$	0.244*** (4.80)	0.197*** (4.80)	0.063*** (3.70)	0.323*** (4.69)	0.742*** (4.80)	0.597*** (4.69)
Sigma ( $v$ ) $\sigma_{vi}$	0.038 (0.01)	1.894*** (3.02)	0.014 (0.01)	1.815*** (3.02)	2.304*** (3.11)	1.635** (1.98)
Lambda	6.410*** (12.58)	0.104*** (9.83)	4.500*** (4.10)	0.178** (2.59)	0.322** (2.08)	0.362*** (2.84)
Number of obser- vations	23	23	21	22	23	22
Log likelihood	10.41	14.34	24.6	28.9	36.9	22.7

\* p<0.1; \*\* p<0.05; \*\*\* p<0.01 Z-statistic in parentheses <sup>8</sup> Estimation done by assuming exponential distribution of  $u_i$

## Explaining inefficiency in the tax system

Table 6 presents the results obtained from estimating Equation 8 when technical efficiency is predicted from the model that assumes a half-normal distribution of  $u_i$  and when technical inefficiency is predicted from the model that assumes an exponential distribution of the term  $u_i$ . The table also presents estimation results for technical inefficiency predicted from the time-varying decay inefficiency model.

The results indicate that cohesive political institutions, or strong executive constraint and institutionalised democracy, are strong factors for reducing inefficiencies in the tax system. A possible explanation is that these three factors enhance efficiency in the provision of public goods and improves accountability and inclusiveness and, therefore, motivate taxpayers to meet their obligations to the state. The results are consistent with the findings from Cyan et al. (2013) and Langford and Ohlenburg (2015). The results show that politics play an influential role in determining the level of efficiency or inefficiency in tax collection via political choices and the functionality and effectiveness of tax administration in the country. Thus, our analysis of the determinants of the level of inefficiency in the tax system confirms the hypothesis that improvements in political institutions towards greater inclusiveness reduce inefficiency in the tax system.

Unlike the findings from Cyan et al. (2013), the estimated coefficient of population growth is statistically significant and has a positive sign in all the specifications. This supports the theoretical explanations by Minh Le et al. (2012) that tax administration becomes increasingly difficult with a rapid growth in population of taxpayers, thereby leading to higher inefficiency in the tax system.

The estimated coefficient is statistically significant and has a negative sign, which suggests that the more complex a tax system the higher the possibility that it could increase inefficiency in the tax system.

The estimated coefficient of the value of public debt (one year lagged) has a negative sign and is statistically significant in most instances when technical inefficiency is predicted from the model that assumes a half-normal distribution of  $u_i$ , but is insignificant for the predicted inefficiency obtained from the model assuming  $u_i$  is the exponential distribution of technical inefficiency.

Table 6: Explaining inefficiency in the tax system (by OLS)

Variable	Assuming half-normal distribution of $u_i$		Assuming exponential distribution of $u_i$	
	Coefficient	t-statistic	Coefficient	t-statistic
Executive constraints index	0.011 (0.67)	-0.003** (-2.11)	0.001 (0.33)	-0.003** (-2.20)
Institutionalised democracy index	0.001 (0.63)	-0.003** (-2.15)	0.001 (0.31)	-0.003** (-2.26)
Population growth (%)	0.334*** (6.43)	0.335*** (6.18)	0.296*** (5.34)	0.296*** (5.12)
Herfindahl index		-0.461*** (-4.96)		-0.359*** (-3.62)
Public debt (log values)	-0.017* (-1.86)	-0.020* (-1.66)	-0.013 (-1.38)	-0.010 (-0.75)
Change in monetary base (proxy for seignorage)	0.025 (1.26)	-0.017 (-0.95)	0.014 (0.66)	-0.027 (-1.36)
Number of observations	223	223	223	223
Adjusted R-squared	0.835	0.823	0.791	0.778

\* p&lt;0.1; \*\* p&lt;0.05; \*\*\* p&lt;0.01 t-statistic in parentheses

## Summary statistics for level of inefficiency

Tables 7 and 8 indicate that the tax types with the highest levels of efficiency are import VAT, import duty, PAYE, company tax and petroleum tax, whilst the tax types with the lowest levels of efficiency are self-employed tax, domestic excise taxes and export duty.

The low levels of efficiency in self-employed tax could be explained by the high informality in a large number of self-employed activities. Most self-employed activities can be found in the informal sector, which constitutes a large share of economic activity in the country (Ofori, 2009). The low levels of efficiency in the collection of self-employed tax and domestic excise taxes could also be explained by the numerous exemptions which reduces the taxable base, and acts of lobbying against fiscal reforms by the economically and politically powerful group of business operators (Boakye, 2011). The finding from the analysis also points to the fact that Ghana's internal revenue agency historically has lacked the administrative capacity to identify, assess and collect taxes from potential taxpayers in the informal sector.

The high level of efficiency in the collection of import VAT, duty and PAYE, could in part be attributed to the all-encompassing tax administration reforms that have included increased automation and provision of logistics, and taxpayer segmentation. For example, the installation of computer-based information systems at the ports and the Customs Division of the Ghana Revenue Authority has contributed significantly to an efficient customs collection system in the country (Kloeden, 2011).

Table 7: Descriptive statistics: Level of efficiency of tax system (%)

Variable	Number of observations	Time invariant model				Time-varying decay model			
		Mean	Std deviation	Minimum	Maximum	Mean	Std deviation	Minimum	Maximum
PAYE	30	76.5	0	76.5	76.5	93.2	2.43	89.0	96.9
Self-employed tax	30	22.2	0	22.2	22.2	25.9	13.5	8.3	51.4
Company tax	30	78.4	0	78.4	78.4	62.8	11.1	45.1	80.6
Other direct tax	30	35.7	0	35.7	35.7	50.8	13.1	30.7	72.8
Domestic excise tax	30	33.8	0	33.8	33.8	23.9	13.2	7.0	49.2
Domestic VAT	30	53.9	0	53.9	53.9	42.4	14.0	21.9	66.5
Import VAT	30	89.1	0	89.1	89.1	60.5	6.0	51.0	70.2
Petroleum tax	30	84.4	0	84.4	84.4	90.0	3.3	84.3	94.7
Import duty	30	88.1	0	88.1	88.1	72.6	8.7	58.2	86.2
Export duty	30	30.6	0	30.6	30.6	17.0	11.9	3.4	40.6
Other trade tax	30	39.3	0	39.3	39.3	14.8	9.8	2.9	38.6
Overall average	330	57.5	24.9	22.2	89.1	51.5	28.7	2.9	96.9



Table 8: Descriptive statistics: Level of efficiency of tax system (%)

Variable	Number of observations	Half-normal distribution of $u_i$				Exponential distribution of $u_i$			
		Mean	Std deviation	Minimum	Maximum	Mean	Std deviation	Minimum	Maximum
PAYE	23	51.8	29.5	2.0	90.4	56.2	30.0	0.009	89.1
Self-employed tax	23	8.7	2.1	5.6	12.3	9.8	2.4	6.3	15.4
Company tax	23	57.1	18.8	26.1	85.9	64.3	17.5	34.3	88.9
Other direct tax	23	22.7	18.6	3.1	71.2	25.0	19.8	3.8	73.1
Domestic excise tax	23	20.1	12.6	5.2	61.0	24.0	14.7	5.7	71.1
Domestic VAT	23	36.7	14.3	6.2	58.7	42.3	15.1	7.2	69.9
Import VAT	23	69.8	14.6	42.5	94.3	76.6	11.3	53.1	94.6
Petroleum tax	23	56.6	27.0	18.3	94.4	61.3	27.2	20.1	93.1
Import duty	23	68.3	15.3	38.1	89.4	76.1	11.2	50.6	89.8
Export duty	23	25.5	23.6	0.3	78.5	29.7	26.5	0.3	86.0
Other trade tax	23	11.8	8.7	2.0	29.1	13.8	9.7	2.6	31.0
Overall average	232	39.0	27.8	0.3	94.4	43.6	29.4	0.009	94.6

## Comparing tax effort indicator to expenditure-Revenue gap

Table 9 presents estimates of the tax effort using the stochastic frontier method and the ratio of tax revenues to total expenditures. The tax effort index is obtained by simply dividing the actual tax collections by the respective potential tax revenue capacity.

By comparison, the time-varying decay inefficiency model produces tax effort estimates that are significantly higher than the estimates obtained from using the other two alternative specifications. The tax types for which the highest proportion of true maximum potential have been harnessed are import duty, import VAT, company tax, PAYE and petroleum tax, whilst the tax types with the least harnessed true maximum potential are self-employed tax, domestic excise taxes and export duty. With the exception of import VAT, import duty, company tax, PAYE and petroleum tax, the data presented in Table 9 indicate that less than 50% of the optimum tax potential has been realised. The results show that Ghana has not optimally used its tax potential. The findings are compared with those obtained by Castañeda and Pardinas (2012) for Mexico, Alfirman (2003) for Indonesia, and Garg et al. (2014) for India.

Table 10 presents the estimated tax effort for all taxes, which are compared to the revenue-expenditure gap of the country. It is clear that the estimated tax efforts from using the specifications that assumes half-normal and exponential distribution of the technical inefficiency term show very low levels of tax effort in Ghana. When this figure is compared to the revenue-expenditure gap, one may conclude that a comparatively high tax effort has been achieved in the period between 1985 and 1998, which has contributed to meeting 88% of the country's expenditure needs, whilst for the period between 1999 and 2014, the average tax effort is between 31% and 33%, which covers 70% of the country's expenditure needs. This means that there is enough of an unexploited tax gap to be harnessed to meet the country's expenditure needs. Hence, government should improve on its domestic revenue mobilisation effort to meet the expenditure needs. However, the recommendation to improve tax revenue mobilisation does not imply collecting all missed tax revenues to meet the country's expenditure needs, as tax policy decisions also depend on a number of factors which include the commitment of the political leadership. Ghana's public expenditure needs could reflect the collective preference for public goods, as well as the mutual reliance between public preferences for public expenditures and taxes. However, political considerations interfere with an arrangement in which the collective preference for public expenditure reflects the tax revenue effort.

Table 9: Tax-GDP ratios (actual and potential) and tax effort indicators

Tax types	Actual tax ratio	Time-varying decay model		Half-normal dist of $u_i$		Exponential dist of $u_i$	
		Potential tax ratio	Tax effort	Potential tax ratio	Tax effort	Potential tax ratio	Tax effort
PAYE	1.508	1.617	0.932	2.910	0.518	2.682	0.562
Self-employed tax	0.276	1.066	0.259	3.164	0.087	14.109	0.020
Company tax	2.142	3.412	0.628	3.754	0.571	2.978	0.719
Other direct tax	0.663	1.304	0.508	2.926	0.227	5.177	0.128
Domestic excise tax	0.878	3.672	0.239	4.281	0.205	5.664	0.155
Sales tax/ domestic VAT	1.312	3.097	0.424	3.577	0.367	3.366	0.390
Import VAT	2.672	4.416	0.605	3.827	0.698	3.133	0.853
Petroleum tax	1.935	2.151	0.900	3.418	0.566	2.884	0.671
Import duty	2.725	3.756	0.726	3.990	0.683	3.199	0.852
Export duty	1.272	7.466	0.170	4.988	0.255	4.845	0.263
Other trade tax	0.256	1.736	0.148	2.163	0.119	9.656	0.027

Table 10: Estimated tax effort

Year period average	Actual tax share of GDP	Half-normal dist of $u_i$		Exponential dist of $u_i$		Revenues / expenditures
		Potential tax share of GDP	Tax effort index	Potential tax share of GDP	Tax effort index	
1985–1998	11.710	24.634	0.480	19.343	0.608	0.876
1999–2014	13.396	46.155	0.311	48.845	0.325	0.698

Table 11 points to a high and positive relationship between tax effort indexes obtained from the specifications assuming half-normal and exponential distributions of the inefficiency term  $u_i$  and the expenditure needs of the country, as well as a high and positive relationship between the two aforementioned tax effort indexes and the tax-related institutional reform indicator. The estimated correlation coefficients confirms the hypothesis that tax effort improves with tax-related institutional reforms and shows that it also improves with the rising expenditure needs of the country.

Table 11: Pairwise correlation coefficients

	taxeff_tvd	taxeff_hnorm	taxeff_expo	Rev/exp_gap	inst_ref	exe_const	idem
tax eff_tvd	1.00						
tax eff_hnorm	0.77	1.00					
tax eff_expo	0.72	0.84	1.00				
rev-exp_gap	0.29	0.72	0.66	1.00			
inst_ref	0.62	0.63	0.79	0.57	1.00		
exe_const	-0.28	-0.36	-0.24	-0.43	0.28	1.00	
idem	-0.32	-0.40	-0.31	-0.46	0.35	0.99	1.00

## 7. Conclusion and recommendations

This study has been motivated by the fact that the Government of Ghana has been searching for possible ways to increase tax revenues to finance public expenditures and to narrow the deficit without distorting economic activities too much. However, there are concerns regarding the initiatives' likely impact of unduly burdening residents or citizens.

SFA has been used to estimate the country's maximum tax potential, and to determine the tax performance of the country in terms of how much tax the country has collected in relation to the true estimates of its maximum tax potential. The analysis was conducted in three stages. The first involved estimating the frontier model to investigate the determinants of the country's tax potential, and to estimate the tax potential of the country. The second stage of the analysis involved obtaining the values of the predicted inefficiency term from the first-stage regression analysis and examining factors that explain inefficiency in the country's tax system. The third stage of the analysis entailed a comparison of the estimated tax effort indicator with the public expenditure-revenue gap.

The analysis confirms the hypothesis that a country's maximum tax potential increases with increases in the taxable base. However, this was not found to be the case for all tax types. Expansions in the taxable bases for all tax types, with the exception of taxes on international trade, have not led to growth in the collection of the respective tax types. The findings could reflect the possible existence of substantial revenue leakages, including tax evasion and corrupt practices as indicated in a study by Amoah, Asumah and Amaning (2014). They may also be an indication of the low rates of compliance by taxpayers. However, the study finds tax institutional reforms have made an important contribution to improving tax collection and capacity in Ghana, thus confirming the hypothesis that tax-related institutional improvement is important for increasing a country's optimum tax potential. Other factors found to be important in increasing the country's tax capacity are increases in foreign loans, government current and capital expenditures in the previous period, and reductions in the levels of inflation and foreign grants in the country. Foreign grants were found to be regarded as an alternative to tax revenue mobilisation by the Ghanaian government. Increased urbanisation was also found to be important in improving tax revenue mobilization and capacity in the country.

The study also validates the hypothesis that a more cohesive political institution and institutionalised democracy in the form of improvements in political institutions towards greater inclusiveness reduces inefficiencies in the tax system. In addition, the findings of the study show that a rapidly growing population increases inefficiencies in the tax system because there are difficulties in administering tax with a rapidly growing population. Other factors that were found to have led to reduced inefficiencies in the tax system are a less complex tax system and increased government debt obligations.

Additionally, the study shows high levels of efficiencies in the collection of import VAT, import duty, company tax, petroleum tax and PAYE, whilst very low levels of efficiencies have been identified in the collection of self-employed tax and other tax types. These findings are also reflected in the levels of estimated tax efforts. Tax effort in the collection of import VAT, import duty, company tax, PAYE and petroleum tax have been very high, whilst tax effort in the collection of self-employed tax and other tax types has been very low. Finally, the study finds that Ghana's overall tax effort is low whilst its revenue-expenditure ratio remains fairly high. The high correlation between the country's tax effort and the revenue-expenditure gap suggests that there is a substantial tax gap to be exploited to meet the country's rising expenditure needs. Although tax effort is low, the collection rate has not been so low in terms of mobilizing domestic resources to meet the rising expenditure needs of the country.

Overall, the findings from the analysis of both direct and indirect taxes suggest that tax effort in Ghana is the result of a combination of economic, institutional/administrative and demographic characteristics, which can be influenced or controlled by government in the short or long term, and collective preferences for public goods.

In line with the findings of the study, the following recommendations are made: First, government's goal of improving tax revenues through measures that expand the taxable bases could be met if a concerted effort is made to consciously deal with revenue leakages, which may include different forms of tax evasion, corrupt practices and high levels of informality. There is a need to promote measures that would urgently strengthen tax administration to help address tax leakages. In addition to an organized programme of action, a continuous and in-depth investigation must be carried out to address tax leakages and improve strategies to enhance taxpayer compliance. In the long term, the aim should be economic transformation of the country towards pro-growth activities and reduced informality, which would go a long way to improve the country's taxable capacity and collection. These efforts would complement the tax institutional reform initiatives that have been implemented to improve tax collection and capacity in the country.

It must also be acknowledged that despite the fact that institutional reforms have contributed positively to tax revenue mobilization in the country, expansions in the tax bases for most individual tax types, namely direct and domestic indirect taxes, have not translated into improvements in their collection rates. Also, there have been low levels of efficiency in the collection of specific tax types including self-employed tax, domestic excise tax and domestic VAT. The findings suggest the need to consider further reforms to some key institutional arrangements related to the aforementioned

tax types to reduce tax leakages and to improve efficiency. The key institution that needs to be reformed is the Domestic Tax Revenue Division (DTRD) of the Ghana Revenue Authority (GRA). The DTRD is a merger of the operational wings of the erstwhile Value-Added Tax (VAT) Service and the Internal Revenue Service (IRS). This division is responsible for the collection of all domestic direct and domestic indirect taxes (that is, excluding customs duty and other taxes on imports and exports).

The following are possible measures that can be taken to deal with the issues of the inability of expansions in the tax bases to translate into improvements in tax revenues and to tackle low levels of efficiencies in the collection of certain tax types: With regard to direct taxes, namely individual (PAYE) income taxes, self-employed tax, company tax and other direct tax (including capital gains tax), there is a need to enhance the capacity of the DTRD of the GRA to make it more diligent in implementing tax laws and put in place administrative measures to improve taxpayer compliance by lowering compliance costs. Such measures may include the development of information technology capacities, tax mapping and taxpayer audits. Instead of offering tax amnesties to corporate entities, the DTRD of the GRA could establish taxpayer compliance systems and systems for the timely and effective detection of leakages. In addition to that, the enforcement of the tax laws must be intensified by developing taxpayer audits and prosecuting tax evaders. Measures that simplify compliance and hence reduce compliance costs would ultimately lead to increased efficiency in tax collection and an improved tax effort.

In connection with indirect taxes, namely domestic excise tax and domestic VAT, there is a need to improve on the current filing and payments system to minimise the direct involvement of the DTRD of the GRA in calculating the tax liability of taxpayers. The launch and coming into full operation of the e-tax portal in 2014, which includes the online filing and payments system, is highly commended. It is recommended that the online system should be upgraded to include the Automated Excise Data Management System so as to allow taxpayers to file their declaration through the internet. The ultimate outcome of this initiative is an improvement in the administration and collection efficiency and productivity. Additionally, although the introduction of a VAT system is expected to reduce prospects for tax leakage, it is simply not enough to depend on the "self-policing" system of collecting VAT. There is a need to intensify intervention in the country's VAT's "self-policing" system to make taxpayers conscious of the fact that they are being closely monitored. The GRA may also consider introducing incentive schemes within the DTRD to reward officials within the division based on penalties realised from taxpayers. A given percentage of the penalties collected could be committed to a special fund, which would then be shared with officials of the DTRD in proportion to their levels of relative involvement in identifying offenders and collecting penalties.

With regard to both direct and indirect taxes, the exemptions policy and incentives need to be relooked. Political commitment for reforms is necessary and tax payers who are politically connected to the corridors of power, and therefore influential, must be included in tax collection through the elimination of tax exemption. The tax

incentives structure also needs to be reviewed considering the fact that company tax has not increased in response to expansions of the respective taxable base. In Ghana, tax incentives have become pervasive, which goes a long way to weaken tax effort.

In addition, the Ghanaian government must reduce its reliance on foreign grants as an alternative to domestic revenue mobilisation. The government's drive to increasing tax collection to enable servicing part of its debt obligations, in addition to meeting part of its expenditure, must be commended. In a similar fashion, efforts by the government to reduce inflation and thereby stabilise domestic prices improve the country's tax revenues.

Political reforms that ensure greater inclusiveness of the citizenry in the governance of the country and which constrains the powers of the executive are proven to be effective as ways of reducing inefficiencies in the country's tax system. When political institutions are reformed towards greater democracy, the incidence of corruption is reduced which in turn reduces inefficiencies the country's tax system. Rather than reducing the growth of the population of taxpayers, the government may consider measures that would help improve the country's tax administration capacity (including expansion of logistics and frequent training of personnel). There is also a need to revisit parts of the country's constitution related to the executive powers of government to impose greater constraints on the executive and help reduce corruption emanating from the activities of the politically influential to be exempt from tax payments.

The study also shows that there is enough tax space to exploit to meet the country's rising expenditure needs. Hence, government should make all concerted efforts to improve on its domestic revenue mobilisation to meet the expenditure needs. However, improving tax revenue mobilisation does not imply collecting all missed tax revenues to meet the country's expenditure needs. Measures to improve on tax effort should be implemented with a greater focus on covering the informal sector of the economy and collecting revenue from sources that are not currently subject to taxation.

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# Appendix

Table A1: Definitions and measures of tax base and economic structure

	Tax type	Tax base
1.	PAYE	Gross domestic product per capita
2.	Self-employed tax	Gross domestic product per capita
3.	Company tax	Industry and services value added
4.	Other direct tax (including property Tax)	Gross domestic product per capita
5.	Domestic excise tax	Manufacturing value added
6.	Domestic sales tax/VAT	Gross final consumption expenditure
7.	Import VAT	Total value of imports, excluding non-processed agriculture and agricultural inputs
8.	Petroleum tax	Gross domestic product per capita
9.	Import duty	Total value of imports, excluding non-processed agriculture and agricultural inputs
10.	Export duty	Total value of exports
11.	Other trade tax (including special taxes)	Total value of trade

Table A2: Tax institutional reforms

Year/ period	Key activity	Description/explanation of activity
1985	Birth of 3 autonomous institutions	National Revenue Secretariat; Customs, Excise and Preventive Service (CEPS) and Internal Revenue Service (IRS)
1983–1986	Tariff system reforms	Simplification and reduction in duties
	Granting of full operational and administrative autonomy and partial financial autonomy to CEPS and IRS	Revenue institutions, namely NRS, CEPS and IRS were removed from the civil service and granted autonomy to operate outside civil service
	Introduction of new incentive policy for staff of CEPS and IRS to improve productivity in tax collection.	
	Functional/organizational restructuring	Re-organization of tax institutions along functional lines (as opposed to organization based on tax types)
1991	Relocation of NRS under the Ministry of Finance, but with retention of some measure of independence	
1999	Introduction of VAT system	Replacement of sales tax with VAT in 1999 after an initial introduction in March 1995 was abandoned in June 1995 following mass protest. Introduction of the VAT system included re-opening of VAT offices in all regional capitals
	Automation and logistics	Complete computerization of the long room at CEPS
2002	Complete automation of clearing procedures [with the installation of the Ghana Customs Management System (GCMS)] and the Ghana Community Network (GC-Net) computer-based information systems at Tema and Kotoka International Airport and at CEPS headquarters	
	Launching a large taxpayers' unit and setting up a system of taxpayers' identification numbers	This was done in support of the LTU and expected to be implemented by all revenue agencies
2009	Integration and merger of revenue collection agencies into a single authority	This has led to establishment of the GRA, with a Domestic Tax Revenue Division, Customs Division and Support Services Division

Note: Each year or period will receive the value 1 for an activity, 2 for 2 key activities, and the value 'n' for 'n' number of key activities identified.



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