Estimating Addis Ababa tax offices efficiency: a data envelopment analysis approach

Jemal Esleman Jibril

Abstract—Governments have preferred to implement new taxes and increase tax rates in the expectation of finding a solution to its diminishing tax revenue, while improving the efficiency and effectiveness of the body responsible with managing taxation might offset this need. Efficiency can simply be defined as the ratio of output to input and is evaluated against a best practice frontier Data Envelopment Analysis model. This research measured & analyzed the Technical and Scale Efficiency of 14 small and medium tax offices in charge of direct and indirect taxes within the jurisdiction of Addis Ababa City Administration, using data from Ethiopian Revenues and Customs Authority and Addis Ababa Finance and Economic Cooperation Bureau. The study used Total Number of Taxpayers, Office Rent Expense and Total Number of Employee as input and Direct and Indirect Taxes as output for the year 2015/16. The average technical efficiency scores under constant returns to scale and variable returns to scale assumption indicate that tax offices should be able to collect their current level of revenues with approximately 40.7% & 9% less inputs respectively. Many of inefficient DMUs have also excess input usage and output. The scale inefficiency is 36.1% with 75% of the tax offices exhibiting increasing returns to scale. These suggest that tax collecting offices managers must improve their operational planning and management practices in an efficient way. This could be via adopting best practices of other tax offices and an optimal combination of factors of production, improving tax compliance, and minimizing office rent cost, adequate investment and further training in, and the adaption of new technologies relevant to modernization of tax offices. The next measure would then be to improve their scale efficiencies by increasing its scale operations through internal growth.

Keywords: Constant Returns to Scale (CRS), Data Envelopment Analysis (DEA), Decision Making Units (DMU's), Efficiency, Scale Efficiency, Slacks, Technical Efficiency, and Variable Returns to Scale (VRS)

1. Introduction

Tax is a typical instrument which States across the globe depends upon so as to carry out the needs of their citizens. Tax administrations exist to ensure obedience with the existing tax laws and the efficiency and effectiveness with which tax offices achieve their mission has always been a high priority for rulers. In developing countries, though, the administrative dimension of taxation has long been familiarized by tax administrators, especially those working on tax policy Goode (1981), Bird and de Jantsch (1993), there has been a slight analysis of this administrative dimension, at least by economists. The prevailing evidence from government budgetary information clearly indicates that the budget cost of collecting direct and indirect tax is over 1 percent of the revenues from these taxes, and can sometimes be significantly higher, Sandford (1995).

Unfortunately, there is little information on how "efficient" any tax administration may actually be in using administrative "inputs" (e.g., humans, materials, information, rules, systems) to generate "outputs" like direct and indirect taxes.

The recent international trends of rising government deficits and escalating debt have put further considerable burden to the revenue collection agencies at least in two ways. Firstly, tax administrators are forced to increase tax collections, through robust enforcement.

Secondly, the fiscal upset is forcing reductions in resources allotted to the tax offices. Tax administrative is therefore being forced to do more, and to do more with minimal resources. These advances mean that inefficient tax offices will need to take ladders to increase the efficiency of their tax revenue collection activities. While public spending efficiency has received a great deal of attention, tax collection efficiency has received considerably less notice, largely because the absence of comparable data across tax administrations has made the comparative analysis of tax offices impossible. Governments have chosen to implement new taxes and increased tax rates in the hope of finding a solution to increase tax revenue, however improving the efficacy and efficiency of the body charged with managing taxation might offset this need (Barrilao-gonzalez. n.d).

Efficiency is simply the ratio of total outputs to total inputs. Efficiency can be measured using parametric models and non-parametric models. Data Envelopment Analysis (DEA), a non-parametric model is a linear programming-based technique for measuring the performance efficiency of decision making units relative to the best practicing.

It was originally developed for performance measurement. It has been successfully employed for assessing the relative performance of a set of firms that use a variety of identical inputs to produce a variety of identical outputs. The principles of DEA date back to Farrel (1957). The recent series of discussions on this topic started with the article by

Charnes et al. (1978). A good introduction to DEA is available in Norman and Stoker (1991). Cooper et al. (2000) provide recent and comprehensive material on DEA. The paper attempts to determine the relative and scale efficiency, magnitude of inefficiency and ranking of tax collection offices which deal with declarations, assessments, collection and tax appeal review of individuals and companies at the city government level.

* *Jemal Jibril has pursued masters of Science degree in Project Planning and Management at Yom Institute of Economic Development and Debre Markos University, Ethiopia,*
* *He had also MSc in Accounting and Finance in Ethiopian Civil Service University,*
* Coordinator, Risk & Audit Initiative @ Tax Transformation Program, Ministry of Revenues, Ethiopia
* *Ph-+251912063142. E-mail: jemsamr@gmail.com*

1.1. BACKGROUND OF THE STUDY AREA

After the bilateral agreement which have been signed in 2011, all tax collecting offices of Addis Ababa city government are came under direct control of ERCA. The reason for the merger is to improve efficiency and enhance quality in taxation works as a means of increasing revenues and customer satisfaction resulting from a more efficient tax administration system.

The vision of the Addis Ababa Tax Authority is to see the city expenditure is covered from the tax revenue. The allocation of public resources to each tax office is based on the budget of the city government for the inland revenues authority. For the year 2015/2016, Birr 512.70 million recurrent budgets is ratified by the city administration for the tax authority tax activities. From this amount, a total of Birr 493.92 million is disbursed. The tax collection trend in the Addis Ababa City Tax Authority jurisdiction shows an increasing trend. In 2011, it was collected 4.3 billion Birr. But after the merger with ERCA, for example by 2015/16, it was reached Birr 21,109.16 million (92.54% of the planned goal) and in 2016/2017, by showing 20% average increment, it is reached 23 Billion Birr and it increases covering capacity of expenditure budget from 51% to 75%. There is a potential to collect more than 40 Billion Birr per year in the city (Tax for Development newspaper, 9th year, no. 108, Nov, 2017). It is collected from the direct taxes, indirect taxes, municipality revenues and salary income taxes collected from the agents (Federal Revenues and Customs Authority Addis Ababa branch offices) and rental taxes collected by one of the federal branches, Large Taxpayers Branch Office.

1.2. STATEMENTS OF THE PROBLEM

The study aims to measure the relative Technical and Scale efficiency of Addis Ababa City Administration Tax Offices which were under the administration of ERCA. Tax administration should be effective in the sense of ensuring high compliance by taxpayers, and efficient in the sense that administrative costs are low relative to revenue collected. In 2015/16, The Ethiopian Revenues and Customs Authority tax administration cost is reached to 1.00% of the total collected tax revenues. It indicates that for every Birr 100 tax revenues collected, Birr 1.00 is spent. The Addis Ababa City Tax Administration cost is reached to 2.34% of the total collected tax revenues. It indicates that for every Birr 100 tax revenues collected, Birr 2.34 is spent (ERCA's Annual Main Activity Performance Report, July, 2016). The efficiency ratio of the city is below the federal tax authority and is similar with the prevailing evidence from government budgetary information that indicates that the budget cost of collecting direct and indirect tax is over 1 percent of the revenues from these taxes, and can sometimes be significantly higher, Sandford (1995). Though there is no prior efficiency measurement is conducted in these tax offices, this research finding reveals that on average 40.7% & 9% inefficiency is exhibited in CRS & VRS technical efficiency measures respectively. And the scale inefficiency is 36.1%. This shows that the problem is still existed in all measure of efficiency.

The causes of the inefficiency of the tax collection agencies could fall under at least in four ways, Olson (1965). Firstly, there have been extended and bitter labor disputes on the issue of updating the managerial procedures of tax offices, particularly with regard to increasing the use of computers. Secondly, the sector suffers from chronic bureaucracy, low levels of education among employees and, prevalent corruption (Addis Standard Newspaper, May22, 2014). Thirdly, tax office administrators' appointment has been prone to politically dominant interest groups and to their private agendas, which has hindered modernization and development of economic, democratic, professional and promotion on the basis of merit. Finally, there is a historically determined deficit of capital, which is one contemporary illustration of how and how far, the country and the city lag behind the nations of the industrialized world.

Despite the follow-up inspection procedures carried out by the ERCA, auditing or feedback regarding the tax offices' activities is still not enough, as can be seen from the yearly reports presented by tax office. These reports focus mainly on the financial performance of the unit that is the collected amount of revenue. However, information on operational activity is not standardized and in the case of some offices, even neglected. This, in turn, implies that the City Government is, at best, under-informed as to the return on its policy. From this, it can be inferred that the tax offices are free to set their own private agendas, sidestepping the public objectives which they are assumed to achieve. Since a worldwide process of modernization of public administration is being carried out throughout State institutions, Keehley et al. (1997) and the necessity for efficiency of tax offices came in to the tax administrators' agenda, the researcher emphasizes the need to apply the DEA benchmark procedure to analyze the efficiency of the tax offices' activities. This would be at least one step in the right direction in the attempt to reduce the lag behind other countries and cities tax offices.

1.3. RESEARCH GAPS

Various research works have been conducted in relation to the tax administration issue of Ethiopia. But little studies that focus on efficiency of tax offices are conducted. To the best of the researcher's knowledge, no studies have been conducted so far to estimate the relative efficiency of tax offices using DEA model in Ethiopia. However, the researcher has got a study by Yifru (2016), on Efficiency of Private Commercial Banks in Ethiopia, using input-oriented CRS and VRS single stage DEA model. The researcher makes a reference on studies which are relevant to tax offices efficiency conducted in Europe and Asia. The study tried to bring an answer for the query of relative efficiency of tax collecting offices under investigation.

1.4. RESEARCH OBJECTIVES

1.4.1. GENERAL OBJECTIVE

The main objective of the study is to investigate the relative efficiency of tax collecting offices of the Addis Ababa City Government using DEA model.

1.4.2. SPECIFIC OBJECTIVES

- To estimate relative technical efficiencies (TE) and scale efficiency (SE) of individual Decision-Making Units (DMUs)
- To measure the magnitude of inefficiency behind this tax collecting offices
- Ranking tax collecting offices based on their efficiency scores

1.5. RESEARCH QUESTIONS

- How efficiently do tax offices utilize their resources and to their scale size?
- How much inefficiency is existed in each tax offices?

- Which tax office is relatively better efficient and inefficient than others?

1.6. SIGNIFICANCE OF THE STUDY

The paper contributed to the literature in a number of ways. To the best of the researchers' knowledge, this is the first known attempt to estimate relative efficiency of tax offices by procuring DEA model in the city. The measurement of efficiency the research employed were also unlike from other common measures, for instance simple tax ratios (cost-to-revenue), often used to measure the efficiency with which tax revenues are collected. The disadvantage in procuring these ratios is that incapability to account for the fact that tax collection is a production process that transforms multiple inputs to multiple outputs. DEA efficiency scores estimation permitted to consider for these inputs and outputs and also for the environmental factors that affect how the inputs are combined in the production process James Alm et al. (2013). The analysis provided information on suitable political and administrative measures that can lead to improvements in the general setup behind the tax offices. Finally, it becomes useful for further study to those whom want to undertake more research in this area.

1.7. SCOPE OF THE STUDY

As mentioned in the main objectives, the study assesses the relative efficiency (Technical and Scale only) of 14 Inland Revenue collecting offices of Addis Ababa City Administration. Due to unavailability of data, the investigation is limited to the period 2015/16 only. The variables like Total Number of Tax Payers, Office Rent Expense and Total Number of Employees were used as input and Direct Taxes and Indirect Taxes are taken as output variables. Other input and output variables of tax offices were not considered in this empirical study.

1.8. LIMITATIONS OF THE STUDY

The paper has two limitations: first, limitations related to the data set and second, those related to the DEA method.

With reference to the data set, the homogeneity of the tax offices used in the analysis is questionable, since the study had compared offices with relatively different size (small to medium), may face different restrictions and therefore, might not be considered to be directly comparable. Additionally, the data obtained was not as wide as it is expected. If a larger amount of data were available, a further analysis with other methods such as the Tobit regression could be performed which would greatly improve the conclusions. Reducing the number of observations in DEA variables increases the likelihood that a given observation will be judged relatively efficient, Banker (1993).

Some of the limitations of the DEA model are the following: the DEA does not make any functional form on the data, neither does it make distributional assumptions for the inefficiency term, nor does it make a prior distinction between the relative importance of any mix of inputs and outputs.

1.9. DESCRIPTION OF THE STUDY AREA

The study was conducted in fourteen (14) Addis Ababa City Administration tax offices which are currently operating in the city. Their classification of tax collection responsibility is based on the physical geography of the sub cities which are classified for appropriateness of the city administration and the ability of taxpayers. The city has 10 micro taxpayer offices, 2 medium taxpayer offices and 2 project offices. The names of the offices are Bole Sub City Micro Taxpayers Branch Office, Arada Sub City Micro Taxpayers Branch Office, Yeka Sub City Micro Taxpayers Branch Office, Kirkos Sub City Micro Taxpayers Branch Office, Gulele Sub City Micro Taxpayers Branch Office, Akaki Kaliti Sub City Micro Taxpayers Branch Office, Nifas Silk Lafto Sub City Micro Taxpayers

Branch Office, Kolfe Keranyo Sub City Micro Taxpayers Branch Office, Lideta Sub City Micro Taxpayers Branch Office, Addis Ketema Sub City Micro Taxpayers Branch Office. The two medium tax payer branches are Addis Ababa Number 1 Medium Taxpayers Office and Addis Ababa Number 2 Medium Taxpayers Office. Lastly Merkato Number 1 and Merkato Number 2 project offices are project offices which are established recently and responsible for collecting tax on the Merkato trade area which is said to be Africa's biggest trading area. From these tax offices, Addis Ababa Number 2 Medium Taxpayers Office and Arada Sub City Micro Taxpayers Branch Offices were excluded from the data set since they are supposed to be outliers.

1.10. ORGANIZATION OF THE PAPER

The paper is organized as follows. The next chapter contains literature reviews with theoretical and empirical literatures of DEA measure of efficiency. Chapter three presents the method of the research work it has been conducted. Chapter four communicates with data analysis and presentation of findings. Final part of the paper summarizes presented results and discusses possible directions for future research work. References and appendices are attached here with.

CHAPTER TWO

2. LITERATURE REVIEW

2.1. THEORETICAL LITERATURE REVIEW

Tax is a compulsory contribution to the support of government, levied on person's property, income, commodities, transactions, etc. Taxes are a special kind of imposition that can be distinguished from fees and fines on the basis that they are imposed on the community at large and are not specifically connected with the receipt of any particular services, the granting of any special rights or privileges, or the breach of any law by the payer. Taxpayers are compelled by law to pay taxes and are obliged to do so even though they may not necessarily receive any direct benefits in return. Taxation is the principal means by which governments raise revenue. Without taxation, governments would be unable to finance their operations or deliver the many public goods and services that they provide to the community. The achievement of any tax system is dependent upon the Management charged with its enactment (Lasheras and Herrera, 1991). Governments have chosen for the announcement of new taxes and an increase in tax rates in situations where such action may have proved unnecessary, had greater efforts been made on ensuring optimal organization within the management of the tax system. Therefore, a tax system should not be considered solely in terms of the structure of taxation or the quantification of taxable events, but rather, must also be approached with a view to the efficiency and efficacy of the tax administration charged with overseeing it (Jiménez and Barrilao, 2001). The tendency towards offsetting deficit by incrementing fiscal pressure might be substituted by a more rigorous control of the management of the tax system, increasing its efficiency, whilst reducing the incidence of fraud (Rubio, 1996; Ruibal, 2008).

Unfortunately, there is little information on how "efficient" any tax administration may actually be in using administrative "inputs" (e.g., humans, materials, information, rules, systems) to generate "outputs" like direct and indirect taxes. The recent international trends of rising government deficits and escalating debt have put further considerable burden to the revenue collection agencies at least in two ways. Firstly, tax administrators are forced to increase tax collections, through robust enforcement. Secondly, the fiscal upset is forcing reductions in resources allotted to the tax offices. Tax administrative is therefore being forced to do more, and to do more with minimal resources.

These advances mean that inefficient tax offices will need to take ladders to increase the efficiency of their tax revenue collection activities. While public spending efficiency has received a great deal of attention, tax collection efficiency has received considerably less notice, largely because the absence of comparable data across tax administrations has made the comparative analysis of tax offices impossible. Governments have chosen to implement new taxes and increased tax rates in the hope of finding a solution to increase tax revenue, however improving the efficacy and efficiency of the body charged with managing taxation might offset this need (Barrilao-gonzalez. n.d.).

2.1.1. TYPES OF TAXES

1. Direct Taxes

The most important and widely imposed modern tax is income tax. As its name suggests, income tax is a tax on income (i.e. earnings).

Corporation income tax- is a tax on the profits, or net income (total income minus costs), of corporations.

Estate tax - tax on the property (including real, personal, and intangible property) left by a person at death.

Gift tax- is a tax on the value of gifts received by an individual in excess of a certain sum per year and over a certain cumulative amount over a person's lifetime.

Individual income tax - tax on the income of individuals or families, generally applied to wages, salaries, tips, interest, and dividends. It is also called personal income tax.

Inheritance tax -A tax on the income (including property) received by an heir from the estate of a person who has died. Bequests to charitable organizations are not taxed.

Poll tax - A tax of a specific monetary amount imposed directly on an individual. The other name used is a lump-sum tax or head tax. In the Pollution tax -A tax levied on a company that produces air, water, or soil pollution over a certain level established by the government.

Property tax- is a tax on property, usually meaning only real property, such as land, buildings or houses, and machinery. Personal property, such as furniture, vehicles, or jewelry, is largely excluded, as is intangible property, such as money, stocks, bonds, or bank deposits (Taxation Principle and Theory).

2. INDIRECT TAXES

In addition to income tax, most countries also impose some form of consumption tax. A consumption tax is a tax whose economic incidence falls on the consumer (e.g. through the increased cost of goods or services). It is the opposite to income tax, as its base is consumption rather than earnings.

Value added tax (VAT) - is a form of consumption tax where the seller pays the government a percentage of the value added to goods or services at each stage of production. The value added at each stage of production is the difference between the seller's cost of materials and the selling price. In essence, a VAT is just a general sales tax that is collected at multiple. As with general sales taxes, consumers bear the final burden of value-added taxes

It is the most widely known consumption tax. VAT was first imposed in France in 1954 and has been adopted throughout the European Union (EU). It is a requirement for EU membership that Member States impose VAT at a minimum rate of at least 15% (although reduced rates are allowed for certain supplies). In Ethiopia also, VAT is taxed at a flat rate of 15%. Excise tax -is a selective tax imposed on the production and sale of specific products. It is charged with different rates.

Sales Tax - is imposed on the sale of goods or services. The tax is computed as a percentage of the total sales price. Sales taxes differ from excise taxes in that sales taxes impose the same tax rate on a broad range of goods and services, whereas excise taxes apply only to specific goods or services. Although collected from sellers at the retail level, consumers bear the cost of sales taxes. Tariff tax - is levied on imported or exported goods. Also called duty or customs duty.

2.1.2. PERFORMANCE MANAGEMENT

Early performance measurement used to mainly focus on financial output performance ignoring other areas (such as production or customer service) or ignoring the concept of efficiency. The performance of DMUs is assessed in Data Envelopment Analysis using the concept of efficiency or productivity, which is the ratio of total outputs to total inputs. Efficiency can be simply defined as the ratio of output to input. More output per unit of input reflects relatively greater efficiency. If the greatest possible output per unit of input is achieved, a state of absolute or optimum efficiency has been achieved and it is not possible to become more efficient without new technology or other changes in the production process.

Efficiency can be measured in different ways. Technical efficiency of a tax office is a comparative measure of how well it processes inputs to achieve its outputs, as compared to its maximum potential for doing so, as represented by its production possibility frontier. Scale efficiency refers to the amount by which efficiency can be increased by moving to the most efficient scale size.

Scale efficiency measures can be obtained for each firm by conducting both a CRS and a VRS DEA, and then decomposing the TE scores obtained from the

CRS DEA in to two components, one due to scale inefficiency and one due to “pure” technical inefficiency (i.e. VRS TE). If there is a difference in the CRS and VRS TE scores for a particular firm, then this indicates that the firm has scale inefficiency. If inputs and/or outputs are measured in dollars rather than physical units, the efficiency differences observed can be due to price efficiency as well as scale and technical efficiency.

Allocative efficiency results from an efficient mix of inputs used to produce the mix of outputs. It refers to whether inputs, for a given level of output and set of input prices, are chosen to minimize the cost of production, assuming that the organization being examined is already fully technically efficient and, Global (Economic) Efficiency is the one which reflects the production of goods and services that afford the greatest benefits to society at the lowest possible social cost.

Afonso et al. (2006) highlighted the importance behind the rational use of resources available to the public sector and the need for high-caliber fiscal policies. Both these aspects are considered crucial for economic growth and stability as well as for individual well-being.

In recent years' various attempts have been made at measuring the degree of public expenditure efficiency through quantitative analysis methods, including composite indicators and non-parametric approaches. However, tax revenue is the key funding source behind public spending; therefore, taxation system efficiency is of pivotal importance to the longevity and well-being of any public-sector activity. Increasing the revenues obtained from taxation can be achieved only at progressively higher marginal costs (Afonso et al., 2006)

2.1.3. TYPES OF EFFICIENCY MEASUREMENT MODELS

Regression and Stochastic frontier analysis have been the popular methods of measuring efficiency. Data Envelopment Analysis (DEA) is one of the latest additions to the bracket of these techniques. The econometric approach to the construction of frontiers and the estimation of efficiency relative to the constructed frontiers has similarities and differences with the mathematical programming approach. Both are analytically rigorous benchmarking exercises that exploit the distance functions introduced to measure efficiency relative to a frontier. However, the two approaches use different techniques to envelop data more or less tightly in different ways. At the risk of over simplification, the differences between the two approaches boil down to two essential features.

• The econometric approach is stochastic. This enables it to attempt to distinguish the effects of noise from those of inefficiency, thereby providing the basis for statistical inference.

• The programming approach is nonparametric. This enables it to avoid confounding the effects of misspecification of the functional form (of both technology and inefficiency) with those of inefficiency.

A. Parametric Models (Econometric Models)

Econometric models can be categorized according to the type of data they use (cross-section or panel), the type of variables they use (quantities only, or quantities and prices), and the number of equations in the model. The most widely used model, the single equation cross-section model, and the panel data models. In both contexts the efficiency being estimated can be either technical or economic. And also, multiple equation models and shadow price models, which typically involve multiple equations, (Timothy j. Coelli et al. 2005).

B. Non-Parametric Model (Data Envelopment Analysis)

Data envelopment analysis (DEA) is a mathematical programming-based technique to evaluate the relative performance of organizations. While the main applications have been in the evaluation of not-for-profit organizations, the technique can be successfully applied to other situations competing with other techniques as cost benefit analysis and multi criteria decision making as can be seen, for instance, in a recent study about the best choice for traffic planning, namely, the design and location of a highway in Memphis, Bougnol et al. (2005).

2.1.4. HISTORY AND APPLICATIONS OF DEA

DEA is a mathematical programming technique presented in 1978 by Charnes et al. (1978), although its roots may be found as early as 1957 in Farrel's seminal work, Farrell (1957) or even to Debreu's, which introduced in the early fifties the "coefficient of resource utilization", Debreu (1951). It deserves special attention and also the work of the Dutch Nobel-prized Tjalling Koopmans and his “activity analysis concepts”, Koopmans (1951).

The DEA technique is usually introduced as a non-parametric one, but in fact it rests on the assumption of linearity, Chang and Guh (1991) and for the original constant returns to scale (CRS) models even in the stricter assumption of proportionality. Its application has been focused mainly on the efficiency assessment of not for-profit organizations, since these cannot be evaluated on the basis of traditional economic and financial indicators used for commercial companies.

The first application of DEA was in the agriculture field; as a matter of fact, Farrell applied it to 1950 data of 48 states in the United States of America, considering 4 inputs and 2 outputs.

At that time, the DEA term was not yet created, so in fact the first time the term DEA and that technique was applied in the area of education, specifically in the analysis of Program Follow Through, conducted in the USA, in the late seventies, Rhodes (1978). Since then it has been used to assess efficiency in areas such as health, Wilson et al. (2012), county goals, Seiford and Zhu (2002), courts, Schneider (2005), universities, Bougnol et al. (2010) and many other not-for-profit sectors. Nowadays DEA can be seen to have spread to other fields such as transit, Chiu et al. (2011), mining, Chen et al. (2010), air transportation, Pestanae Dieke (2007) and even banking, Emrouznejad and Anouze (2010).

2.1.5. ADVANTAGES AND LIMITATIONS OF DEA

The main advantage of DEA is that it can readily incorporate multiple inputs and outputs to calculate technical efficiency. By identifying the “peers” for organizations that are not observed to be efficient, it provides a set of potential role models that an organization can look to, in the first instance, for ways of improving its operations. However, like any empirical technique, DEA is based on a number of simplifying assumptions that need to be acknowledged when interpreting the results of DEA studies.

Its main limitations include but not limited to the following: being a deterministic rather than statistical technique, DEA produces results that are particularly sensitive to measurement error. DEA only measures efficiency relative to best practice within the particular sample. Thus, it is not meaningful to compare the scores between two different studies. DEA scores are sensitive to input and output specification and the size of the sample. Despite these limitations, data envelopment analysis is a useful tool for examining the efficiency of government service providers. Just as these limitations must be recognized, so must the potential benefits of using DEA (in conjunction with other measures) be explored to increase our understanding of public sector performance and potential ways of improving it?

2.2. EMPIRICAL LITERATURE REVIEW

At the empirical level, DEA methods have been extensively applied for the estimation of the efficiency scores of individual production units (cross-section) in various areas such as: health services, education, public transportation, post offices, municipalities, banking, insurance, etc.

On the contrary, at the revenue side of the government sector, empirical studies on the productive efficiency of tax offices seem to be rather rare. Although efficiency of the tax administration is one of the four "canons" recommended by Adam Smith (1776) in his long-standing treatise on taxation. Moreover, one notices that economists are more interested in the empirical investigation of individual compliance costs of taxation rather than the measurement of the operational efficiency of existing tax administrations (see Sandford, Godwin and Hardwick (1989); Slemrod (1992).

Analysis of efficiency of tax offices is scarce, probably because of the non-disclosure policy of public entities such as tax offices everywhere including in Ethiopia. The study refers to the following papers: James Alm and Denvil Duncan (2013), Moesen and Persoons (2002), Gonzalez and Miles (2000), Ramón Fuentes (2014), Sang-Lyul Ryu and Seok-Young Lee (2013), Katharaki and Tsakas, (2010) and C.P Barros (2007).

James Alm and Denvil Duncan (2013) attempted to determine the relative efficiency of tax collection agencies of 30 OECD (Organization of Economic Co-operation and Development) countries for the period 2005 to 2009 using input-oriented variable-return-to-scale three stages DEA model and econometric model. They used salary and information technology administrative costs related to tax function as inputs and personal income tax (PIT), corporate income tax (CIT), and value-added tax (VAT) in total, separately, and in various combinations as output variables. Their findings indicate that 12 of the 30 countries in the sample are relatively efficient at collecting any of the three types of tax revenues (personal income, corporate income, and value added taxes). And the average efficiency scores show that with the current level of output, countries have a scope to minimize approximately 10 to 13 percent of their existing input usage.

Moesen and Persoons (2002) analyzed the efficiency of 289 regional tax offices dealing with personal income tax matters in Belgium for the fiscal year 1991, with Free Disposal Hull (FDH) and DEA taking labor as input and number of audited returns with a different complexity as output. Their examination reveals that organizational designs do matter such as the presence of a Central Tax Office and to a lesser degree the monitoring system within each Regional Directorate General. Equally is the positive impact of managerial skills. Offices which are daily managed by a qualified (higher ranking) civil servant seems to accomplish better on average.

Which is an argument for investing in human capital also in the public sector?

Gonzalez and Miles (2000) analyzed the efficiency of 15 Spanish regional tax offices for the year 1995 with DEA, using a bootstrap technique. The single input used was the ratio of the number of tax inspectors to the total personnel; the two outputs used were the ratio, the number of actions performed by the tax office to total tax payers and the ratio of debt to gross added value. Their conclusions were that the average efficiency was 0.81 and that only third of the 15 offices analyzed were efficient.

Ramón Fuentes, (2014) analyzed how the productivity growth of the tax offices located in the province of Alicante (Spain) evolved between 2004 and 2006. The methodology employed was Output-oriented Data Envelopment Analysis (DEA) based Malmquist Indices to compute the levels of productivity and smoothed bootstrap to avoid the sensitivity of the results to sampling variations. The inputs were office area and number of employees and the outputs were number of tax returns and number of taxpayers. The finding shows the aggregated development of Malmquist productivity index and its components for the whole of the period 2004-2006, total average productivity increased by 5.73%, with a simultaneous improvement in all components.

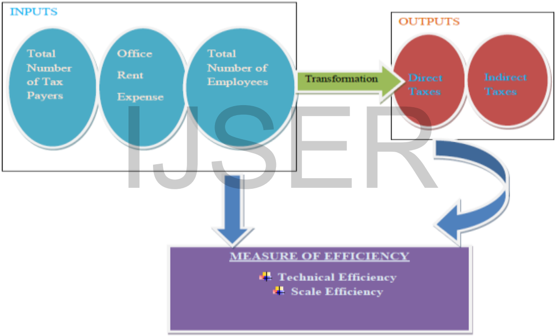
Sang-Lyul Ryu and Seok-Young Lee (2013) Using data envelopment analysis discovers how the efficiency of collecting national tax in tax jurisdictions has been changed in Korea over the period 1998-2011 for six tax jurisdictions. The input variables taken were direct taxpayers, indirect taxpayers and real GDP (RGDP). Direct tax and other taxes were taken as output variables. They got the mean efficiency scores 0.62 for pooled sample of 84 observations, suggesting that there exists a significant level of waste in national tax collection activity. Furthermore, trend analysis indicates that the aggregate efficiency for tax jurisdictions has declined steadily over time since the currency crisis of 1997.

Katharaki and Tsakas, (2010) studied the technical and scale efficiency of 27 tax offices in Greece during the period 2001-2006 utilizing DEA and Window analysis. They used labor in each tax office, measured by the number of employees; the number of computers operating in each tax office; the number of natural persons (NP) paying taxes; and the number of legal entities (LE) paying taxes as inputs and incoming taxation funds related to natural persons and the incoming taxation funds related to legal entities as outputs. And find that ‘‘scale size’’ and the structure of regional economy where tax offices operate are important factors affecting their efficiency.

C.P Barros (2007) estimates the technical and allocative efficiency of 41 tax offices in central and great Lisbon from 1999 to 2002, utilizing DEA. The inputs used were labor, measured by the number of workers; capital, measured by the rents paid for the premises and the tax population (population registered in the office’s files) and the outputs used were the total amount of personal income tax collected; value of corporate income tax collected; value of VAT, value of inheritance and donations taxes and value of other taxes and found the results are, at best, mixed, leading to conclude that the Government's regulatory body, the Central Tax Authority (CTA), falls short of achieving its stated aims. To estimate the relative efficiency of public spending, DEA has been employed in a variety of public finance studies, Adam, Delis, and Kammas (2011) and taxation, Thanassoulis, Dyson, and Foster (1987).

2.3. CONCEPTUAL FRAMEWORK

The proposed framework which explains the input and output variables used for the estimation of technical and scale efficiency of tax collecting offices of Addis Ababa City Administration is as follows:



Author

CHAPTER THREE

3. RESEARCH METHODS

3.1. INTRODUCTION

Generally, the research method part includes the operational definition of variables, research design, model specification, research method, sample design such as: population, sampling frame, sampling unit, the sample size, sources of data. In addition, methods of data analysis and presentations are also part of this section.

The paper was concerned with the concept of technical and scale efficiency, given that analyzing other types of efficiency entails the need for awareness of market prices, or, where necessary, social cost, values that, in the case of the public sector, remain largely unknown (Barrilao-Gonzalez n.d.).

3.2. OPERATIONAL DEFINITION OF VARIABLES

The following variables are operationalized as follows:

1) Tax offices mean an Inland Revenue small & medium size branch office established by Addis Ababa City Administration to deal

with tax declarations, assessments, collection, enforcement and doubtful tax demands of individuals and companies at Addis Ababa City level, for collecting tax revenues.

2) Decision making units (DMUs) are entities responsible for converting inputs in to outputs, such as firms. In this study, DMU refer to 12 Addis Ababa City Administration tax collecting offices.

3) Technical Efficiency: is comparative measure of how well it processes inputs to achieve its outputs, as compared to its maximum potential for doing so.

4) Pure Technical Efficiency: is the remaining efficiency element that refers to resource up keeping or output improvement.
5) Scale Efficiency: is the ability of each DMU's to operate as close to its most productive scale size as possible.
6) Ranking: giving grade and setting precedence for the efficiency scores of each DMU's.
7) Total Number of Employees: the total number of permanent employees who had been working for each tax offices in the sample period.

8) Total Number of Taxpayers: all types of taxpayers who were registered and active in each DMU's in the sample period excluding employee and students.
9) Office Rent expense: is an expense which were disbursed for office building rent of each DMU's in the sample period
10) Direct Taxes: It includes all types of Inland Revenue direct taxes collected by each tax offices in the sample period which are included in appendix E6 except salary income tax collected from the agents (Federal Revenues and Customs Authority Addis Ababa branch offices) and rental

taxes collected by one of the federal agents, Large Taxpayers Branch Office.

11) Indirect Taxes: It includes all types of Inland Revenue indirect taxes collected by each tax offices in the sample period which are included in appendix E6.

3.3. RESEARCH DESIGN

To estimate the technical and scale efficiency of the DMU's, this analytical study was used a database from ERCA and AFECO for the year 2015/16, containing information on inputs and outputs. The study was employed DEA methodology, based on the article by Charnes et al. (1978), set up as a non-parametric, deterministic approach that enables us to obtain a measurement of relative efficiency between tax offices, in order to identify those that present optimal performance when compared with the remainder.

In many studies the analysts have tended to select input-oriented models because many DMU's have particular orders to fill (e.g. electricity generation) and hence the input quantities appear to be the primary decision variables, although this argument may not be as strong in all industries. In some industries the DMUs may be given a fixed quantity of resources and asked to produce as much output as possible. In this case an output orientation would be more appropriate.

Several criteria can be applied to the selection of inputs and outputs. Usually, the criterion of available archival data is used. Next, the literature survey is a way to ensure the validity of the research and as such, another criterion to take into account. The last criterion for measurement selection is the professional opinion of managers in the area concerned and the realistic approach required when analyzing these statistics. For this study, it follows all four mentioned criteria.

In a general production function, labor, land and capital are included as inputs. Prior studies for example Barros (2007); JamesAlm and Denvil Duncan (2013); Katharaki and Tsakas, (2010); Sang-

Lyul Ryu and Seok-Young Lee (2013); were used total amount of tax collected by regional tax office in tax jurisdictions as one of outputs.

Barros (2007) takes number of tax population, rent expense and number of employee as input variables and direct and indirect taxes with different segregation as output variables.

James Alm and Denvil Duncan (2013) uses salary expense and information technology costs as input variables and tax revenues as output variable.

Katharaki and Tsakas, (2010) used labor in each tax office, measured by the number of employees; the number of computers operating in each tax office; the number of natural persons (NP) paying taxes; and the number of legal entities (LE) paying taxes as inputs and incoming taxation funds related to natural persons and the incoming taxation funds related to legal entities as outputs.

Sang-Lyul Ryu and Seok-Young Lee (2013) Using data envelopment analysis taken input variables like direct taxpayers, indirect taxpayers and real GDP (RGDP). Direct tax and other taxes were taken as output variables.

Taking into account the existing literature and availability of data, the study includes the Total

Number of Taxpayers, Office Rent Expense and Total Number of Employees as input and Direct Taxes and Indirect Taxes as output in estimating the efficiency for each observation. The traditional micro-economic theory of factors of production concepts of the use of labor and land is considered for input selection. The justification for the inclusion of the total number of taxpayers as an input variable is that from this population each tax offices can generate their tax revenues. The output variables such as direct taxes and indirect taxes are included as they are the reasons for existence of each tax offices & generate the major and the dominant source of revenues for each DMU. If we see the 2015/16 budget year, from the total tax revenues collected in the city, Direct Taxes (including salary taxes which is Br 13,601.98 million) & Indirect Taxes Br 6,929.83 million is collected. In total, it shows 97.26% from Birr 21,109.16 Million tax revenues. The remaining is collected from the municipal revenues and rent revenue collected by the federal large taxpayers' office.

3.4. MODEL SPECIFICATION

The study employed single stage input-oriented CRS based on Charnes, Cooper and Rhodes (1978) and VRS DEA approach based on Banker, Charnes and Cooper (1984). The linear programming is formulated to estimate efficiency scores. Assume there are data on *N* inputs and *M* outputs for each of *I* firms. The input and output for DMUj be (x1j, x2j, x3j, ……, xNj) and (q1j, q2j, q3j, ….., qMj), respectively. The $N \times I$ input matrix, *X*, and the $M \times I$ output matrix, *Q*, represent the data for all *I* firms.

Where j=1, 2,…, *I*,

Input (x): N number of input items: xi where i=1…, *N*

Output (q): M number of output items: qr where r=1…, *M*. Thus, the input X and the output Q data matrixes can be arranged as;

X (input) = x11 x12 ……….x1*I*

x21 x22 ……….x2 *I*

x31 x32 ……….x3 *I*

xxx xxx ………xxx

xxx xxx ………xxx

xN1 xN2 ……….xN12

Q (output) = q11 q12 ……….q1 *I*

q21 q22 ……….q2 *I*

qxx qxx ………qxx

qxx qxx………. qxx

qM1 qM2 ……..qM12

So, there are three inputs x1j, Total Number of Taxpayers (TNT), x2j, Office Rent Expense (ORE), x3j, Total Number of Employees (TNE) and the two outputs q1j, Direct Taxes (DT), q2j, Indirect Taxes (IDT) and the number of DMU's (tax offices in this case) *I* are 12. The input-output matrix represents the data of all DMU's can be presented as follows:

X (Input) = TNT1 TNT2 TNT3 TNT4…………TNT12

ORE1 ORE2 ORE3 ORE4……......TNE12

TNE1 TNE2 TNE3 TNE4………...TNE12

Q (Output) = DT1 DT2 DT3 DT4……….......DT12

IDT1 IDT2 IDT3 IDT4…………….IDT12

Efficiency is measured as a ratio of all outputs to all inputs. For each DMU's a measure of the ratio of all outputs over all inputs, such as u'q*i*/v'x*i*, where u is an *M×1* vector of output weights and v is a

$N \times 1$ vector of input weights. Then to select the optimal weights the mathematical programming problem is as follows:

Max u, v (u′qi/ v′xi), (1)

Subject to u′qj/ v′xj≤1 J = 1,2,…..,I,

u,v ≥ 0

This involves finding values for (u) and (v) that maximize the ratio of DMUj, the DMU being evaluated, subject to the constraint that all efficiency measures must be less than or equal to one. Efficiency value takes the values between zero and one. The problem with this particular ratio formulation is that it has an infinite number of solutions. To avoid this, one can impose the constraint $v'x_i = 1$, which provides:

Max μ, σ $(\mu' q_i)$, (2)

Subject to $\sigma' x_i = 1$,

$\mu' q_j - \sigma' x_j \leq 0$, $j = 1, 2, \ldots, I$

$\mu, \sigma \geq 0$,

Where u's and v's are replaced by μ's and σ's. This change reflects the transformation, called the multiplier form of the linear programming problem. (R.Ramanathan, 2003) in writing his book on 'An Introduction to Data Envelopment Analysis, A Tool for Performance Measurement', mentions the possibility to write the dual of any linear programming problem using certain rules. These rules are available in textbooks on linear programming, such as (Taha, 1997). Using the duality in linear programming, one can derive an equivalent envelopment form of this problem as:

Min $\theta, \lambda \theta$,

(3)

Subject to $-q_i + Q\lambda \geq 0$,

$\theta x_i - X\lambda \geq 0$,

$\lambda \geq 0$,

Where θ is a scalar and λ is a $I \times 1$ vector of constants. Q is a vector of outputs of every DMU and X is the vector of all inputs of every DMU. This envelopment form involves fewer constraints than the multiplier form ($N+M < I+1$). (Cooper, Seiford, & Tone, 2000) provides a rule of thumb of $I \geq \max\{N \times M, 3\times (N+M)\}$; where I is number of DMUs, N is number of inputs and M is number of outputs. This pre-condition has been fulfilled by the analysis in this study Gordana Savić, A. D. et al. (2015).

The value of θ obtained will be the efficiency score for the *ith* DMU. It satisfies $\theta \leq 1$, with a value of 1 indicating a point on the frontier and hence a technically efficient firm, according to the Farrell (1957) definition. These linear programming problems will be solved *I* times, once for each firm in the sample. A value of θ is then obtained for each DMU's (Coelli et al. 2005).

The above approach takes in to account the CRS that is applicable when all DMU's are operating at an optimal scale. In other situations, this is not the case. The scale of operations may have an impact on the outputs, creating “economies” or “diseconomies” of scale. The BCC model, developed by Banker et al. (1984), can deal with variable returns to scale, Jorge Santos et al. (2013). Banker, Charnes and Cooper (1984) suggested an extension of the CRS DEA model to account for VRS. The use of CRS specification when not all DMU’s are operating at the optimal scale will result in measures of TE which are confounded by scale efficiencies (SE). The use of VRS specification will permit the calculation of TE devoid of these SE effects. The CRS can be easily modified to account for VRS by adding the convexity constraint $\pi' \lambda = 1$ to equation (4) to provide:

Min θ, λ θ, (4)

Subject to $-q_i + Q\lambda \geq 0$,

$\theta x_i - X\lambda \geq 0$,

$\pi' \lambda = 1$,

$\lambda \geq 1$,

Where π is an I×1 vector of ones. As a result, this forms a convex hull of intersecting planes that envelop the data points more tightly than CRS conical hull. So that VRS efficiency scores are greater than or equal to CRS efficiency scores. The convexity constraint $\pi' \lambda = 1$, ensures that an inefficient tax office is "benchmarked" against similar size tax offices. That is, the projected point (for that firm) on the DEA frontier is a convex combination of observed firms (Coelli et al. 2005)

3.5. INPUT AND OUTPUT SLACKS

This is a value which shows the discrepancy in the constant or proportional change of input and output variables (Coelli, 2008). It also represents the amount of value for improvement in both input and output. Slacks only show the variable discrepancy between the constant output and input. It is only perceived that the value must be either increased or decreased (Cooper, Seiford, & Zhu, 2011). Efficient tax offices did not have input and output slack because they are expected to use the inputs to produce their output efficiently. Thus, no need of changing inputs and outputs for the efficient tax offices. But input or output slacks exist in inefficient tax offices.

3.6. SCALE EFFICIENCIES

The scale efficiency is the "unit where the size of operations is optimal so that any modifications on its size will render the unit less efficient" (Kao & Liu, 2011, p.225). Scale efficiency can be achieved by conducting both CRS and a VRS DEA, and then decomposing the CRS TE in to one due to pure technical inefficiency (VRS) and one due to scale inefficiency. If there is a difference in TE scores of CRS and VRS for a specific DMU, then that DMU has scale inefficiency (Coelli et al. 2005).

Moreover, scale efficiency shows whether the tax offices operating at increasing or decreasing returns to scale. When output increases by the same proportion with the increase in inputs, this time CRS existed. IRS occurs when the output increases by a larger proportion than the increase in inputs during the production process. Similarly, if output increases by less than proportional change in inputs, there are DRS (Banker et al., 2004, p.346). Thereby, it can be interpreted that the direct and indirect taxes of the offices have increased by a larger proportion of the given amount of number of tax payers, rent expense and number of employee, and thus they need to increase its number of taxpayers, rent expense and number of employee to become more efficient.

Moreover, Kao & Liu, (2011) says that scale efficiency value is also given by:

Scale Efficiency = CRS TE/VRS TE

Where, all of these values are bounded by zero and one.

However, this measure does not indicate whether scale inefficiency can be due to the existence of either increasing or decreasing returns to scale. As (Coelli et al. 2005) discusses, this issue is decided by running an additional DEA problem with the non-increasing returns to scale (NIRS).

This is done by changing the DEA model in LP (4) by replacing the π′ λ =1 restriction with π′ $\lambda \leq 1$, to provide

Min θ, λ θ, (5)

Subject to $-q_i + Q\lambda \geq 0$,

$\theta x_i - X\lambda \geq 0$,

$\pi' \lambda \leq 1$,

$\lambda \geq 1$,

The constraint $\pi' \lambda \leq 1$ ensures that the *ith* firm is not "benchmarked" against firms that are substantially larger than it, but may be compared with firms smaller than it. By comparing the VRS and NIRS scores one can determine the scale inefficiencies. If the VRS and NIRS equal to one another but differs from CRS, there exists DRS. On the other way, IRS exist when the NIRS and CRS measures are equal but differ from the VRS. The three efficiency measures will be equal when the tax office reaches at its most productive scale size.

3.7. RESEARCH METHODS

In order to achieve the main research objectives quantitative research method is used. DEA is applied to measure the relative efficiency of decision making units. DEA has been used in a number of public finance studies to assess the relative efficiency of public spending, Adam, Delis, and Kammas (2011) and taxation, Katharaki and

Tsakas (2010); Barros (2007); Thanassoulis, et al. (1987).

The output produced by tax agencies can be measured in several ways. One could measure using the rate of contested cases resolved, Barros (2007), the number of taken actions against criminal accounts, Katharaki and Tsakas (2010), or the number of returns that are audited, Moesen and Persoon (2002).

An ideal analysis would also distinguish between revenues collected through voluntary payments with law enforcement activities. Unfortunately, it was hardly easy to have enough information on the sources of revenues to account for this distinction. As a result, the output measures focus on tax revenues collected measured distinctly as Direct Tax and Indirect Tax. The study takes them as the appropriate measures of output since the core objective of tax agencies is to collect revenues (James Alm & Denvil Duncan, 2013). The efficiency scores were obtained by DEAP statistical software and, descriptive statistics was run by EVIEWS 8 software packages.

3.8. SAMPLE DESIGN

A sample design is a definite plan for obtaining a sample from a given population. The sample was included 14 tax collecting offices of Addis Ababa city administration, for the period 2015/16. It is possible to measure efficiency using cross sectional data in the case of DEA. Shwu-Huei Huang, Ming-Miin Yu et al. (2017) employed DEA to evaluate operating efficiency in departments of 20 Taiwanese local tax offices for 2013, Hoque and Rayhan used DEA to measure efficiency of 24 banks in Bangladesh for the year 2010. Similarly, Yifru Yirdaw (2016) used DEA to measure efficiency of 17 private commercial banks in Ethiopia.

3.9. POPULATION OR UNIVERSE

The total number of small and medium sized tax collecting offices administered by Addis Ababa City Government is 14. So, the research was taken all tax offices of small and medium size except two tax offices which were supposed to be outliers.

3.10. SAMPLING FRAME

It is the list of populations and which consist of all categories of sampling units or units of analysis. Hence the sampling frame in this study was the 14 tax collecting offices of Addis Ababa City Administration.

3.11. SAMPLING UNIT/UNIT OF ANALYSIS

The sampling units in the study are the small and medium size tax collecting offices of Addis Ababa City Administration.

3.12. SAMPLING TECHNIQUE

3.13. SAMPLE SIZE

The study was based on the efficiency evaluation of 12 Addis Ababa City Administration tax offices located here in Addis Ababa. The sample used in the analysis represents characteristically similar tax offices in the city administration.

3.14. SOURCES OF DATA

All data required for the study were collected from secondary sources. It was collected from published and unpublished documents, plans, books, and other related materials collected from AAFECB and ERCA.

CHAPTER FOUR

RESULT AND DISCUSSION

4.1. INTRODUCTION

This chapter presents the results of the DEA efficiency estimation of each tax offices. Of the 14 existing tax offices, 12 were taken into consideration for this study, excluding the two tax offices of Arada sub city small tax payers branch office and Addis Ababa number two (2) medium taxpayers branch office, which considered to be outliers, and whereby their data is not homogeneous and therefore not subject to generalization to the remaining offices. Indeed, their inclusion would have undermined the coherence of the results to a considerable extent. The DEA models run in this study is under input orientation (also known as input minimization).

4.2. DESCRIPTIVE STATISTICS

It is necessary to start the analysis with descriptive statistics so that we can get information about the inputs, outputs and other variables status. The descriptive statistics for variables used to calculate the DEA efficiency estimates and other variables using EVIEWS 8 package are as shown in table 1.

Table 1: Descriptive statistics for inputs, outputs and other variables of Addis Ababa tax offices

Variables Name	Obs.	Mean	Std. Dev	Min	Max	Sum
Total Number of Taxpayers	12	29544.17	17110.54	4965	60482	354530
Office Rent Expense	12	9363434	5271047	2554092	20516058	112361210
Total Number of Employees	12	322.5	49.95907	221	398	3870
Direct Taxes	12	324.6658	206.6814	129.4200	760.48	3895.99
Indirect Taxes	12	285.3025	214.5336	95.47	838.69	3423.63
Establishment year	12	2010.417	0.900337	2010	2013	-
Service year	12	5.583333	0.900337	3	6	67
Enterprise Taxpayers	12	1620	1107.586	72	3185	19440
Individual Taxpayers	12	27924.17	16224.24	4893	57646	335090

Note: Direct Taxes and Indirect Taxes are measured in Million Ethiopian Br

With regard to tax collection inputs, on average, 29,544 active taxpayers from all tax offices, with a maximum of 60,482 in Nifassilk Lafto sub city and a minimum of 4965 in Addis Ababa Medium no.1 are existed in discharging their tax responsibilities. From these taxpayers 19,440 are companies registered as enterprise taxpayers and 335,090 are individual company taxpayers. On average, 9363434 Birr office rent expense is disbursed with a maximum of Birr 20,516,058 in Merkato no.1 branch office and a minimum of Birr 2,554,092 Merkato no.2 branch office. On average, 323 persons were allocated as employee, with a maximum of 398 in Bole sub city and a minimum of 221 in Lideta sub city. Similarly, in relation to outputs on average, Birr 324.6658 million direct taxes were collected, with a maximum of Birr 760.48 Million in Addis Ababa Medium no.1 and a minimum of Birr 129.4200 million in Lideta.

On average, Birr 285.3025 million indirect taxes were collected with a maximum of Birr 838.69 million in Addis Ababa Medium no.1 and a minimum of Birr 95.47 million in Lideta sub city. When we see other variables, the mean establishment year is 2010 with a maximum of 2013 in AAM1 and a minimum of 2010 in ADK, AKK, BOL, GUL, KIR, KOK, LID, NIL &YEK. On average the 5.58 service year is served with a maximum of 6 years in ADK, AKK, BOL, GUL, KIR, KOK, LID, NIL &YEK and a minimum of 3 years in AAM1. On average, 1620 enterprise taxpayers were operated with a maximum of 3185 in Yeka sub city and a minimum of 72 in Addis Ababa medium no.1.and also, on average, 27924 individual taxpayers were operated with a maximum of 57646 in Nifassilk Lafto sub city and a minimum of 4893 in Addis Ababa medium no.1. Generally, tax offices were found to be hardly different in those inputs they procure and outputs they produce.

In table 2, for the purpose of comparison of the characteristics of the variables in each tax offices are listed with a ratio. It is clear that the mean value of the number of employee over number of taxpayers' ratio is .0169673 and its standard deviation is lower than the mean and equal to .0002324. The mean value of the ratio, direct tax/ number of taxpayers' is 22409.14 and its standard deviation is higher than the mean and equal to 41690.43. The mean value of the ratio, direct tax/office rent expense is 43.59572 and its standard deviation is lower than the mean and equal to 31.53445. The mean value of the ratio, direct tax/number of employee is 989731.6 and its standard deviation is lower than the mean and equal to 616239.8. The mean value of the ratio, indirect tax/number of taxpayers is 22881.11 and its standard deviation is higher than the mean and equal to 46741.89. The mean value of the ratio, indirect tax/office rent expense is 40.41876 and its standard deviation is lower than the mean and equal to 40.29239. The mean value of the ratio, indirect tax/number of employee is 873629.6 and its standard deviation is lower than the mean and equal to 692400.2. Off course a high degree of homogeneity is needed in DEA analysis. In this case, it can be asserted that the tax offices analyzed have some degree of homogeneity.

Table 2: Comparison of the characteristics of the variables in each tax offices

No.	Tax Offices	Number of Employee/ Number of Taxpayers	Direct Tax per/ Number of Taxpayers	Direct Tax/Office Rent Expense	Direct Tax /Number of Employee	Indirect Tax/Number of Taxpayers	Indirect Tax/ Office Rent Expense	Indirect Tax/Employee
1	AAM1	.0588117	153168.2	53.86813	2604384.	168920.4	59.40808	2872226.
2	MR1	.0294642	22603.38	12.97520	767147.0	22252.70	12.77390	755245.0
3	MR2	.0272385	23503.41	119.9330	862873.2	30365.23	154.9474	1114789.
4	ADIK	.0132448	5768.384	44.06873	435521.1	5508.339	42.08206	415887.3
5	AKK	.0089289	4976.083	20.63867	557301.6	3838.004	15.91840	429841.3
6	BOL	.0074925	13079.44	62.93297	1745678.	9607.116	46.22554	1282236.
7	GUL	.0146091	7869.964	10.77737	538703.1	5973.773	8.180672	408907.8
8	KIR	.0131316	13360.74	30.02467	1017452.	10730.42	24.11374	817146.8
9	KOK	.0071045	5917.588	35.14618	832937.5	4075.752	24.20701	573687.5
10	LID	.0097002	5680.551	18.44778	585610.9	4190.405	13.60848	431991.0
11	NIF	.0055884	6234.086	77.58230	1115533.	4849.046	60.34568	867692.3
12	YEK	.0082935	6747.884	36.75360	813639.1	4262.054	23.21407	513905.3
	Mean	.0169673	22409.14	43.59572	989731.6	22881.11	40.41876	873629.6
	Std..Dev.	.0002324	41690.43	31.53445	616239.8	46741.89	40.29239	692400.2

Note: Direct Tax and Indirect Tax are measured in Ethiopian Br

4.3. INPUT OUTPUT RELATIONSHIP

All the inputs taken in this study such as Total Number of Taxpayers, Office Rent Expense and Total Number of Employees have positive relationship with the output direct taxes, and except Total Number of Taxpayers, all inputs have positive relationship with the output indirect taxes.

The following graphs from EVIEWS 8 software show the input-output relationship of each input and output variables under consideration.

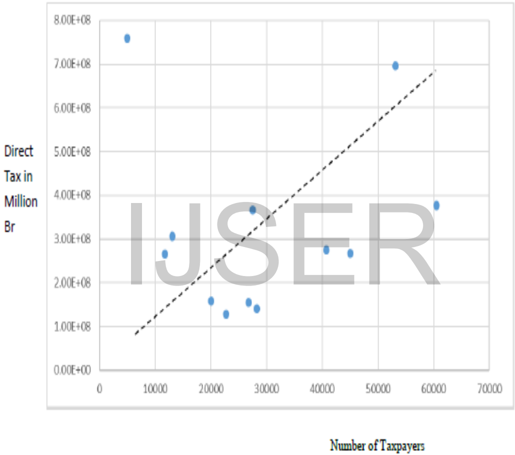


Fig.1: Relationship between Number of Taxpayers

and Direct Tax

As it is shown in Figure 1, Direct tax is directly related with the number of taxpayers and vice versa. It means that an increase in the number of direct taxpayers will lead to an increase in the direct tax. It could be on account of many of the taxpayers in the city are put under the category of direct tax payers.

Figure 2 shows Office rent expense is directly related with direct tax. An increase in office rent expense generates an increase in direct tax and vice versa. Since office is a major factor for any activity, an increase in office expense budget make to have enough working space and convenient rooms for each department so as to undertake their tasks and good customer handling.

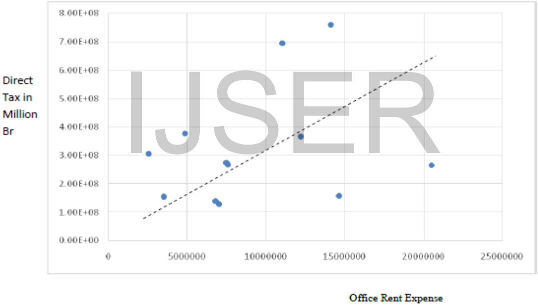


Fig.2: Relationship between Office Rent Expense and Direct Tax

In figure 3 also the number of employees on the tax offices has a positive significant relationship with direct tax. An increase in the number of employee leads to an increase in direct tax and vice versa. When the number of personnel in the tax office increases, they process more works. But the quality of workers is essential.

ct

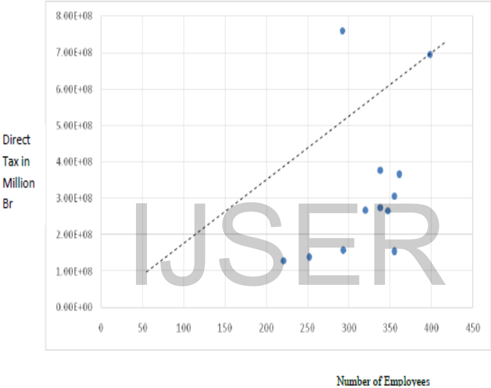


Fig.3: Relationship between Number of Employees and Direct Tax

Figure 4 shows the inverse relationship of number of taxpayers and indirect tax. An increase in the number of taxpayers will lead to a decrease in the indirect tax and vice versa. The possible reasons could be as it is said above majority of taxpayers is direct tax payers. Or may be an increase in the number of taxpayers may lead the DMUs busy in their operation and system. This leads to work load and inefficiency in collecting these taxes.

So, the tax administering body should not go for increasing the number of taxpayers with the aim of increasing indirect taxes. Rather it has a chance to see other alternatives to increase revenues from indirect tax. This could be achieved via giving accessible, reliable and timely information service along with the precise and timely treatment of requests and appeals.

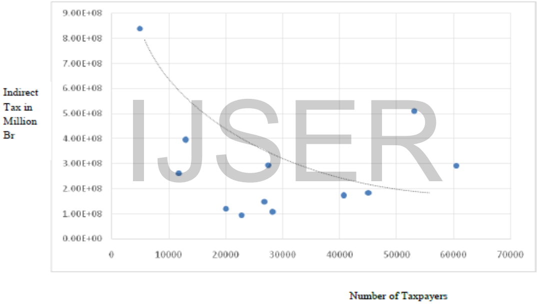


Fig.4: Relationship between Number of Taxpayers and Indirect Tax

In figure 5, indirect tax is directly affected by the movement in office rent expense. An increase in office rent results in an increase in indirect tax and vice versa. An increment in office rent expense may be done for office space, convenience for transportation, quality, etc. This adds value for the general working environment so as to achieve the stated objectives & have a high amount of taxes. But what the tax offices could do should be minimizing the expense to the minimum by searching other alternatives like renting a building in the upper floors or in the long run building their own office makes them avoiding office rental expense.

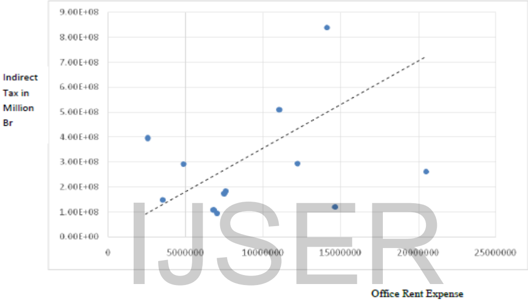


Fig.5: Relationship between Office Rent Expense and Indirect Tax

As it is seen in figure 6 the Number of employee is directly related with the indirect taxes. This means that, an increase in the number of employee will contributed to a more amount of indirect taxes. In order to use the chance of increment of direct tax with the increase of the personnel, the tax administering body should increase the productivity of employees through communicating and sustaining high ethical standards in employees; identify and resolve conflicts of interest between the private interests of employees and public responsibilities; preparing effective training opportunities; making recruit and promotion on the basis of merit and equal opportunity and protect employees against arbitrary dismissal.

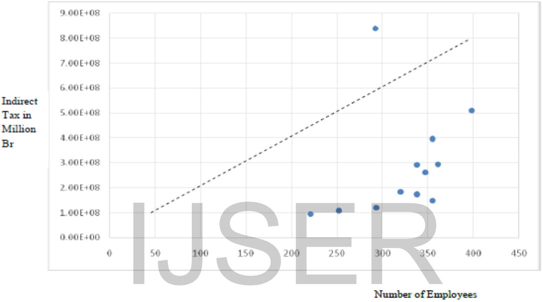


Fig.6: Relationship between Number of Employees and Indirect Tax

4.4. COMPARATIVE ANALYSIS OF TAX OFFICES EFFICIENCY IN CRS AND VRS MODEL

The DEA efficiency scores in this study are estimated using the computer program, DEAP, version 2.1, developed by Tim Coelli, The University of Queensland.

Table 3 summarizes the results of the input-oriented DEA analysis in CRS and VRS scores, scale efficiency and the status of returns to scale of 14 DMUs (by including the two DMUs i.e. AAM2 and ARA which were supposed to be outliers) attached here in appendix E1, helps us to compare with the

12 DMUs efficiency scores that were run by excluding the two outliers.

Table 3 CRS, VRS and Scale Efficiency results of fourteen DMUs

No.	DMUs Code	DEA CRS model Overall Technical Efficiency	DEA VRS model Pure Technical Efficiency	Scale Efficiency	Returns to Scale
1	AAM1	0.823	1.000	0.823	IRS
2	AAM2	1.000	1.000	1.000	CRS
3	MR1	0.163	0.791	0.206	IRS
4	MR2	0.652	1.000	0.652	IRS
5	ADIK	0.177	0.938	0.189	IRS
6	AKK	0.081	0.946	0.086	IRS
7	ARA	1.000	1.000	1.000	CRS
8	BOL	0.248	0.650	0.381	IRS
9	GUL	0.084	0.836	0.101	IRS
10	KIR	0.155	0.685	0.226	IRS
11	KOK	0.138	0.802	0.173	IRS
12	LID	0.079	1.000	0.079	IRS
13	NIL	0.306	0.915	0.334	IRS
14	YEK	0.145	0.780	0.186	IRS
	Mean	0.361	0.882	0.388	

As it is seen in the efficiency results from Table 3, the mean overall technical efficiency (CRS), pure technical efficiency (VRS) and scale efficiency scores of these tax offices are 0.361, 0.882 and 0.388 respectively.

When CRS technical efficiency is taken, only AAM2, and ARA tax offices are efficient with a score of 1.000, the rest twelve (12) DMUs are inefficient. And unfortunately, all inefficient tax offices are below the average 0.36. Whereas the VRS assumption taken in to consideration, five (5) of the DMUs are technically efficient with a score of 1.000, namely AAM1, AAM2, MR2, ARA and LID. The rest nine (9) are inefficient and six (6) tax offices are below the average 0.882. Moreover, only AM2 and ARA tax offices are scale efficient whereas the rest are scale inefficient with increasing returns to scale nature. Ten (10) of the fourteen (14) DMUs are operating below the average 0.388 scale efficiency.

As expected, only AAM2 and ARA (which assumed to be outliers so that excluded from the model) are efficient in CRS, VRS and SE. Though, AAM1 and LID is technically inefficient at CRS and their scale is inefficient, they turn to efficient at VRS assumption.

The lowest technically inefficient DMU is LID with a score of 0.079 and the highest technically inefficient DMU is AAM1 scoring 0.823, under CRS assumption. When VRS technology is assumed, the lowest technically inefficient DMU is BOL with a score of 0.650 and the highest technically inefficient DMU is AKK scoring 0.946. The lowest scale inefficient DMU is LID with a score of 0.079 and the highest is AAM1 with a score of 0.823.

4.5. CRS EFFICIENCY DISCUSSION OF THE TWELVE DMUs

Table 4 presents the results of the input-oriented DEA analysis of 12 DMUs, under the assumption of CRS. In contrast to Table 3 (36.1% average efficiency score), this DEA scores makes increase the average overall technical efficiency to 59.3% and turned

AAM1, MR2 & BOL from inefficiency to efficiency by scoring equal to one. Of the 12 DMUs, 8 DMUs are below the average efficiency score of 0.593, under CRS assumption. Below in table 4, the technical inefficiency score distance to the unity shows the possibilities for DMU's to reduce their inputs usage while maintaining outputs unchanged. This average efficiency score suggests that the DMUs input can be minimized by 40.75%, given the outputs.

Three of the twelve (25%) tax offices, namely AAM1, MR2 and Bole are fully efficient with a score of 1.000. Whereas, nine (75%) of tax offices are inefficient and have efficiency scores ranging from the lowest technically inefficient for example 0.207 by GUL to the highest technically inefficient DMU NIL with a scores of 0.952 in CRS DEA model.

Table 4: Efficiency Results of Twelve DMUs under CRS

No.	DMUs Code	DEA CRS model Technical Efficiency
1	AAM1	1.000
2	MR1	0.295
3	MR2	1.000
4	ADK	0.445
5	AKK	0.326
6	BOL	1.000
7	GUL	0.207
8	KIR	0.509
9	KOK	0.530
10	LID	0.306
11	NIL	0.952
12	YEK	0.541
	mean	0.593

4.5.1. RADIAL MOVEMENT AND PROJECTED VALUE

Radial Movement gives the value for input-output variables for improvement (Coelli, 2008). The Radial Movement shows the adjusted proportionality of input and output variables (Coelli, 2008). Projected value shows the proportionality of input and output for every radial and slack movement.

The radial values for the DMU2 i.e. MR1 are -8,307 for Number of Taxpayers, Rent Expense is Birr -14,472,850.000 and -245 for Number of Employees. The projected value of input for the MR1 against each output is 1,737.959 (Number of Taxpayers), Rent Expense is Birr 4,941,697.693 and 102.212 (Number of Employee). MR1 can adopt a Direct Tax of 266.200 million and Indirect Tax of 262.070 million output values to achieve efficiency. The values are to be decreased by -8307 for Number of Taxpayers, Birr -14,472,850.000 for Rent Expense and -245 for Number of Employee.

The radial values for the DMU4 i.e. ADIK are -14871.850 for Number of Taxpayers, Rent Expense is Birr -1946653.240 and -196.974 for Number of Employees. The projected value of input for the ADIK against each output is 7802.162 (Number of Taxpayers), Rent Expense is Birr 1561729.760 and

158.026 (Number of Employee). ADIK can adopt a Direct Tax of 154.610 million and Indirect Tax of 147.640 million output values to achieve efficiency. The values are to be decreased by -14871.850 for Number of Taxpayers, Birr -1946653.240 for Rent Expense and -196.974 for Number of Employee.

Similarly, the lowest inefficient DMU is NIL and the radial values for this DMU are -2893.516 for Number of Taxpayers, Rent Expense is Birr -232506.963 and -16.170 for Number of Employees. The projected value of input for the NIL against each output is 22704.091 (Number of Taxpayers), Rent Expense is Birr 4627493.037 and 321.830

(Number of Employee). NIL can adopt a Direct Tax of 377.050 million and Indirect Tax of 293.280 million output values to achieve efficiency. The values are to be decreased by -2893.516 for Number of Taxpayers, Birr -232506.963 for Rent Expense and -16.170 for Number of Employee.

Likewise, the highest inefficient DMU is GUL, its radial values are -15907.522 for Number of Taxpayers, and Rent Expense is Birr -11616152.807 and 232.394 for Number of Employees. The projected value of input for the GUL against each output is 1030.501 (Number of Taxpayers), Rent Expense is Birr 2930118.572 and 60.606 (Number of

Employee). GUL can adopt a Direct Tax of 157.840 million and Indirect Tax of 119.810 million output values to achieve efficiency. The values are to be decreased by -15907.522 for Number of Taxpayers, Birr -11616152.807 for Rent Expense and -232.394 for Number of Employee. Similar interpretations can be made for the remaining five inefficient DMUs (see Appendix B1, B2, B3, B4, B5 & B6).

4.5.2. SUMMARY OF SLACKS

This is a value which shows the discrepancy in the constant or proportional change of input and output variables (Coelli, 2008). It also represents the amount of value for improvement in both input and output. Slacks only show the variable discrepancy between the constant output and input. It is only perceived that the value must be either increased or decreased (Cooper, Seiford, & Zhu, 2011). Efficient tax offices did not have input and output slack because they are expected to use the inputs to produce their output efficiently. Thus, no need of changing inputs and outputs for the three (3) efficient tax offices. But input or output slacks exist in inefficient tax offices. Slacks are calculated radially in DEAP software. Among inefficient tax offices, six (6) tax offices i.e. MR1, ADIK, GUL, KOK, NIL & YEK have input slacks except for total number of employees and, all inefficient DMUs i.e.

MR1, ADIK, AKK, GUL, KIR, KOK, LID, NIL & YEK have slacks for indirect taxes. But MR1, ADIK, GUL, KOK, NIL & YEK showed both input and output slacks. There is no DMU is existed having slack for direct taxes.

From DEAP software results attached here in appendix A2, it is understood that DMU MR2 should decrease the number of taxpayers by 1,731 and 1,101,510 Birr rent expense to become efficient. Similarly, DMU ADIK can decrease their input of number of taxpayers by 4,129 to become efficient. DMU GUL also should decrease its input usage of number of taxpayers by 3,118 and rent expense Birr

99,226 to become efficient. DMUs KOK, NIL and YEK need to reduce their number of taxpayers by 4,461, 34,884 and 2,465 respectively to become efficient.

4.5.3. SUMMARY OF PEERS

The term Peer or Reference set indicates an inefficient firm to follow or as a reference (Coelli, 2008). It is a point that an inefficient DMUs targets to move from the Farrell efficient point to Pareto-Koopman efficient point based on the two-stage DEA solution or Pareto optimal solution (Yong-bae Ji and Choonjoo Lee). From table 5 here below, the 2ND and 7th inefficient DMUs such as MR1 and GUL can follow the input-output trend of AAM1. Like this DMU ADIK, KOK, NIL can follow the input-output trend of any of BOL or MR2. DMU AKK and LID can follow the input-output trend of any of MR2, BOL or AAM1. Similarly, DMU KIR can follow the input-output trends of any of BOL, AAM1, or MR2 and, DMU YEK can follow the input-output trends of any of MR2 or BOL. But the efficient tax offices don't have to follow any tax office and are the peer of them only. Thus, it is necessary to rank the tax offices according to the Efficiency Scores and the number of Peer Counts.

Table 5: Rank of Tax Offices under CRS-Input Orientation Frontier

No.	DMUs Code	CRS Technical Efficiency	Peers	Peer Weights	Peer Counts	Rank
1	AAM1	1.000	AAM1	1.000	5	3
2	MR1	0.295	AAM1	0.350	0	11
3	MR2	1.000	MR2	1.000	7	1
4	ADIK	0.445	BOL, MR2	0.052 0.387	0	8
5	AKK	0.326	MR2, BOL, AAM1	0.028, 0.164, 0.024	0	9
6	BOL	1.000	BOL	1.000	7	2
7	GUL	0.207	AAM1	0.208	0	12
8	KIR	0.509	BOL, AAM1, MR2	0.226, 0.254, 0.055	0	7
9	KOK	0.530	BOL, MR2	0.342, 0.094	0	6
10	LID	0.306	MR2, BOL, AAM1	0.007, 0.125, 0.053	0	10
11	NIL	0.952	BOL, MR2	0.283, 0.590	0	4
12	YEK	0.541	MR2, BOL	0.140, 0.334	0	5

Furthermore, peer weight is a number of variables that can be followed for the respective reference firm (Cooper et al., 2011). For the 2nd DMU i.e. MR1, since it has peers value for DMU 1 (AAM1). Thus, it can follow 35% of the number of taxpayers, rent expense and number of employee of AAM1 to become efficient. For the 4th, DMU i.e. ADIK, since it has peers value for DMU 6 (BOL) & 3 (MR2). Thus, it can follow 5.2%, 38.7% of the number of taxpayers, rent expense and number of employee of BOL and MR2 respectively to become efficient. For the 5th, DMU i.e. AKK, since it has peers value for DMU 3, 6 & 1 (MR2, BOL & AAM1). Thus, it can follow 2.8%, 16.4% and 2.4% of the number of taxpayers, rent expense and number of employee of MR2, BOL & AAM1 respectively to become efficient. For the 7th DMU i.e. GUL, since it has peers value for DMU 1 (AAM1). Thus, it can follow 20.8% of the number of taxpayers; rent expense and number of employee of AAM1. For the 8th DMU i.e. KIR, since it has peers value for DMU 6, 1 & 3 (BOL, and AAM1& MR2). Thus, it can follow 22.6%, 25.4% and 5.5% of the number of taxpayers, rent expense and number of employee of BOL, AAM1 and MR2 respectively to become efficient. For the 9th DMU i.e. KOK, since it has peers value for DMU 6 & 3 (BOL & MR2). Thus, it can follow 34.2% and 9.4% of the number of taxpayers, rent expense and number of employee of BOL & MR2 respectively to become efficient. For the 10th DMU i.e. LID, since it has peers value for DMU 3, 6 & 1 (MR2, BOL & AAM1). Thus, it can follow 7%, 12.5% & 5.3% of the number of taxpayers, rent expense and number of employee of MR2, BOL & AAM1 respectively to become efficient. For the 11th DMU i.e. NIL, since it has peers value for DMU 6 & 3 (BOL & MR2). Thus, it can follow 28.3% and 59% of the number of taxpayers, rent expense and number of employee of BOL & MR2 respectively to become efficient. For the 12th, DMU i.e. YEK, since it has peers value for DMU 3 & 6 (MR2 & BOL). Thus, it can follow 14% & 33.4% of the number of taxpayers, rent expense and number of employee of MR2 & BOL respectively to become efficient.

Finally, peer count shows the number of times a peer firm is being used as the reference unit. The 1st DMU i.e. AAM1 has been used as a peer 5 times, while DMU 3 & 6 i.e. is MR2 & BOL is used as a peer 7 times each. Therefore, DMUs MR2 & BOL is the most efficient DMUs followed by AAM1 and are appropriate examples to share for other inefficient DMUs.

4.5.4. SUMMARY OF INPUT TARGETS

Target values are different from slack values. Slacks show discrepancies while targets show predicted value. This shows the model that is to be followed for the preferred and perceived inputs; in this case, the specific inputs employed by each inefficient DMU will help in making them efficient. However, these inputs i.e. the number of taxpayers, rent expense and number of employee remain the same for efficient DMUs. Appendix A5 shows the input target for nine (9) inefficient DMUs. DMU 2 i.e.MR1; for constant output of direct and indirect taxes, it must have an efficiently proportional total number of taxpayer of 1738, office rent expense of

Birr 4,941,698 and total number of employee of 102. So, MR1 should decrease the numbers of taxpayers by 10039, financials of rent expense by 15,574,360 and number of employee by 245.

Likewise, for DMU 4 i.e. ADIK; for constant output of direct and indirect taxes, it must have an efficiently proportional number of taxpayer of 7802, rent expense of Birr 1,561,730 and number of employee of 158. So, ADIK should decrease the numbers of taxpayers by 19001, financials of rent expense by 1,946,653 and number of employee by 197. For DMU 5 i.e. AKK; for constant output of direct and indirect taxes, it must have an efficiently proportional number of taxpayer of 9188, rent expense of Birr 2,215,385 and number of employee of 82. So, AKK should decrease the numbers of taxpayers by 19035, financials of rent expense by 4,589,317 and number of employee by 170.

For DMU 7 i.e. GUL; for constant output of direct and indirect taxes, it must have an efficiently proportional number of taxpayer of 1031, rent expense of Birr 2,930,119 and number of employee of 61. So, GUL should decrease the numbers of taxpayers by 19025, financials of rent expense by 11,715,378 and number of employee by 232.

For DMU 8 i.e. KIR; for constant output of direct and indirect taxes, it must have an efficiently proportional number of taxpayer of 13992, rent expense of Birr 6,226,409 and number of employee of 184. So, KIR should decrease the numbers of taxpayers by 13499, financials of rent expense by 6,006,864 and number of employee by 177. For KOK, DMU 9; for constant output of direct and indirect taxes, it must have an efficiently proportional number of taxpayer of 19403, rent expense of Birr 4,018,067 and number of employee of 170. So, KOK should decrease the numbers of taxpayers by 25639, financials of rent expense by 3,565,688 and number of employee by 150.

For DMU 10 i.e. LID; for constant output of direct and indirect taxes, it must have an efficiently proportional number of taxpayer of 6979, rent expense of Birr 2,149,159 and number of employee of 68. So, LID should decrease the numbers of taxpayers by 15804, financials of rent expense by 4,866,320 and number of employee by 153.

For DMU 11 i.e. NIL; for constant output of direct and indirect taxes, it must have an efficiently proportional number of taxpayer of 22704, rent expense of Birr 4,627,493 and number of employee of 322. So, NIL should decrease the numbers of taxpayers by 37778, financials of rent expense by 232,507 and number of employee by 16.

For DMU 12 i.e. YEK; for constant output of direct and indirect taxes, it must have an efficiently proportional number of taxpayer of 19568, rent expense of Birr 4,045,249 and number of employee of 183. So, YEK should decrease the numbers of taxpayers by 21187, financials of rent expense by 3,437,283 and number of employee by 155.

4.6. VARIABLE RETURNS TO SCALE IN DEA AND SUMMARY OF EFFICIENCY

Variable returns to scale (VRS) is a type of frontier scale used in DEA. It helps to estimate efficiencies whether an increase or decrease in input or outputs does not result in a proportional change in the outputs or inputs respectively (Cooper, Seiford, & Zhu, 2011). This method includes both increasing and decreasing returns to scale. Hence, VRS may exhibit increasing, constant and decreasing returns to scale when working in Data Envelopment Analysis Program (DEAP).

Before discussing the interpretations and findings, look into the previous interpretations, where the procedure to extract, apply and execution of data to perform the analysis is discussed. However, here this section includes interpretations and findings and how **VRS** differs from ***CRS***.

Table 6: Efficiency Results of Twelve DMUs under VRS Frontier

No.	DMUs Code	DEA CRS model Overall Technical Efficiency	DEA VRS model Pure Technical Efficiency	Scale Efficiency	Returns to Scale
1	AAM1	1.000	1.000	1.000	CRS
2	MR1	0.295	0.791	0.372	IRS
3	MR2	1.000	1.000	1.000	CRS
4	ADK	0.445	0.938	0.475	IRS
5	AKK	0.326	0.946	0.344	IRS
6	BOL	1.000	1.000	1.000	CRS
7	GUL	0.207	0.836	0.247	IRS
8	KIR	0.509	0.726	0.701	IRS
9	KOK	0.530	0.854	0.620	IRS
10	LID	0.306	1.000	0.306	IRS
11	NIL	0.952	0.996	0.956	IRS
12	YEK	0.541	0.830	0.651	IRS
	Mean	0.593	0.910	0.639	

Table 6 above shows efficiency summary for input oriented **VRS** *DEA*. The above table shows the difference in technical efficiency between **CRS** and **VRS** frontier. The overall Technical Efficiency is broken down into Pure Technical Efficiency specified by the VRS DEA score (average = 91%) and Scale Efficiency (average = 63.9%). In contrast to CRS model, the VRS model placed four DMUs (33.33%) as efficient, namely AAM1, MR2, BOL and LID, but eight DMUs (66.66%) namely MR1, ADK, AKK, GUL, KIR, KOK, NIL and YEK still remained inefficient. The VRS DEA model made LID technically efficient in opposite to CRS DEA model. Therefore, LID attains pure technical efficiency but remained scale inefficient with increasing returns to scale nature. Therefore, the inefficiencies assigned to LID under CRS assumption is purely due to its scales of operations.

The lowest technically inefficient DMU is KIR with a score of 0.726 and the highest technically inefficient DMU is NIL scoring 0.996, under VRS assumption.

The presence of inefficiency of inputs in the production process is indicated by efficiency scores. For example, on average the tax offices in Addis Ababa tax jurisdiction have a scope for reduction of inputs by 9%.

4.6.1. SCALE EFFICIENCY

In appendix C1, the average Scale Efficiency of the tax offices are 63.9% and six (50%) of the twelve DMUs are below this average SE score. Of the twelve DMUs, three (25%) of DMUs namely AAM1, MR2 and BOL are both technical and scale efficient and have six peer counts except BOL (zero peer counts) in VRS. Such seldom appearance of efficient DMU in the reference set of inefficient DMU is likely to possess a very uncommon input/output mix. Thus, it is not suitable example to share for other inefficient DMUs Yifru (2016). Of these nine-scale inefficient DMUs, only LID is technically efficient at VRS and has eight peer counts. The rest eight DMUs are both scale and technically inefficient. The highest scale inefficient DMU is GUL by scoring 0.247 and the lowest scale inefficient DMU NIL with a score of 0.956.

The investigation further investigates the nature of returns to scale of each DMU. Table 6 shows the nature of returns to scale of each DMU. Here nine (75%) of DMUs namely MR1, ADK, AKK, GUL, KIR, KOK, LID, NIL and YEK said to be operating in an increasing return to scale suggesting that they are not operating at an optimal scale because they can achieve further scale economies if they were increased their volume of operation. In this situation there exists a higher degree of specialization, managerial and technical indivisibilities and dimensional relations.

The rest three (25%) of DMUs like AAM1, MR2 and BOL exhibits constant returns to scale having limits of their scale economies. Here there is no DMUs shown decreasing returns to scale. For all DMUs that display IRS in their operation, a more than proportionate increase in output is achieved in relation to an increase in input. Thus, DMUs that work with IRS could achieve substantial efficiency gains by increasing its scales of operation. This could be attained through inside progress. NIL becomes the only lowest inefficient DMU in all the three efficiency measurements of CRS, VRS and SE with efficiency score of 0.952, 0.996 and 0.956 respectively. GUL is the highest inefficient firm in CRS and SE scoring score of 0.207 and 0.247 and KIR is the highest inefficient DMU at VRS having 0.726 efficiency score.

The lowest inefficient DMU NIL needs only 0.048 and 0.004 of reduction to its input at CRS and VRS respectively to become efficient. Similarly, the highest inefficient DMU at CRS is GUL. It needs as much as 0.793 less reduction in their input usage to become inefficient and also the highest inefficient DMU at VRS is KIR. It needs 0.274 reductions in its input usage to become efficient.

4.6.2. SUMMARY OF SLACKS

All inefficient tax offices have either input or output slacks except for the total number of employees. Moreover, the findings from the summary of slacks, peer weights, peer counts, input targets can be interpreted the same way as it was interpreted for the CRS DEA model. As here, from Appendix C2, DMU 2 has increasing returns to scale, so MR1 has scale returns discrepancy of Birr 3856809.369 for office rent expense. DMU 4 has IRS, so ADIK has scale returns discrepancy of 10493.102 for total number of taxpayers. DMU 5 has IRS, so AKK has scale returns discrepancy of 5178.917 for total number of taxpayers. DMU 7 has IRS, so GUL has scale returns discrepancy of 2831716.511 for office rent expense. DMU 8 has IRS, so KIR has scale returns discrepancy of 4490.617 for total number of taxpayers. DMU 9 has IRS, so KOK has scale returns discrepancy of 21085.980 for total number of taxpayers. DMU 11 has IRS, so NIL has scale returns discrepancy of 48099.391 for total number of taxpayers. DMU 12 has IRS, so YEK has scale returns discrepancy of 16958.833 for total number of taxpayers.

4.7. EFFICIENCY AND THE FRONTIER LINE

In reality, no firm can produce a single output by consuming one input only. Figure7 illustrates the concepts of efficiency, slacks and references or peers in an intuitive manner using two inputs and one output. The concept of frontier is especially important for the analysis of efficiency, because we measure efficiency as the relative distance to the frontier. For example, firms that are technically inefficient operate at points in the interior of the frontier, while those that are technically efficient operate somewhere along the technology defined by the frontier. The DMU is called efficient when the DEA score equals to one and all slacks are zero (Cooper, Seiford, and Tone, 2006). If only the first condition is satisfied, the DMU is called as efficient in terms of “radial", “technical", and “weak" efficiency. If these two conditions are satisfied, the

DMU is called efficient in terms of "Pareto-Koopmans" or "strong "efficiency (Yong-bae Ji and Choonjoo Lee).

In figure7, it is portrayed using two inputs and one output utilized. Thus, Total Number of Taxpayers and Office Rent Expense are used as input variable with Indirect Taxes as output variable. Though, three variables are taken, it is not possible to represent them on the XY plane. For demonstration purpose, the input, Total Number of Employee and the output, Direct Taxes are not taken as an input and output variables as they have no non-zero slack value. Since constant returns to scale is assumed, it is possible to normalize the inputs Number of

Taxpayers and Office Rent Expense by the single output Indirect Tax. That time, Figure7 can easily contract three efficient DMUs: AAM1, MR2 & BOL that are on the frontier line and are considered 100% efficient. DMU s MR1, ADIK, AKK, GUL, KIR, KOK, LID, NIL & YEK are remained inefficient since they do not lie on the efficient frontier line.

In figure 7, DMUs AAM1, MR2 & BOL lie on the efficiency frontier, and hence are the most efficient. But there is a time where their performance can be improved. For example, DMU BOL is on the Farrell efficient point, however the two inputs could be reduced to point MR2 and still produce the same output. In this case, BOL has an input slack of the distance MR2 BOL. Therefore, BOL is not efficient in terms of "Pareto-Koopmans" or "strong" efficiency. Since MR2 has a large peer count (7) and its nearness to the origin than AAM1, it is the most efficient DMU. Geometrically the distance O MR2 > O AAM1 though it is a slight difference.

Inefficiency can be seen as how much the inputs must contract along a ray from the origin until it crosses the frontier. For example, in figure 7 below, the technical efficiency of DMU GUL (which is the highest inefficient DMU) is defined as the distance OA/OG. Likewise, the efficiency of lowest inefficient DMU NIL is the distance between

ON/ONIL. Point OA and point ON are therefore, the Farrell efficient point.

DMU NIL, the lowest inefficient DMU has 0.952 efficiency score and the highest inefficient DMU GUL scored 0.207 efficiency score. Thus, NIL has excess input utilization of only 4.8%. Whereas GUL exhibited 79.3% excess input utilization given the output unchanged as compared to efficient DMUs.

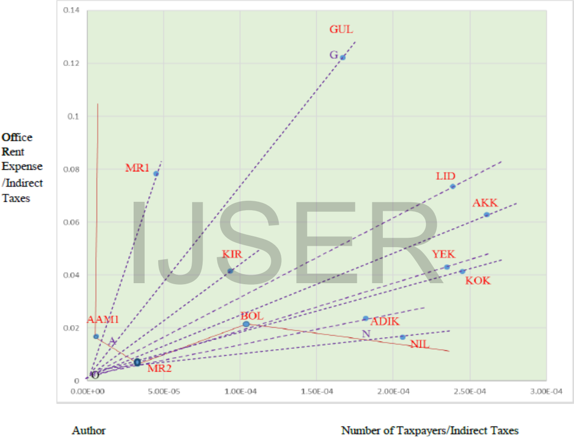


Fig.7: CRS input orientation efficiency frontier line

4.8. THE NATURE OF RETURNS TO SCALE

In figure 8 below, frontiers determined by economies of scale are presented considering one input (Number of Employee) and one output (Direct Taxes) for the 12 DMUs. The figure displays CRS, VRS & Non-Increasing Returns to Scale (NIRS) frontiers. If CRS is considered, then only DMU AAM1 is efficient. But DMUs AAM1 & LID could be efficient if VRS is assumed. At the point where VRS and NIRS are frontiers are equal then decreasing returns to scale exist for those DMUs on the efficient frontier (in the data no DMU operates at a DRS). Where the two frontiers are unequal, then IRS holds for those DMUs (such as DMU LID).

For the CRS frontier, increasing returns to scale exists for the remaining inefficient DMUs if the sum of the reference weights is less than one. Otherwise there exists decreasing returns to scale.
Figure 8 shows all inefficient DMUs such as MR1, MR2, ADIK, AKK, BOL, GUL, KIR, KOK, NIL & YEK are operating at increasing returns to scale. It is also presented in appendix E5.
The efficiency of DMU GUL for example, is defined as θ GUL, *input, CRS* = the distance between G G'/G GUL for input-oriented CRS DEA model represents that one can obtain the same output by reducing the input by the ratio of 1- θ GUL, *input, CRS.*

Efficiency for output-oriented CRS DEA model is defined as θ GUL, *output, CRS* = G‴ GUL/ G‴ AAM1 and it represent that one can achieve the higher output by the ratio 1- θ GUL, *output,* CRS. Hence the input-oriented VRS frontier efficiency measure is defined as θ GUL, *input, VRS* = the distance between G G''/G GUL. At DMU AAM1 all efficiency frontier measures are meet equal regardless of their assumptions. This point is called the most productive scale size (MPSS).

Likewise, the efficiency of DMU NIL for example, is defined as θ NIL, *input, CRS* = the distance between N N'/N NIL for input-oriented CRS DEA model represents that one can obtain the same output by reducing the input by the ratio of 1- θ *NIL, input, CRS.*

Hence the input-oriented VRS frontier efficiency measure is defined as θ NIL, *input, VRS* = the distance between N N''/N NIL.

It is possible to decompose the technical inefficiency of CRS in to pure technical inefficiency and scale inefficiency. In Figure 8, the distance between G' GUL contributes to the CRS technical inefficiency of DMU GUL and the distance G'' GUL contributes to technical inefficiency of DMU GUL in VRS model. Since scale efficiency is calculated by dividing technical efficiency of CRS by VRS, then the distance G' G'' contributes to scale efficiency.

Similarly, the distance between N' NIL contributes to the CRS technical inefficiency of DMU NIL and the distance N'' NIL contributes to technical inefficiency of DMU NIL in VRS model. Hence the distance N' N'' contributes to scale efficiency. Similar interpretations can be made for all remaining inefficient DMUs.

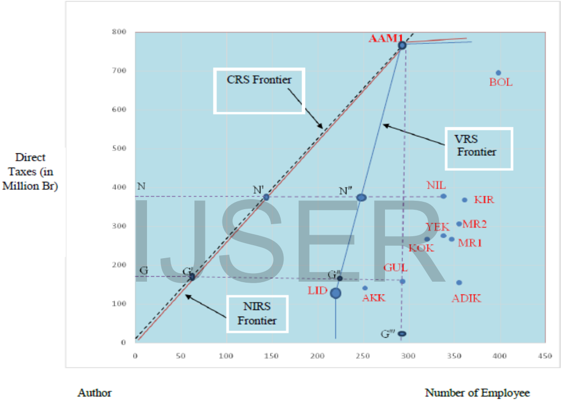


Fig.8: Efficiency concept and Scale Returns on frontier line

4.9. EFFICIENCY TO ESTABLISHMENT AND SERVICE YEAR

In Figure 9, the efficiency of DMUs with respect to establishment period is plotted. Two of efficient DMUs (AAM1, MR2) in CRS, VRS & Scale efficiency have established after the mean year 2010. LID, VRS efficient DMU and BOL, efficient DMU in all of efficiency measures and all inefficient DMUs except MR1 are established at the mean year 2010. Whereas, MR1 is established after the average year of establishment 2010. Therefore, all efficient DMUs are established at and after the mean year 2010. But two of the three efficient DMUs are established after the mean year. Thus establishment year does not affect efficiency scores.

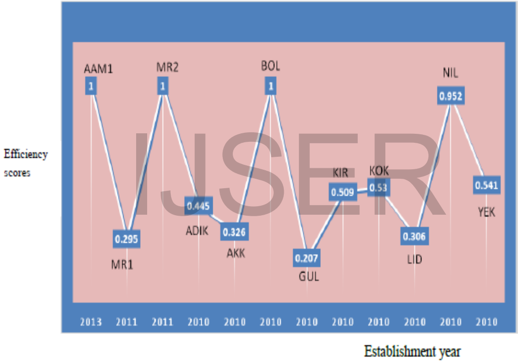


Fig.9: Establishment year vs efficiency score under CRS

In figure 10, two of efficient DMUs (AAM1, MR2) in CRS, VRS & Scale efficiency have below the mean service years of 5.58. LID, VRS efficient DMU and BOL, CRS, VRS and Scale efficient DMU and all inefficient DMUs except MR1 have service years above the mean service years of 5.58. While MR1 have served below the average 5.58 service years. Therefore, service year doesn't have effect on the efficiency of DMUs.

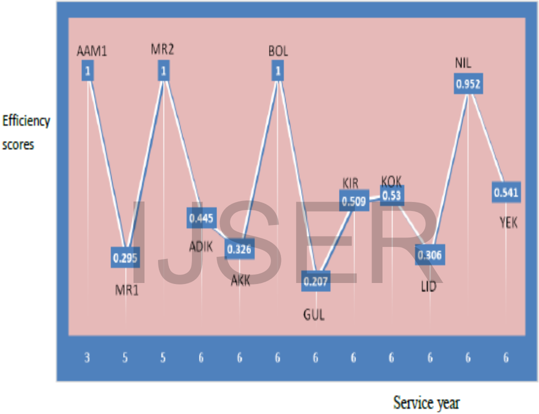


Fig.10: Service year vs efficiency score under CRS

4.10. EFFICIENCY TO ENTERPRISE TAXPAYERS AND INDIVIDUAL TAXPAYERS

From table 1, the average number of Enterprise Taxpayers and Individual Taxpayers is computed. The average number of Enterprise Taxpayers is 1620 and the average number of Individual Taxpayers is 27924.17. All efficient DMUs (AAM1 & MR2) in CRS, VRS & Scale efficiency measurement except BOL which have more than the average number of Enterprise Taxpayers and the VRS efficient DMU i.e. LID have below the average number of Enterprise Taxpayers. All inefficient DMUs except MR1, ADIK & KIR which have below the average number of Enterprise Taxpayers, have above average number of Enterprise Taxpayers.

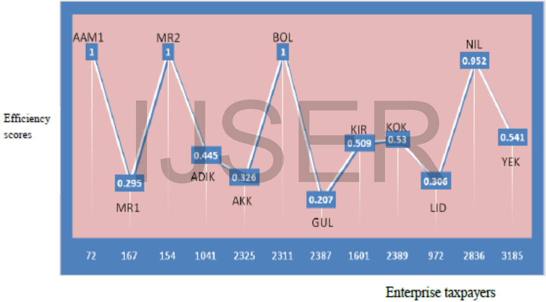


Fig.11: Enterprise taxpayer vs efficiency score under CRS

Similarly, in figure 12, efficiency with respect to individual company is plotted, all efficient DMUs (AAM1 & MR2) in CRS, VRS & Scale efficiency measurement except BOL (which have more than the average number of Individual Taxpayers) and the VRS efficient DMU i.e. LID have below the average number of Individual Taxpayers. Part of Inefficient DMUs like KOK, NIL & YEK have above the average number of individual taxpayers. The remaining inefficient DMUs MR1, ADIK, AKK, GUL & KIR have below the average number of Individual Taxpayers. Thus, efficiency is not affected by the type of the taxpayers whether they are enterprise taxpayers or individual taxpayers.

Appendix E2 is compiled the descriptive statistic results for these variables.

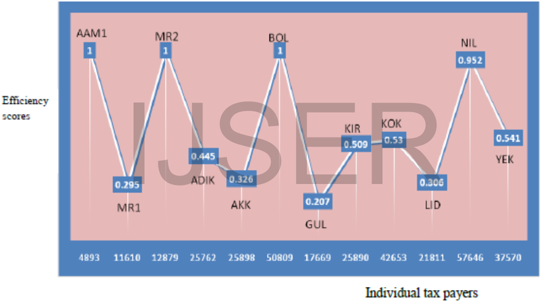


Fig.12: Individual taxpayers’ vs efficiency score under CRS

CHAPTER FIVE

5. CONCLUSIONS AND POLICY IMPLICATION

5.1. CONCLUSIONS

Given the current challenge of budget deficit in government, tax offices performance is of major importance for government revenue generation. This study analyzed the technical efficiency and scale efficiency of Addis Ababa City Administration small and medium sized tax collecting offices using cross-sectional data in the year 2015/16 with input-oriented CRS and VRSDEA approach. The inputs used were Total Number Taxpayers, Office Rent Expense and Total Number of Employees. And the two outputs are direct tax and indirect taxes. The finding indicates that, three DMUs i.e. AAM1, MR2 & BOL are efficient with an efficiency score equal to one in CRS, VRS &, SE exhibiting constant returns to scale nature having limits on their economies of scale. About 75% of the tax offices are exhibiting increasing returns to scale. The possible reasons to exhibit this nature may be there existing high degree of specialization, managerial & technical indivisibility and, dimensional relations. No DMU is having with decreasing returns to scale. DMU LID is efficient in VRS measure only. The rest 8

DMUs remained inefficient in all forms of efficiency measure. All inefficient DMUs except NIL, scored below the average efficiency of 0.593 under CRS and excluding ADK & AKK, all inefficient DMUs efficiency score is below the average 0.996 under VRS. Many of inefficient DMUs have excess inputs and output in their operation.

5.2. POLICY IMPLICATION

Considering the results, the policy implications of this paper are as follows: Most of the inefficient DMUs are operating below their optimal relative technical efficiency and scale size. Therefore, those inefficient DMUs office managers must improve their operational planning and a management practice in an efficient way. It is in association with (Lasheras and Herrera, 1991), the achievement of any tax system is dependent upon the Management charged with its enactment. This could be via an optimal combination of factors of production, improving tax compliance so as to get voluntary tax payers, adequate investment in, and adaption of new technologies relevant to modernization of tax offices, and further training and education in the adaption and use of the new technology. The office rent expense should be minimized by having their own buildings or through reducing office area or changing from ground floors to upper floors; the salaries should be more directly related to performance. The next step would then be to improve their scale efficiencies. These tax offices should increase its scale operations through internal growth or consolidation in the sector.

These measures will define an organizational governance environment with transparency, accountability and efficiency improvements which explicitly force the tax offices to achieve efficiency in their operational activities. Moreover, the savings that will result from the improved efficiency will reduce waste, allowing more resources to be diverted into alternative public uses. The restructure of the AARA, which is now being implemented proclaims independency of the authority from ERCA, may result in efficiency improvement through a better coordination of managerial tasks and specialization. The anticipated result is the improvement of the efficiency. Future DEA research should see additional methods for treatment of variable selection problems reported herein, as well as empirically testing conclusions in a variety of management control settings.

REFERENCES

[1] *Adam Smith (1776), "The Wealth of Nations: An Inquiry into the Nature and Causes of the Wealth of Nations"*

[2] *Afonso, A., Schuknecht, L. and Tanzi, V. (2006), "Public Sector Efficiency Evidence for New EU Member States and Emerging Markets," Working Paper Series, No 581, European Central Bank, Frankfurt.*

[3] *Banker, R., Charnes, A. and Cooper, W. (1984), "Some Models for Estimating Technical and Scale Inefficiencies in Data Envelopment Analysis," Man Sci, 30: 1078–1092.*

[4] *Banker, R.D. (1993), "The Maximum Likelihood, Consistency and Data Envelopment Analysis,"*

Management Science, Vol. 39, No. 10, pp.1265–1273.

[5] *Barros, C.P. (2005), "Performance Measurement in Tax Offices with a Stochastic Frontier Model," Journal of Economic Studies, Vol. 32 No. 6, pp. 497-510.*

[6] *Barros, C.P. (2007), "Technical and Allocative Efficiency of Tax Offices": A Case Study, Int. J. Public Sector Performance Management, Vol. 1, No. 1, pp.41–61.*

[7] *Barrilao-gonzalez, P.E., Villar-Rubio, E. & Delgado-Alaminos, J. (n.d.), "Relative Efficiency within a Tax Administration: the Effects of Result Improvement"*

[8] *Bird, Richard and Milka Casanegra de Jantsche (eds.) (1993), "Improving Tax Administration in Developing*

Countries," Washington D.C.: International Monetary Fund.

[9] *Bougnol M-L, Dul´a JH, Retzlaff-Roberts D, Womer NK (2005), "Non Parametric Frontier Analysis with Multiple Constituencies," J Oper Res Soc 56(3):252–266*

[10] *Chang K-P, Guh Y-Y (1991), "Linear Production Functions and the Data Envelopment Analysis," Eur J Oper Res 52(2):215–223*

[11] *Charnes, A., W. W. Cooper, and E. Rhodes (1978), "Measuring the Efficiency of Decision Making Units," European Journal of Operational Research 2: 429-444.*

[12] *Chen X, Chen X, Zhou H, Zhou H (2010), "Coal enterprises AQ9 safety investment efficiency analysis*

based on data envelopment," Knowl Discov Data Min (Jan):175–178

[13] *Chiu Y-h, Huang C-w, Ma C-M (2011), "Assessment of China Transit and Economic Efficiencies in a Modified Value-Chains DEA Model," Eur J Oper Res 209(2):95–103*

[14] *Coelli, T. (2008), "A Guide to DEAP Version 2.1: A Data Envelopment Analysis (Computer) Program," CEPA Working Paper 96/08, 1-49.*

[15] *Coelli, T., D. S. P. Rao, C. J. O. Donnel, and G. E. Battese (2005), "An Introduction to Efficiency and Productivity Analysis," 2nd ed. 233 Spring Street, New York, NY 10013, USA: Springer.*

[16] *Coelli, T.J. (1998), "A Multi-Stage Methodology for the Solution of Oriented DEA Models," Operations Research Letters, 23, 143-149.*

[17] *Cooper, W.W., Seiford, L.M., & K. Tone (2000), "Data Envelopment Analysis: A Comprehensive Text with Models, Applications, References and DEA-Solver Software," Kluwer Academic Publishers, Boston.*

[18] *Cooper, W.W., Seiford, L.M., & Zhu, J. (2011), "Handbook on Data Envelopment Analysis"*

[19] *Dyson, R. G., & Foster M. J. (1987), "Cost Efficiency Benchmarking for Operational Units with Multiple Cost Drivers," Decision Sciences, Volume 31 Number 4 Fall 2000. Printed in the U.S.A.*

[20] *Emrouznejad A, Anouze AL (2010), "Data Envelopment Analysis with Classification and Regression Tree-a Case of Banking Efficiency," Expert Syst 27(4):231–246*

[21] *Ethiopian Revenues & Customs Authority's Establishment Proclamation no. 587/2008*

[22] *Ethiopian Revenues & Customs Authority's Five Year (2016-2020) Strategic Plan*

[23] *Farrell, M.J. (1957), "The Measurement of Productive Efficiency," Journal of the Royal Statistical Society, Series A, Vol. 120, No. 3, pp.253–290.*

[24] F. Y. Edgeworth (1897), "The Pure Theory of Taxation," the Economic Journal, Vol. 7, No. 25. (Mar., 1897), pp. 46-70.

[25] *Federal Tax Administration Proclamation no. 983/2008, of Federal Democratic Republic of Ethiopia, Federal Negarit Gazeta Special Edition*

[26] *Goode, Richard (1981), "Some Economic Aspects of Tax Administration," IMF Staff Papers, 28 (3), 249-274.*

[27] *Gordana Savić, Aleksandar Dragojlović, Mirko Vujošević, Milojko Arsić & Milan Martić (2015), "Impact of the Efficiency of the Tax Administration," Economic Research-Ekonomska Istraživanja, 28:1, 1138-1148.*

[28] *Harold O. Fried, C. A. Knox Lovell and Shelton S. Schmidt (n.d.), "Efficiency and Productivity"*

[29] *Hoque, R., &Rayhan, I. (n.d.), "Data Envelopment Analysis of Banking Sector in Bangladesh," Institute of*

Statistical Research and Training, University of Dhaka, Dhaka

[30] *Income Tax Proclamation no. 286/2002, Federal Democratic Republic of Ethiopia, Federal Negarit Gazeta, 8th Year no. 34 Addis Aababa-4th July, 2002.*

[31] *Income Tax Proclamation no. 979/2008, Federal Democratic Republic of Ethiopia, Federal Negarit Gazeta Special Edition.*

[32] *James Alm and Denvil Duncan (2013), "Estimating Tax Agency Efficiency"*

[33] *John W. Creswell (2003), "Research Design Qualitative, Quantitative, and Mixed Methods Approach," 2ndEd.*

[34] *Jorge Santos, Elsa Ros´arioNegas, and Lu´ıs Cavique Santos, A.B. Mendes et al. (eds.) (2013), "Introduction to Data Envelopment Analysis, Efficiency Measures in the Agricultural Sector: With Applications," DOI 10.1007/978-94-007-5739-4 3, © Springer Science +Business Media Dordrecht*

[35] *Kao, C., & Liu, S.-T. (2011), "Scale Efficiency Measurement in Data Envelopment Analysis with Interval Data: A Two-Level Programming Approach. Journal of CENTRUM Cathedra: The Business and Economics," Research Journal, 4(2), 224–235. https://doi.org/10.7835/jcc-berj-2011-0060.*

[36] *Keehley, P., Medlin, S., MacBride, S. and Longmire, L. (1997), "Benchmarking for Best Practices in the*

Public Sector: Achieving Performance Breakthroughs in Federal, State and Local Offices," San Francisco, CA: Jossey-Bass Publishers.

[37] *Koopmans, T.C., (1951), "An Analysis of Production as an Efficient Combination of Activities," Cowles Commission for Research in Economics, Monograph no. 13, (John Wiley and Sons, New York).*

[38] *Maria Katharaki, Marios Tsakas, (2010), "Assessing the Efficiency and Managing the Performance of Greek Tax Offices," Journal of Advances in Management Research, Vol. 7 Issue: 1, pp.58-75, https://doi.org/10.1108/09727981011042856.*

[39] *Moesen, W. and Persoon, A. (2002), "Measuring and Explaining the Productive Efficiency of Tax Offices:*

A Non-Parametric Best Practice Frontier Approach," Tijdschrift Voor Economieen Management, Vol. 47, No. 3, pp.399–416.

[40] *Norman, M. and B. Stroker (1991), "Data Envelopment Analysis: An Assessment of Performance," Wiley.*

[41] *Park, J. E., Ryu, S. L. (2012), "Efficiency and Productivity Analysis- The Case of Korean Regional Tax Offices," Korean Journal of Taxation Research, 29(3), pp. 223-252.*

[42] *Pestana Barros C, Dieke PUC (2007), "Performance Evaluation of Italian Airports: A Data Envelopment Analysis," J Air Transport Management 13(4):184–191*

[43] *Ramón Fuentes (2014), "Productivity at SUMA Tax Offices: A Step Further, Conference Proceedings 15th Toulon-Verona Conference "Excellence in Services," College of Management Academic Studies, Rishon Lezion, Israel, 3-4.*

[44] *R.Ramanathan (2003), "An Introduction to Data Envelopment Analysis, A Tool for Performance Measurement," Sage Publications New Delhi.*

[45] *Rhodes, Edwardo (1978), "Data Envelopment Analysis and Approaches for Measuring the Efficiency of Decision-making Units with an Application to Program Follow-through in U.S. Education" Pittsburgh, PA: Ph.D. dissertation. School of Urban & Public Affairs, Carnegie Mellow Univ.*

[46] *Sandford, Cedric (ed.) (1995), "Tax Compliance Costs: Measurement and Policy" Bath, UK: Fiscal Publications.*

[47] *Sandford, C., Godwin, M. and Hardwick, P, (1989), "Administrative and Compliance Costs of Taxation. Fiscal Publications," (Bath).*

[48] *Sang-Lyul Ryu, Seok-Young Lee (2013), "An Exploratory Study of Efficiency in Tax Jurisdictions," Advanced Science and Technology Letters Vol.34, pp.46-49, http://dx.doi.org/10.14257/astl.2013.34.12*

[49] *Schneider M (2005), "Judicial career incentives and court performance: an empirical study of the German labour courts of appeal," Eur J Law Econ 20(2):127–144*

[50] *Seiford LM, Zhu J (2002), "Value judgment versus allocative efficiency: a case of Tennessee county jails," J Manag Sci Reg Dev 4(July):89–98*

[51] *Shwu-Huei Huang, Ming-Min Yu, Ming Shenq Huang, Yu-Shan Wei and Ming Huei Chen (2017), "Efficiency of Tax Collection and Tax Management in Taiwan's Local Tax Offices," Pacific Economic Review P1-129.*

[52] *Simon James, Thamrongsak Svetalekth and Brian Wright (2012), "Tax Charters, Performance Indicators and The Case or Strategic Approach to Tax Administration," Discussion Papers in Management, University of Exeter.*

[53] *Slemrod, J., (1992), "Why People Pay Taxes: Tax Compliance and Enforcement," (Press. Ann Arbor, University of Michigan).*

[54] *Thirtle, C., Shankar, B., Chitkara, P., Chatterjee, S. and Mohanty, M.S. (2000), "Size Does Matter: Technical and Scale Efficiency in Indian State Tax Jurisdictions," Review of Development Economics, Vol. 4No. 3, pp. 340-52.*

[55] *Tim Coelli (n.d.), "A Guide to DEAP Version 2.1: A Data Envelopment Analysis (Computer) Program,"* [*http://www.une.edu.au/econometrics/cepa.tm CEPA Working Paper 96/08*](http://www.une.edu.au/econometrics/cepa.tm)

[56] *Timothy J. Coelli, D.S. Prassada Rao, Christopher J. O'Donnell and George E. Battese (1998), "An*

introduction to Efficiency and Productivity Analysis," Springer Science + Business Media, Inc., 2nd edition.

[57] *Venkatesh Bhagavath (n.d.), "Technical Efficiency Measurement by Data Envelopment Analysis: An Application in Transportation"*

[58] *William Crandall (2010), "Revenue Administration: Performance Measurement in Tax Administration," International Monetary Fund Fiscal Affairs Department, Technical Notes and Manuals, Washington DC, USA.*

[59] *Wilson Asa B, Kerr Bernard J, Bastian Nathaniel D, Fulton Lawrence V (2012), "Financial Performance Monitoring of the Technical Efficiency of Critical Access Hospitals: A Data Envelopment Analysis and Logistic*

Regression Modeling Approach," (Report). J Healthc Management 57(3):200–212; Discussion 212–3
[60] *Yong-bae Ji, Choonjoo Lee (n.d.), "Data Envelopment Analysis in Stata," The Stata Journal (yyyy) vv, Number ii, pp. 1-13.*