ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

ANALYSIS OF TAX REVENUE FORECASTING IN ETHIOPIA: AN AUTOREGRESSIVE DISTRIBUTED LAG APPROACH

BY:

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ANALYSIS OF TAX REVENUE FORECASTING IN ETHIOPIA: AN AUTOREGRESSIVE DISTRIBUTED LAG APPROACH

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This is to certify that the Research project prepared by Demeke Abate, entitled: Analysis Of Tax Revenue Forecasting In Ethiopia: An Autoregressive Distributed Lag (ARDL) Approach and submitted in partial fulfillment of the requirements for the Degree of Master of Arts in Applied Economic Modeling and Forecasting (Fiscal Policy Analysis and Management) complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

Signed by:

Advisor: Tadele Ferede (PhD) Signature_____ Date_____

ABSTRACT

This study focuses on the investigation of the causal long-term relationship between tax revenue and nominal gross domestic product in Ethiopia. In this research the analysis of short term relationship also under taken. Using an error correction model (ECM) model with annual data over the last 32 years from 1980/81 to 2012/13, the study found a close relationship between tax revenue and nominal gross domestic product. The size of the long-term parameters looks acceptable. The estimation technique employed in this research was auto regressive distributed lag integration approach with one period lag length and the result shows GDP and tax revenue own two period lags affects the tax revenue. These variables have also short term causal relationships and their granger causality is statistically significant.

ACKNOWLEDGEMENT

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1 INTRODUCTION

This chapter is devoted for an introductory part of this study. The issues covered in this heading are; background of the study, statements of the problem, objectives of the study, significance of this the study, limitations of the study and organization of the paper.

1.1 Background of the study

Planning improves the efficiently of public resources utilization and management, hence the government of Ethiopian has launched the consecutive development plans. The recent plan is; the medium- term plan, the Growth and Transformation Plan (GTP) 2010/11–2014/15. In addition the government has a long term vision, to build on the achievements of the GTP and become a middle income country in the coming ten years. In order to realize these plans the government has set twin objectives. On one hand to create a conducive economic environment by creating basic infrastructure, which stimulates private sector savings and investment, and on the other hand, to work towards a stable macro-economic situation, which demands stable and consistent economic policies.

The two main macroeconomic policies that use as an instrument to achieve macroeconomic goals are fiscal policy and monetary policy. These policies are important in promoting growth and development and stabilizing macroeconomic environment in developing countries. However it is understood that there is significant difference between the policy objectives and roles between developed and LDCs.

To implement these plans, it is obvious that huge public resource is required, and thus the demand needs to be in composure with the available resources. However, in many countries including Ethiopia it is a common practice that there is a miss match between total government investment demand and revenue receipts, leading to high fiscal deficit. Indeed, in many instance of macro-economic instability, the usual culprit is fiscal indiscipline. Sometimes this can be caused by weak capacity in revenue forecasting, whereby revenue are over-estimated and expenditures are made to match this overestimation of revenue. However, when the revenue targets cannot be met, it is often very difficult to cut expenditure to match the revenue short fall, and the result is more domestic borrowing, more pressure on interest rates and prices, and crowding out of private sector investment. It is obvious that one of the main reasons for the recent year's inflation in Ethiopia was the high domestic borrowing. Moreover recognizing the

consequence of high domestic borrowing, the government has implemented tight fiscal policy the past three years. It is therefore, important that while forecasting on tax revenues, countries should put emphasis on the need for realistic and achievable revenue targets and budget government outlays on that basis.

In general, countries including Ethiopia, need to attaches a great deal of importance to the revenue forecasting for a number of reasons: Frist, revenue forecasting forms a central pillar of any fiscal framework; and Secondly, the important role the budget plays in achieving and sustaining macro-economic stability and thereby creating a conducive environment that is crucial for private sector investment and economic growth.

1.2 Statement of problem

Simple linear regression or static models are the most commonly used methods to quantify the relationship between the dependent variable and the independent variables. However, in many economic time series, simple trend models or static models result in residuals that are serially correlated, casting doubt on reliability of estimated coefficients. To address this problem the use dynamic models became popular method (Detragiache, et al, 2009), which use both the current and past value of dependent and independent variable to explain the current value of dependent variable. Thus, macro-economic variable including tax revenue has dynamic characteristics.

Therefore, the purpose of this paper is to examine the dynamic and long-run relationship among tax revenue, gross national income (GDP), and tax collection in the past and other factors in Ethiopia, and an ARDL modeling is used for analysis. By doing so it attempts to solve the problems of using modern and robust techniques for revenue forecasting.

In general, when we explore past studies in low income countries including Ethiopia, not only dynamic models but also the use of quantitative analysis was very limited. Studies conducted by IMF to analysis the tax revenue forecasting process, in low income countries including Ethiopia, have revealed that due to data and human capital constraints, in a large number of countries result in the use of rudimentary and qualitative estimation techniques. About 85 percent of the sampled countries use subjective assessments and simple extrapolation techniques as the main methods for deriving budget revenue forecast. Since econometric techniques require a wealth of reliable and relatively detailed data, they are only applied in a few countries (12.9 percent). Hence, a qualitative approach, for instance through experienced expert briefings, may lead to

more reliable accurate forecast. Nevertheless a qualitative forecast is also more vulnerable to discretionary adjustments, and can easily be manipulated without being detected, moreover, as manipulation of forecasts can conceal governance problems (Koyeb et al, 2004). It is common that such practices opens a loop hole for corruption and miss conduct problems during tax collection process.

Indeed, when we review the revenue estimation practice in Ethiopia we see the same story. There is a complete reliance of elasticity approach for overall revenue analysis and forecasting. Other similar methods, which is the effective tax rate approach is used for foreign trade taxation analysis. Other supplementary methods used for revenue projection are subjective expert judgment approach. Moreover, the preparing the medium term fiscal framework (MEFF) relays on elasticity and experts subjective judgment approaches are used as the dominant methods for tax revenue forecasting. However, when we look at the trends of elasticity and buoyancy of revenue in Ethiopia across time was not stable. Hence the implication is that these methods will not be chosen as a good forecasting instrument. In addition, as we explore the revenue budget and actual outturn across time there was discrepancy, the actual miss the target by about 8.5 percent, during 2003/04-2012/13. Consequently, this study attempts to fill this gap; it uses economic theory, long time series data, contemporary econometric techniques and statistical estimation methods to forecast tax revenue.

1.3 Objective of the study

The main objective of this research is to examine the behavioral relationship between the tax revenue receipts and trend to the important macroeconomic variables that affects taxes receipts in Ethiopia. These factors include; gross domestic product, its own lag effect, dummy variables (tax policy and enforcement measures) and inflation. And thus, after specification of the model, and if the model fit to the reality it will be used for tax revenue projection. In analyzing a dynamic economic model it often raises interests to identify and test the long-run properties of variables. The cointegration is examples of long run relationship analysis between different variables. More specifically the study has the following objectives.

- To identify the possible long term relationship among tax revenue, GDP, tax policy and inflation.
- To analyze the possible short term relationship among tax revenue, GDP, tax policy and enforcement measures and inflation.

- To examine the extent and direction of causality between variables of interest.
- To evaluate the tax revenue forecasting method.

1.4 Significance of the study

The significances of the study as follows: first the knowledge gained from the dynamic analysis may help revenue forecasting, formulating relevant and stabile method of projection. Second, the study may useful as a reference for further studies in related regional variation and individual tax type. Third, its major methodological contribution, which applies ARDL modeling and error correction model (ECM), modeling framework to analyze the revenue forecasting among the variables of interest, makes this research more interesting. Fourth, it utilizes longer Ethiopia macroeconomic time series annual data from 1980/81-2012/13.

1.5 Scope and limitation of the study

1.5.1 Scope of study

The scope of this study delimited to analyze the relationship total tax revenue collected at national level with fundamental tax determent factors. It lucks to deal with differences across regions. The study includes deterministic variables in estimation of ARDL model. The estimation was made without exogenous variables. And the data employed in this research limited to Ethiopian annual data from 1980/81-2012/13).

1.5.2 Limitation of the study

The main limitation of the study was it doesn't examine similarities and differences among different individual tax category. Consumer price index that measures consumer's price of both urban and rural residents of the country is not available and consequently the Addis Ababa consumer price index will be used as a proxy for measure of price. The inflation rate which measures the annual change of CPI entered as variable in the model. Quarterly data are not available for government budget deficit and other variables for long period of time this forced to use annual data for all variables. The other important factor that limited the research to depend on specific variables only may the accuracy of estimation.

1.6 Organization of the paper

The paper organized in five sections. The first section deals with introductory part which includes background of the, statement of the problem, objective of the study, hypothesis of the research, significance and limitations of the study and organization of the papers. The second

section presents some related literature review; the third section will contain the recent years tax revenue performance in Ethiopia, the fourth section deals the methodology and data part of the study; the fifth section presents data analysis and interpretation part and the last section may contain conclusion and recommendation chapter.

2. REVIEW OF LITERATURES ON TAX REVENUE FORECASTING

This chapter deals with theoretical and empirical literature related to the tax revenue forecasting. Forecasting, in a sense used here, tax revenue prediction or projection. Basic concepts relating to revenue projections and empirical literature on revenue estimation practices adopted by developing countries, including Ethiopia will be reviewed.

2.1 Theoretical literature review

While studying the theory and practice of taxation, the main concern is whether there is a similar or different in analytical methods between developed and less developing countries (LDCs). In this regard Economists argue that there are many problems and questions in common, more importantly regarding objectives, responsibilities and constraints of taxation. Moreover, economists recommend that, broadly speaking, similar analytical methods can be used (Burgess and Stern, 1993). At the same time there are some issues which arise in LDCs, and some problems are much more acute. Thus the analysis of taxation in less-developed countries may go badly wrong if it fails to take these in to account.

Government is one of the important economic agents that whose activities can significantly affects economic performance. Its function involves revenue collection and disbursement of expenditures. Large share of government revenue is collected from taxes. Taxes represent forced transfers of property from individuals to the government that is charged to spend them. These activities divert the resources from private use to the public and change the pattern of allocation and by doing this the government plays significant role such as distribution, reallocation and stabilization in the economy.

These transfer of resources need to have some important features. Such feature are neutrality, fairness, effectiveness and productive. Tax neutrality can be defined as mode of taxation should not change behavior of agents that are affected by taxation. However, according to Rohac (2005) since the very purpose of taxation is to transfer property from an individual to someone else and to make possible a different use of resources than that which would otherwise take place, taxation could not be conceivably made neutral. But different modes of taxations have impacts in distorting actions of agents in different degrees. In general tax system should promote economic growth, the benefits and burdens should be fair and its collection should be cost effective and increases efficiency.

In the modern economy prices play significant role by influencing and guiding the decisions of buyers and sellers. Taxes disrupt these signals by driving a wedge between the price paid by the consumers and the price received by the producers. By increasing prices and reducing quantity bought taxes affect the economic performance and leads to dead weight loss resource allocation. However, this is not the end of the story of taxation. In developing countries with less provision of public goods and income inequality the governments collects taxes and spend it on infrastructure that can complements private sector.

Indeed, broadly speaking the LDCs economies are characterized by; a very low living standard of some groups, missing markets and the comparative advantage of government in providing public goods. That is why development economic literatures emphatically argue that the role of state is more than minimal (Burgess, et al, 1991). Accordingly, taxation literatures argue that properly designed taxes find a way to raise sufficient resource to finance government expenditure and promote equity between citizens and restore efficiency in the economy as far as possible. This is indeed the corner stone for public sector economics. Moreover the need for raising sufficient revenue to finance government expenditure has got popularity in public sector economics. The experience and research in LDCs during the 1980's and 1990's had given two critical lessons; firstly there is no viable, long-run and substance alternative to taxation as a means of financing government expenditure and secondly successful adjustment and macro-economic stability rely on profound and prominent fiscal corrections being made in the short and medium run (Burgess, 1991).

2.2 Empirical development of tax revenue forecasting

2.2.1 Tax revenue forecasting in low income counties

Understanding revenue forecasting practices is essential in assessing budget planning and management processes. Revenue forecasts define the budget envelope and form the basis for effective medium-term planning. The projections serve as the principal resource constraint and, if integrated in a top-down budget preparation process approach, facilitate the allocation of resource across different spending units. Moreover, transparency of forecasting processes is important in creating accountability in the revenue collection process, as manipulation of forecasts can conceal governance problems (Koyeb, etal, 2004).

Studies conducted on revenue forecasting practices in low-income countries by IMF staffs (Koyobe and Danninger, 2005) shows that countries score low on various aspects characterizing the quality of the revenue forecasting process. Forecasting responsibilities are often not well defined and there are few formal rules and regulations governing the forecast. Revenue forecasts, for the most part, are produced late in the budget process, and estimation techniques are rudimentary (Koyobe and Danninger, 2005, page 14).

> *"Data and human capital constraints in a large number of countries result in the use of rudimentary and qualitative estimation techniques, about 85percent of the sampled countries use subjective assessments and simple extrapolation techniques as the main methods for deriving budget revenue forecast. Since econometric techniques require a wealth of reliable and relatively detailed data, they are only applied in a few countries (12.9 percent). The majority of countries with higher income also report that forecasts are not adjusted in a discretionary manner."*

Moreover, according to this study features of forecasting process do not differ greatly along regional or per capita levels, with a few exceptions.

In this study a more systemic, multivariate analysis was conducted for three key aspects of the revenue forecasting process. The first is formality, a measure of how formal or informal the forecasting procedure is. Secondly is simplicity, addresses how cohesive and centralized the organization of the process is. Thirdly, transparency is of the budget forecast by focusing on public access to relevant information. In this regard, the study found that formality and transparency can be found in countries with a higher per capita income. Also, the study found that, corruption reduces both formality and transparency. A descriptive summery of IMF staffs (Koyobe and Danninger 2005) study are presented as follows;

Budget revenue forecasting has a very mixed coverage; about 50 percent of countries forecast only central government activates, 37 percent covers extra budgetary funds, 20 percent public enterprises, and 3 percent social security administration. In relation to time coverage, most countries have shifted to medium term forecasting. In regard to institution involved in revenue forecasting, the study found that in about 95 percent ministry of finance responsibility.

Moreover, in the econometric analysis of this study various formulations of linear relationships between total tax revenues and nominal GDP and alternatively various forms of time trend were

tested. Thus the summery of the best model or accurate estimation of elasticity/ buoyancy result are presented in (table 2.1);

Table 2.1: linear regression model result of tax revenue to its tax base and time, in LDCs

Tax category	***Description***	***Best estimated regression line***
Tax revenue	*Log function of GDP*	*Ln(rev)=βln(GDP)*
	Linear trend of log revenue	*Ln(rev)=βT*
Income tax	*Log function of GDP*	*Ln(inctax)= βln(GDP)*
	Exponential trend in total revenue function of GDP	*Ln(inctax)= βT*
Personal income tax	*Log function of employ company*	*Ln(PItax)=βln(wage)*
	Exponential trend in total revenue function of GDP	*Ln(PItax)= βT*
Business income tax	*Linear function of log surplus*	*Ln(CIT)=βln(profit)*
	Linear trend	*Ln(CIT)=βT)*
Domestic consumption tax (VAT)	*Linear function of final demanded*	*Ln(VAT)=β(final demand)*
	Log function of final demand	*Ln(VAT)=βln (final demand)*
Excise tax	*No good model*	
Import tax	*Exponential trend total import tax*	*Ln(IMtax)=βT*

2.2.2 Tax revenue forecasting in Ethiopia

In Ethiopia, all public bodies are required to prepare medium term spending plan, by the Council of Ministers Financial Regulation No.190/2010. Consequently, the preparation of the medium term fiscal framework (MEFF), which is government resource expenditure and financing forecasts did base this regulation. The recourse projections define the budget envelope and are used for as the basis for effective medium-term planning. The projections serve as the principal resource constraint and as integrated with a top-down budget preparation process approach, facilitate the allocation of resource across different public bodies. The medium term fiscal framework helps the budget authority to set the Indicative Planning Figures (IPF's) to be issued

for the public bodies, before the budget preparation starts. For public bodies to prepare their annual budget on the basis of the five-year indicative planning figures, a well-articulated Macroeconomic Fiscal Framework (MEFF), that incorporates both recurrent and capital budget needs based on program budgeting to be approved by the Council of Ministers. Moreover, public bodies will get the required indicative planning figures for the preparation of the PIP that forms the basis for the capital budget preparation.

The MEFF was introduced only at Federal level and it was introduced as a three-years rolling resource envelop planning tool, in recent years it covers five years. Its first year fiscal projections serve as ceiling and framework for the preparation of the next year budget, while the outer years fiscal aggregates are generally indicative. Basically the MEFF projections include: basic macroeconomic aggregate projections, aggregate tax and non-tax revenues, external grant and loan projections.

On the spending side: The recurrent spending with some spending, aggregate capital spending, regional transfer and domestic borrowing limit will be presented. Although there is a need to improve the accuracy of forecasts a hard, top-down aggregate budget constraint plays an essential role in budget allocation.

Tax revenue forecasting is done using a combination of tax elasticity/buoyancy, effective tax rate and qualitative (expert judgment or opinion) methods. Income taxes and domestic indirect taxes are entirely determined by elasticity or buoyancy approaches of forecasting. But, foreign trade taxes forecasting are based on effective tax rate approach. Model based forecasting (macro econometric model) is totally unutilized for forecasting.

A study by Tegegn (2008), to evaluate the determinants of tax revenues in Ethiopia had extensively used the elasticity and buoyancy approaches. He estimated the elasticity and buoyancy of individual tax category to its own base and the income (GDP). Thus, he found that, during the year 1961-2005 the individual tax category to its base are inelastic, except the business income tax and agricultural income tax. Moreover, the overall tax revenue elasticity is less than one (0.86). According to this study, overall elasticity 0.86 suggested that the discretionary changes undertaken during 1961-2005 fails to raise the ratio of tax to GDP. He also further argued that this in effective tax collection was a result of inefficient tax administration.

Similarly, the same study Tegegn (2008), suggested that individual tax category in relation to the income (GDP), shows different result. That is, base-to- income elasticity of personal income tax, import tax, and export tax had elasticity greater than one (elastic). On the other hand, business income tax, domestic indirect tax, and agricultural income tax were inelastic to GDP (had less than one elasticity). The overall elasticity of base- to- GDP is higher (greater) than tax-to-base. So, according to Tegegn (2008) study, the implication for such analysis is; the enhancement of base- to- income elasticity that is growth of tax base lays outside the control of authorities (apart from the influence of tax policy itself). This indicates that the growth in tax base is mainly determined by the way structure of the economy changes with economic growth.

3. TAX REVENUE PERFORMANCE IN ETHIOPIA

The aim of this chapter is to highlight public finance situation in Ethiopia; firstly the macroeconomic aspect of public finance will be reviewed, followed by an assessment of the recent year's major tax policy and administration measures and their effectiveness will be presented, finally a summary of descriptive statics of tax revenue performance in recent years will be forwarded.

3.1. The macroeconomic condition and public finance

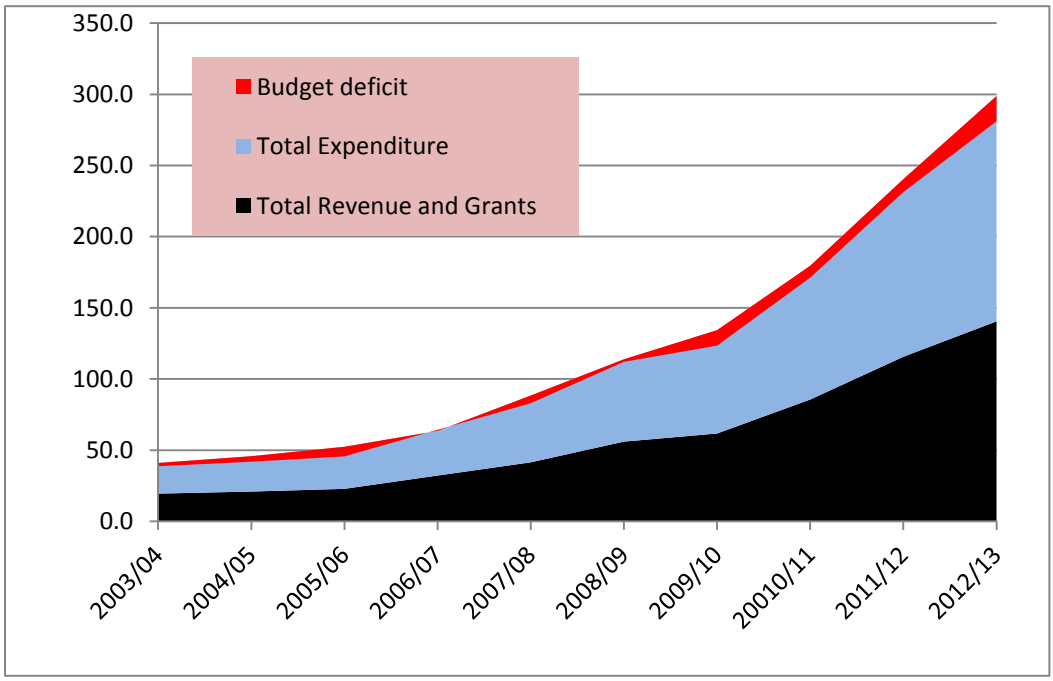
The Ethiopian economy for the first time in recent history has experience sustained and high economic growth. During the past decade (2003/04- 2012/13) on average 11 percent annual economic growth has been recorded. Among several reasons the main contributing factors for the growth is favorable environmental condition, especially for agricultural production. On the other hand, according to IMF recent economic assessment report, the government expenditures had played crucial role for the recent overall economic growth.

However; the economy had also experienced high inflation, on average 14.3 percent inflation was registered, during the period under consideration, it touch a peak (36 percent) during 2009/10. The induced demand, supply problems in production, poor marketing system and imported inflation are often linked as the main causes for this high inflation.

Meanwhile; one can conclude that a decent fiscal sector performance in past decade. Generally, the fiscal policy focused on strengthening domestic revenue mobilization and increasing pro-poor spending. As a result, during the decade government resource mobilization was robust, in both domestic and foreign sources (including grant). During the period under consideration, tax revenue had increased by about 30 percent on average, owing to measures taken to improve tax policy and administration. However; tax revenue performance as measured in the relation to GDP (tax to GDP ratio) is still very low, as compared to sub-Saharan African level. That is on average tax to GDP ratio in Ethiopia during 2003/04- 2012/13 is only 11 percent, as compared to 27 percent of sub- Saharan African average (figre3.4). On the expenditure side, during the decade about 60 percent the total government expenditure spent on pro-poor sectors, which includes; infrastructure, education, agriculture, water and health. Nevertheless, during the period under review, the budget deficit (including grant) stood at on average 2.2 percent of GDP (figure 3.1).

Figure 3.1 Total government financing, 2003/04- 2012/13

In Billion Birr



Source: Mofed

According to the World Bank report, Ethiopia's fiscal performance appears to be adequate given the current state of the economy and financing requirements for development. The overall general government deficit (including grants) declined from 1.6 percent of GDP in 2010/11 to 1.2 percent of GDP in 2011/12. Tax collections have been boosted by the 2010 tax enforcement measures, while public management reforms (such as program-based budgeting) have strengthened public expenditures. Meanwhile, public debt is on a declining trend at 35 percent of GDP in 2011/12 and Ethiopia has a low risk of external debt distress (World Bank).

3.2 The Effectiveness of tax policy and enforcement measures

The intention of tax policy revision taken by the Ethiopian Government in 2002/03 was; to broaden the tax base, as an instrument for investment incentive, and to modernize tax administration. Hence, as revenue receipt lucks behind the required public investment demand, the Government of Ethiopia has taken substantial measures in reforming the country's tax system and achieved creditable results both in tax policy and revenue administration. As a result continuous efforts have been envisaged in these areas to adequately mobilize the development

finance from domestic sustainable sources and maintain macroeconomic stability of the country. Moreover, after the down fall of the Dergue regime 1990's, the government has undertaken comprehensive tax reform with regard to both tax policy and revenue administration to enhance revenue mobilization. Income tax rates were as high as 85 percent in the high income bracket, while import duties were as high as 230 percent were levied on some import items with 23 tariff bands prior to 1993. The tax policy generally lucked equity and fairness as well as it was not conducive for growth and development. On the other hand, the tax administration was characterized by its complexity and luck of transparency.

The tax reform was undertaken with intensive collaboration of the (IMF). Hence, having identified the major weaknesses in the tax policy and administration, the Ethiopian tax system has been redesigned, so that it goes with the best international experiences. As a result rationalization of external tariff (successive significant reductions of the top rates, number of rates and tariff bands) has been effected, a new income tax law is enacted in 2002 and Value Added Tax (VAT) and Turn over Tax (TOT) which both replaced the general sales tax were introduced in January 2003. As a result of successive tariff reforms which have been undergone since 1993, the maximum tariff rate could be reduced from 230 percent to 35 percent the weighted average from 41.6 percent to 17.5 percent and the tariff band reduced from 23 to 6. In addition to broadening the tax base, the successive measures are believed enhanced economic activities through trade liberalization and by providing favorable business environment. Hence, it resulted in achieving rapid growth and development of the country.

Eventually, the reform also embarked in identifying the weaknesses of the tax administration and measures to be implemented. Accordingly the administration was strengthened and modernized by introducing new information technology tools and improving the procedures.

However, despite huge investment in the tax reform Ethiopia implemented, the real tax revenue return is found to be far below the expectation as the tax collection statistics during the implementation period revealed; though tax revenue collection showed a significant nominal growth. The tax to GDP ratio had not shown any improvement. Thus, this undesired tax revenue performance trend attracted policy maker's attention as it has been observed during when Ethiopia registered an impressive double-digit successive economic growth during the decades.

This would be even worse when we compare the tax perform with the African average; particularly the sub-Saharan African countries.

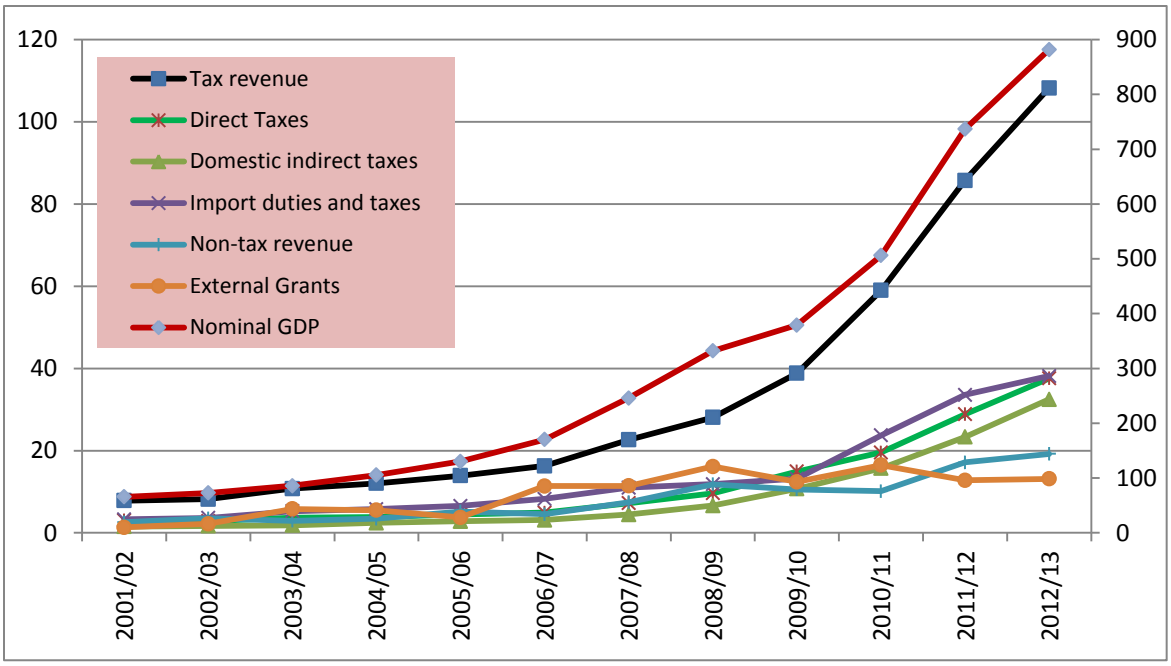
The recent IMF mission also undertook a number of tasks with the overall objective of assessing recent revenue performance, identifying any structural faults in the tax system which could be the cause of weakening performance. The mission assessed the potential scope of possible future impacts on revenues, and make recommendations to improve the robustness of the tax system, while at the same time enhancing the competitiveness of the business tax system. With regard to factors responsible for the revenue decline, the mission analyzed each of the main taxes and concluded that tax evasion might contributed to low performance of income tax whereas policy factors have no effect on the decline in the tax ratio. On the other hand, the mission asserted that the changes in the composition of imports contributed to the decline in indirect taxes. The root causes for this inadequate tax revenue yield dominantly lies on the lack of strong and efficient tax administration. Off course, the need to refine some tax policy area should not be neglected (IMF, 2010).

3.3 Total revenue and grant outturn

During the past decades in absolute terms the total tax revenue growth rate has shown similar pattern with that of nominal GDP growth trend, both variables on average grew by 27 percent. Moreover, the major tax categories growth pattern follows the same trend with the nominal GDP, but the grant has shown different direction, particularly in the recent years (figure 3.2).

Figure 3.2: Revenue and grant (left-hand side), GDP (right-hand side) outturn 2003/04- 2012/13

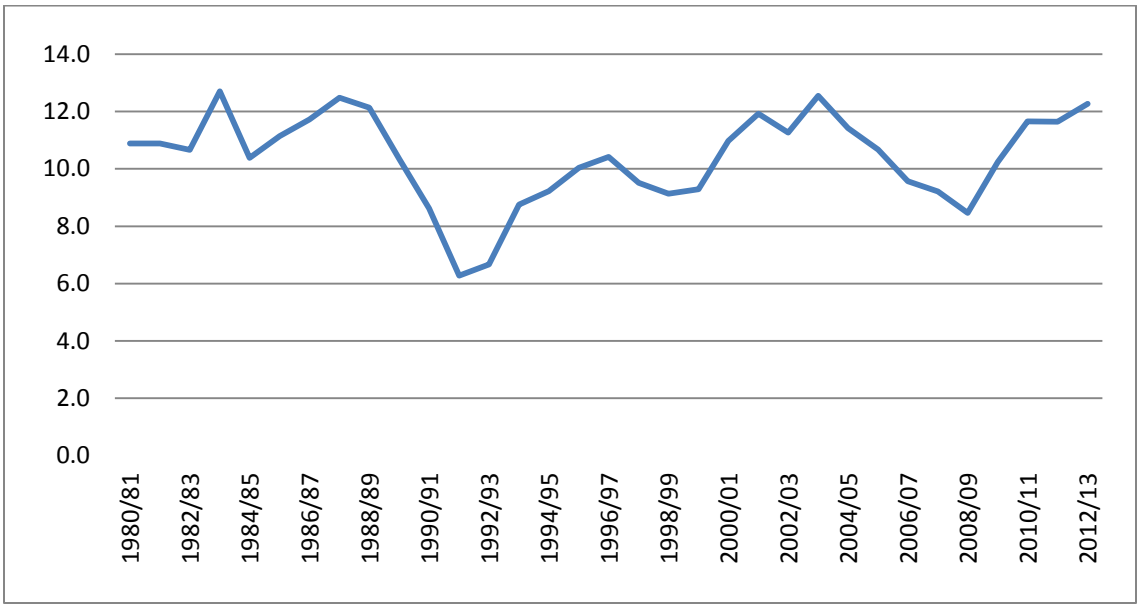
In Billion Birr



Source: Mofed

Hence, the ratio of tax revenue to GDP during the period under consideration was also unchanged; it stood at on average 11 percent (figure 3.3). Nevertheless, the tax buoyancy of tax revenues had not shown any stability; generally it has declined during periods of high economic growth, and increased during periods of moderate growth, with significant variations across tax types (figure3.3).

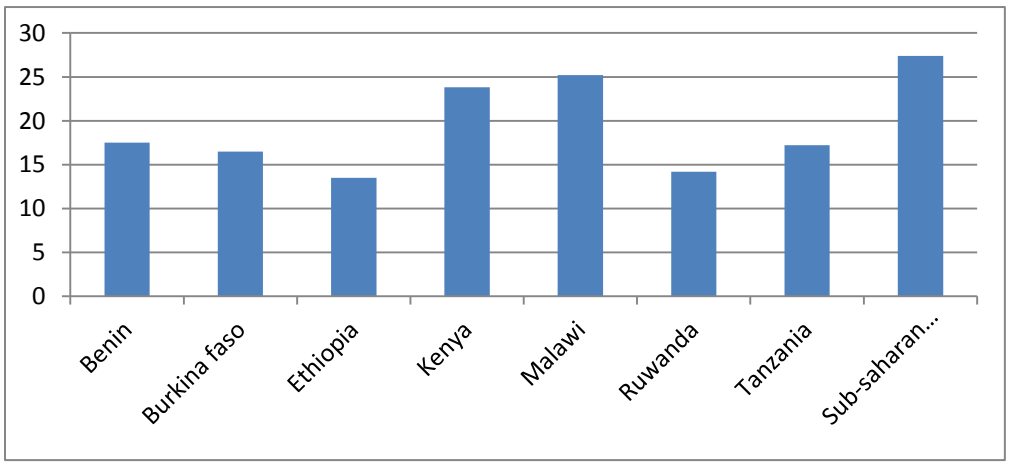
Figure 3.3: Tax revenue performances in percent of GDP, during 1980/81-2012/13



Source: Mofed

In a whole the revenue receipts in Ethiopia were very low (12 percent), as compared to sub-Saharan African level (27 percent). The figure below (figure 3.4) also shows that the Ethiopian domestic revenue performance was almost half of the Sub-Saharan Africa average.

Figure 3.4: Revenue excluding grant in low-income sub-Saharan African (percent of GDP), 2011

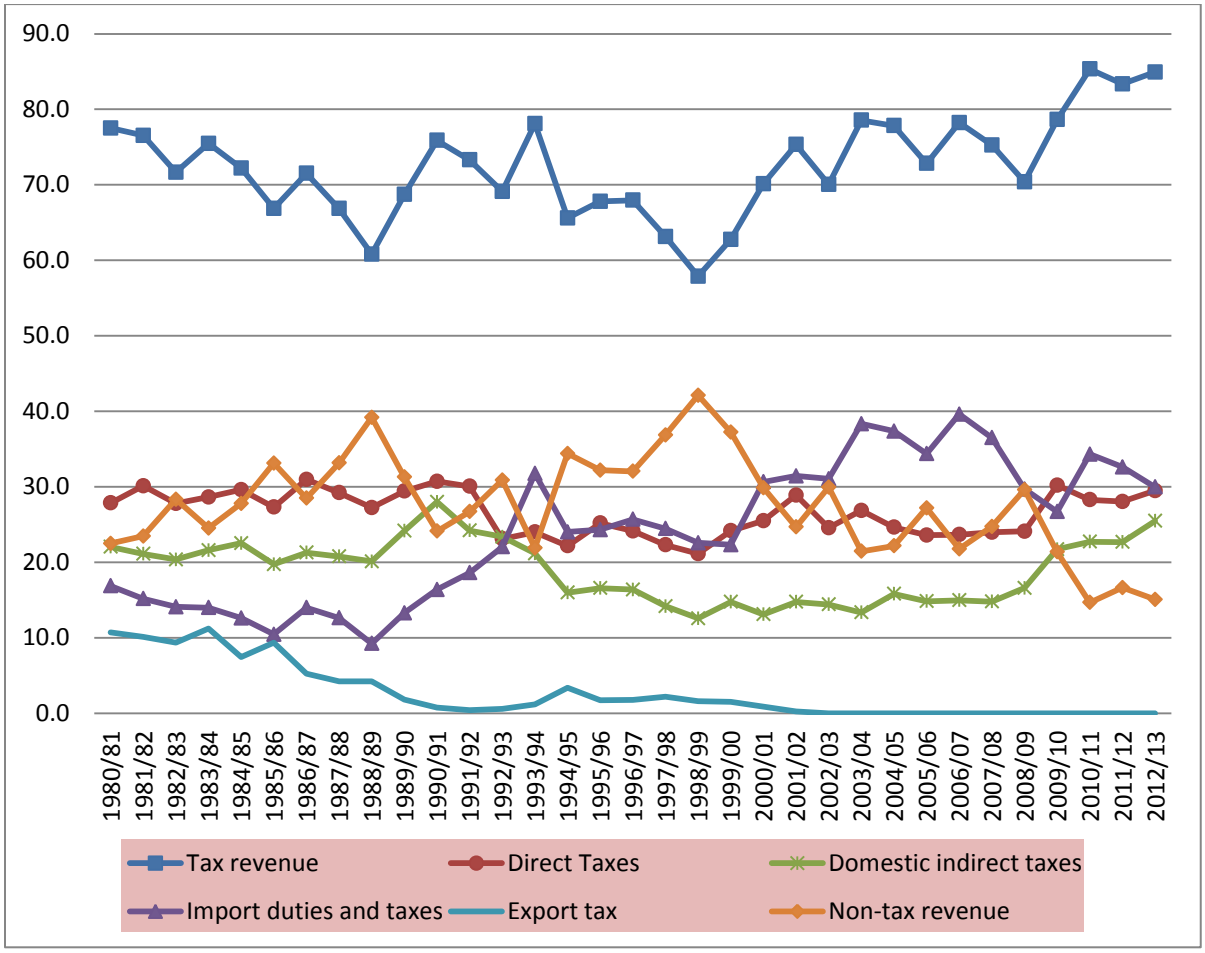


Source: Regional Economic Outlook sub-Saharan Africa 2012

In general, tax revenue accounts the major part government resource. The average proportion of tax revenue to the total government resource during 1980/81- 2012/13 stood at 60.1 percent, and

it also accounts 72.4 percent as compared to the total domestic revenue during the same period. The major categories of tax revenue in Ethiopia are; direct income taxes, domestic indirect taxes, and foreign trade taxes (figure 3.5).

Figure 3.5: Share of each tax categories of total domestic revenue, 1980/81-2012/13



As we observe from the above graph the contribution of direct taxes and domestic indirect taxes has shown an increasing trend, in recent years. On the other hand the share of foreign trade taxes shows, a declining trend; this is though very slow in line with government policy of liberalization, as the economy moves towards international economic integration trade taxes are expected to declining.

4. TAX REVENUE FORECASTING METHODOLOGY AND THE DATA

4.1 Methodology

In modeling and forecasting tax revenue, out of several ways of revenue forecasting methods the most popularly used are three (Detragiache, et al, 2009): (1) effective tax rate approach, (2) elasticity approach, and (3) regression approach. These methods are extensively used to forecast each category of taxes. The common characteristics of these methods are presented as follows;

4.1.1 Effective tax rate approach

The tax rate relates the amount of tax payable to the tax base. The tax base for a given tax is event or condition that gives rise to taxation. In most cases the economic event or condition are defined in the law. For instance, the receipt of wages and sale of goods are taxable events; ownership of a house can be a taxable condition. The law also defines at what rate the event or condition will be taxed, what items may be deducted in calculating the tax, whether any exemptions are allowed, the deadline for paying the fines that apply to late payment, and so on.

However, there are a number of cases that the tax base is unknown or the data may not exist. In such cases, it is often use a proxy tax base, for tax behavior analysis and forecasting. For example we may not know the volume of beer sales, but we may assume that trends in the sale of beer, which is related to trends in the economy as a whole, the private consumption will be used as a good proxy tax base. Table 4.1 below lists tax categories' and suggested proxy tax bases that can be used to study the behavior of these taxes and to forecast future receipts.

Table 4.1 Proxy bases for tax revenue

Tax categories	proxy bases
Corporate tax	Profits derived from national accounts, GDP
Personal income tax	Wages and salaries
Sales tax/ VAT	Private consumption at current prices, GDP
Excise tax	Private consumption at current prices, GDP
Import tax	Value and volume of import in local currency

Source IMF

If we are using a proxy tax base to forecast revenue, we need to find a tax rate relates actual receipt to proxy base.

$$\textbf{\textit{Effective tax rate}} = \frac{\textbf{\textit{tax Revenue}}}{\textbf{\textit{proxy tax base}}}$$

The effective tax rate shows how much revenue is actually collected as a percentage of the proxy tax base. In most cases using the effective tax rate provides for a more realistic forecast than one based on the tax rate defined in law (Detragiache etal, 2009). The reason is that such factors as tax exemptions and evasion are explicitly taken into account when calculating the effective tax rate.

We can postulate that the relationship exists between the proxy tax base and tax receipt and that the effective tax rate is stable over time. We need to test this assumption, and if our test confirms it, we can use the effective tax rate for forecasting. If the effective tax rate is not stable, it may be possible to use the marginal tax rate instead.

$$\textbf{\textit{Marginal tax rate}} = \frac{\textbf{\textit{Δ in tax revenue}}}{\textbf{\textit{Δ in proxy Tax base}}}$$

If the marginal tax rate is stable, we forecast the change in revenue by multiplying the change in the tax base by the marginal tax rate. The change in revenue from a tax decomposed into two parts; one corresponding to a change in the tax base and its impact on revenue, and the other corresponding to a change in the tax system (including changes in the tax rate, the tax structure, the coverage of the tax, and so forth).

4.1.2 Elasticity approach

Tax elasticity is the pure response of tax revenues to changes in GDP. The elasticity of tax revenue is defined as the ratio of the percentage in tax revenue to the percentage change in the tax base, assuming no change in the tax system during the period. On the other hand, tax buoyancy is the total response of tax revenues to changes in GDP. Hence, buoyancy does not distinguish between discretionary and automatic change in tax income. Tax elasticity excludes impact of a change in the tax rate (it is partial effect), but tax buoyancy is a total elasticity. If GDP is taken as proxy for the base, then the elasticity with respect to GDP is:

$$\textbf{\textit{Elasticity}} = \frac{\textbf{\textit{Δtaxbase}}*/\textbf{\textit{taxbase}}*}{\textbf{\textit{ΔGDP/GDP}}}$$

Where * denote the receipt from an unchanged tax system, that is, actual tax revenue adjusted for the estimated impact of changes in tax system over the period. Given an estimate of the elasticity for the tax in question and a forecast of the growth rate of the tax base, a revenue forecast can be obtained by multiplying the growth rate in the base by the elasticity.

Observed elastcities for major tax categories typically fall into a relatively narrow range of values. Such judgment estimates of elasticities are useful, especially where historical data for statistical estimation of the elasticities are generally not available. The following points are some observations that may be relevant in making judgment about elasticities (Detragiache et al, 2009); firstly as the rule of thumb the values of elasticities with respect to tax base are likely to be less than one in the case of taxes on consumption, secondly, elastcites can decline in the presence of high inflation, thirdly, taxes on property and land taxes generally have elasticity with respect to nominal GDP of significantly less than one, because of lags in the reassessment of tax bases and fourthly, a tax is likely to have an elasticity of one when its rate structure is proportional rather than progressive, when it is levied on an ad valorem basis, and when there are no significant lags in collection.

Buoyancy = $\frac{\Delta tax/tax}{\Delta GDP/GDP}$

Buoyancy equal to 1 means that tax revenue is growing exactly as fast as the tax base (say, GDP) this implies that the ratio of tax revenue to GDP is constant over time. If the tax rate is constant, this implies that the marginal tax rate equals the average tax rate. Nevertheless, the main drawback of the elasticity approach is that it does not take into account either past or future changes in the tax system.

4.1.3 Regression approach

We can use regression analysis to estimate the quantitative effect on tax on tax revenue of variables we would expect to have a major influence. This method will produce accurate forecasts if there is a stable relationship between the explanatory variables and total tax revenue.

4.1.3.1 Static regression models

The linear regression model is the static model, which uses current values of independent variable to explain the dependent variable the past values are not included. The model can be presented as follows (equation 4.5);

$$\mathbf{Ln\ T_t = \alpha + \beta\ ln\ GDP_t + \epsilon_t} \quad \text{..... (4.1)}$$

were, T_t is tax at time t, Y_t is GDP at time t,

The slope of coefficient of this regression equation interpreted as; β implies that when there is one percent increase in GDP, tax tend to increase by β percent. But such models suffer from serial correlation. Since both dependent and independent variables trend to exhibit stochastic trend and the implication is therefore, the estimate will not be reliable.

4.1.3.2 Dynamic regression models

Econometric analysis of long-run relations has been the focus of much theoretical and empirical research in economics. In the case where the variables in the long-run relation of interest are trend stationary, the general practice has been to de-trend the series and to model the de-trended series as stationary distributed lag or autoregressive distributed lag (ARDL) models. Estimation and inference concerning the long-run properties of the model are then carried out using standard asymptotic normal theory (Pesaran 1997). Moreover, in many economic time series, simple trend models or static models result in residuals that are serially correlated, casting doubt on reliability of estimated coefficients. To address this problem the use dynamic models became popular method (Detragiache etal, 2009), which use both the current and past value of dependent and independent variable to explain the current value of dependent variable.

Bearing such interest in mind the long run tax revenue function would be expressed empirically as follows:

$$\mathbf{ln}\ \boldsymbol{tax} = \boldsymbol{f}(\mathbf{ln}\ \boldsymbol{NGDP},\ \mathbf{ln}\ \boldsymbol{CPI},\ \mathbf{ln}\ \boldsymbol{tax}\ (-\mathbf{1}), \boldsymbol{lnNGDP}(-\mathbf{1}), \boldsymbol{dumpol}, \boldsymbol{dumenf} \quad \text{..... (4.2)}$$

Where

ln tax = Log of tax revenue;

ln $NGDP$ = Log of nominal Gross Domestic Product

ln CPI = Log of Consumer price index

Ln tax(-1) = log of lagged tax revenue

Dumpol = dummy variable, tax policy measures

Dumenf = dummy variable, tax enforcement measures

Now based on these terminologies the estimable econometric model can link revenue in the current year to the proxy tax base (say GDP) of that same year and the previous year and to

revenue of the previous year. ARDL approach for the analysis of long run relations when the underlying variables are I(1). We consider the following first- order ARDL model:

$$lnT_t = \beta_0+\beta_1 lnY_t+\beta_2 lnT_{t-1}+\beta_3 lnY_{t-1}+\ldots\ldots\ldots+U_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(4.3)$$

Where, U_t is the disturbance term and is uncorrelated white noise.

Transforming the variables in to their log function has its own significance. In the first place the problem of heteroskedasticity can be reduced since it compresses the scale in which the variables are measured, thereby reducing a tenfold difference between two values to a twofold difference (Gujarati, 1995).

To compare and contrast, the above dynamic model with static model, we can estimate buoyancy as β_1 (*equation 4.1)* with (equation 4.2).The buoyancy coefficient reflects both the elasticity of the tax system and any changes in the tax system. If the changes in the tax system are revenue enhancing, then buoyancy will exceed elasticity, because the actual tax revenue will exceed the amount that would have been generated in the absence of changes in the tax system. When using the buoyancy coefficient, therefore, we are assuming that tax laws will change in the future as they have in the past, and the revenue impact of these changes will be the same us the past, and that any change in tax administration implemented in the past that resulted in more revenue will be maintained in the future. These assumptions are acceptable if changes in the past have been small. If however large changes have been implemented in the past, one can make a more accurate forecast by taking these changes explicitly into account.

It is important to keep in mind, however, that, estimations of equations (4.1) and (4.2) above using OLS techniques are only meaningful if the variables involved are stationary. In case of nonstationary, OLS estimation will generate spurious regressions. Since nominal taxes and GDP series (and their logs) are almost certainly nonstationary in most countries, a more appropriate alternative to OLS is to use cointegration procedures to find a long- run relationship between taxes and GDP. If a cointegrating relationship exists, a linear combination of the log of tax and the log of GDP will be stationary. Using the notation I(0) to denote stationary, this means that a coefficient α exists such that:

$$ln\ T - \alpha\ ln\ GDP = I(0) \Leftrightarrow ln\ T = \alpha\ ln\ GDP+I(0)\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(4.4)$$

Equation (4.4) above, α can be interpreted as the long-run elasticity of tax collection to GDP.

4.2. Data Sources and Sample

In this paper it is estimated the elasticities of tax revenues with respect to tax bases. The basic data includes are the macroeconomic variables; nominal GDP (2010 base year), inflation and tax revenues. It also includes dummy variables such as, tax policy and enforcement measures taken by the government of Ethiopia. The data used in this study is annual data, GDP and taxes are obtained from Ministry of Finance and Economic Development (MoFED) and inflation data are obtained from National Bank of Ethiopia (NBE) and Central Statistical Authority (CSA). The data series includes 1980/01-2012/13, Ethiopian fiscal year, which starts July 7 and ends July 6.

4.3 Estimation Technique

The study adopts an Autoregressive Distributed Lag (ARDL) bounds testing approach developed by Pesaran et al (2001) to modeling the long run determinants of tax revenue. This approach has some econometric advantages over the Engle-Granger (1987) and maximum likelihood based approach proposed by Johansen and Juselius (1990) and Johansen (1991) cointegration techniques. Firstly, the bounds test does not require pre-testing of the series to determine their order of integration since the test can be conducted regardless of whether they are purely I(1), purely I(0), or fractionally integrated. Second, endogeneity problems and inability to test hypotheses on the estimated coefficients in the long-run associated with the Engle-Granger (1987) method are avoided (Kazeem Bello Ajide1 & Olukemi Lawanson, 2012). According to Pesaran and Shin (1999), modeling the ARDL with the appropriate lags will correct for both serial correlation and endogeneity problems. Jalil et al (2008) argue that endogeneity is less of a problem if the estimated ARDL model is free of serial correlation. In this approach, all the variables are assumed to be endogenous and the long run and short run parameters of the model are estimated simultaneously (Khan el al, 2005).Third, as argued in Narayan (2005), the small sample properties of the bounds testing approach are far superior to that of multivariate cointegration (Halicioglu, 2007). The approach, therefore, modifies the Auto-Regressive Distributed Lag (ARDL) framework while overcoming the inadequacies associated with the presence of a mixture of I(0) and I(1) repressors in a Johansen-type framework. Fourth, the long and short-run parameters of the model in question are estimated simultaneously. Lastly, the

ARDL has superior small sample properties as compared to the Johansen and Juselius (1990) cointegration test (Pesaran and Shin, 1998).

One of the drawbacks of the ARDL model is that economic interpretations of the regression coefficient are no longer obvious. One way to provide nice economic interpretations to the regression coefficient of the ARDL model is to use the error correction representation of the ARDL model, known as the error correction model (Detragiache, et al 2009). An ARDL representation of equation (4.3) can be specified as follows:

$$\Delta \boldsymbol{lntax} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1}\,\Delta\, \boldsymbol{lnN\,GDP_{t-1}} - \boldsymbol{\Upsilon}(\boldsymbol{lntax_{t-1}} - \boldsymbol{\delta lnNGDP_{t-1}}) + \quad \cup \boldsymbol{t} \quad \ldots \textbf{(4.5)}$$

Where, $(lntax_{t-1} - \delta lnGDP_{t-1})$*, is called the error correction term in first lag, and,* μ *is the white noise error.*

We can notice that the first difference term would be zero in long-run equilibrium, so that the error correction term together with the intercept term, can be regarded as describing a long-run equilibrium. As in the case of the ARDL model, the error correction model does not suffer from serial correlation of the residual, and yet its regression coefficients (***i.e.*** $\boldsymbol{\beta_1}$***,*** $\boldsymbol{\gamma}$***,*** $\boldsymbol{\delta}$) can offer nice economic interpretation.

The implementation of the ARDL approach involves two stages. First, the existence of the long-run nexus (cointegration) between variables under investigation is tested by computing the F-statistics for analyzing the significance of the lagged levels of the variables. (Pesaran, Shin, and Smith, 1999) and (Narayan, 2004) have provided two sets of appropriate critical values for different numbers of repressors (variables). This model contains an intercept or trend or both. One set assumes that all the variables in the ARDL model are of I(0), and another assumes that all the variables are I(1). If the F-statistic lies above the upper-bound critical value for a given significance level, the conclusion is that there is a non-spurious long-run level relationship with the dependent variable. If the F-statistic lies below the lower bound critical value, the conclusion is that there is no long-run level relationship with the dependent variable. If it lies between the lower and the upper limits, the result is inconclusive.

5. EMPIRICAL RESULTS AND DISCUSSION

5.1. Introduction

In this chapter the estimation methods discussed in part four will be used, and the empirical findings and results will be presented accordingly. Here as it is established earlier though the paper gives much emphasis to the long run determinants of tax revenue, it also highlights some discovery on the short run determinants of tax revenue adjustments, shows both the short and long run relationships simultaneously. Data analysis was performed by EVews 5.5 and Microfit 4.1.

5.2. Empirical results

5.2.1. Unit Root test

In general in time series analysis, before running the causality test the variables must be tested for stationarity. In ARDL model treatment of serial correlation and endogenous problems are not a concern at all, and often skip some tests. In this study the conventional ADF test is used. The ARDL bounds test is based on the assumption that the variables are I(0) or I(1). So, before applying this test, we determine the order of integration of all variables using the unit root tests. The objective is to ensure that the variables are not I(2), so as to avoid any possible spurious results. In the presence of variables integrated of order two, we cannot interpret the values of F statistics provided by Pesaran et al. (2001).

In cointegration analysis the variables need to have the same order of integration of having common stochastic trend. Hence, the time series under consideration should be checked for Stationarity before one can attempt to fit a suitable model. That is, variables have to be tested for the presence of unit root(s) thereby the order of integration of each series is determined. The Stationarity of the series can be tested by using an Augmented Dickey-Fuller test. ADF tests are based on models of the form as follows:

$$\Delta y_t = \phi y_{t-1} + \sum_{j=1}^{p-1} \alpha_j \Delta y_{t-j} + u_t \quad \text{.....} \quad [5.1]$$

The hypothesis to be tested is

Ho: $\phi = 0$ or the series is non stationary against

H1: $\phi < 0$ or the series is stationary

Table-5.1 Augmented Dicky Fuller (ADF) Unit-Root test for stationarity

Variables in Log	*SBIC lag*	*t-stat*	*Critical value at 5%*
ΔLNTAX	*1*	*-3.703***	*-2.972*
ΔLNNGDP	*2*	*5.800****	*-3.574*

*Where * model without constant and trend, ** model with constant, and *** model with constant and trend. The abbreviation SBIC is to mean Schwarz Bayesian Information Criterion.*

The Augmented Dickey-Fuller (ADF) unit root test is conducted; the results show (table5.1) that the ADF statistics for all variables exceeded their critical values at least at 5 percent significant level. The implication is that all the variables are found to be non- stationary at level, that is they are not characterized as I(0) series. However, once first differences of the variables are considered the null hypothesis of unit root can be rejected, as the t-statistics are lower than 1 percent critical values. This is an indication that the variables are I(1).

Up to now, the variables involved for analysis are checked for stationarity, and thus both variables are non-stationary at level. The next step therefore is to check the cointgration between the variables. Thus, Johanson Cointegration test between tax and GDP is conducted. The result shows that the variables are significantly cointrgrated at 5 percent (table 5.2). The implication for such result is therefore, the ARDL approach to error correction model is appropriate.

Table 5.2: Johnson Cointegration test between tax and GDP

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.295555	16.37507	15.49471	0.0368
At most 1 *	0.162960	5.514395	3.841466	0.0189

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

5.2.2. ARDL Bound Test for Integration

In using ARDL approach for cointegration, the first step is to conduct the bound test to determine the existence of long run relationships among the variables in the equation. The ARDL model has been specified in chapter in four above (equation 4.3), and the null hypothesis says there is no long- run relationship between the variables in the model, which could be specified as:

H_o: $\beta_2 LNNGDP = \beta_3 LNTAX\ (-1) = \beta_4 LNTAX\ (-2) = 0$

H_1: $\beta_2 LNNGDP \neq \beta_3 LNTAX\ (-1) \neq \beta_4 LNTAX\ (-2) \neq 0$

For this paper all the variables are integrated of I(0), it is better to compare both to the upper and lower bound. The paper selects an optimal lag length based on Schwarz Information Criterion (SIC). Here as it is shown above the optimal lag length that minimizes SIC is 2. The result is presented (table 5.3).

Table 5.3: Unrestricted intercept and restricted trend

Critical Value	Upper Bound	Lower Bound
1%	5.615	4.385
5%	4.895	3.727
10%	4.378	3.219

Calculated F-statistics (Wald) = 1524

The result indicates that Wald or F-statistics fall outside the critical value bounds, which means a conclusive decision, could be made without needing to know the co integration rank. As indicated on the above table the calculated F-statistics (F-statistics=1524) is significantly higher than the upper bound critical value at a 1 percent level of significance (4.43) with 3 explanatory variables, using the unrestricted intercept and restricted trend as reported by the tabulation of Pesaran et al.(2001). This implies that the null hypothesis of no cointegration is rejected at 1 percent significance level. Therefore a cointegrating relationship among the variables is confirmed.

5.2.3 Diagnostic Tests

The various diagnostic tests perform well indicating on the regression analysis of the dynamic model which incorporates both the long run and short run model simultaneously; microfit 4.1 software results is presented in table 5.3. This is the best does not reject the null of Lagrange multiplier test and F version shows that there is no problem of residual serial correlation.

Table 5.3: Diagnostic Test

```
                              Diagnostic Tests
*******************************************************************************
*    Test Statistics  *        LM Version        *         F Version           *
*******************************************************************************
*                     *                          *                             *
* A:Serial Correlation*CHSQ(   1)=   .29966[.584]*F(   1,  25)=   .25224[.620]*
*                     *                          *                             *
* B:Functional Form   *CHSQ(   1)=   .31347[.576]*F(   1,  25)=   .26398[.612]*
*                     *                          *                             *
* C:Normality         *CHSQ(   2)=  14.5549[.001]*       Not applicable        *
*                     *                          *                             *
* D:Heteroscedasticity*CHSQ(   1)=   1.1120[.292]*F(   1,  28)=   1.0778[.308]*
*******************************************************************************
   A:Lagrange multiplier test of residual serial correlation
   B:Ramsey's RESET test using the square of the fitted values
   C:Based on a test of skewness and kurtosis of residuals
   D:Based on the regression of squared residuals on squared fitted values
```

Besides, the Durbin Watson statistic (2.03), as shown in table 5.3, confirms there is no serial correlation of the residual of the repression conducted as a rule of thumb D.W greater than 2 implies no serial correlation (table 5.4). In addition the Ramsey RESET test for functional form specification accepts the regression specification of the dynamic model (figure 5.1). The test of Skeewness and Kurtosis of residuals for normality does not reject the null hypothesis of normality. It points out that the error term is normally distributed. Moreover hetroscedasticity test based on the regression of squared residuals on squared fitted values shows that there is no heteroscedasticity and indicates the existence of constant variance.

Moreover the parameter stability can be tested by the CUSUM test (figure 5.1, and 5.2). Once the ECMs have been estimated, Pesaran and Shin(1997) suggested that structural stability of the long-run and short-run relationships for the entire period is better examined by the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMSQ) of the recursive residual test as

proposed by (Brown et al, 1975) to assess the given parameter consistency. The null hypothesis of these tests is that the regression equation is correctly specified.

Figure 5.1: Plots of CUSUM statistics for coefficients stability Test

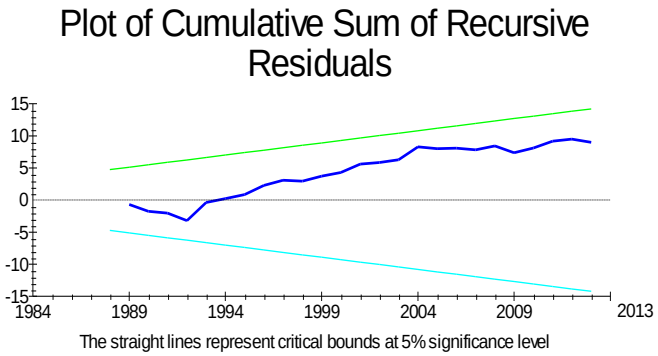
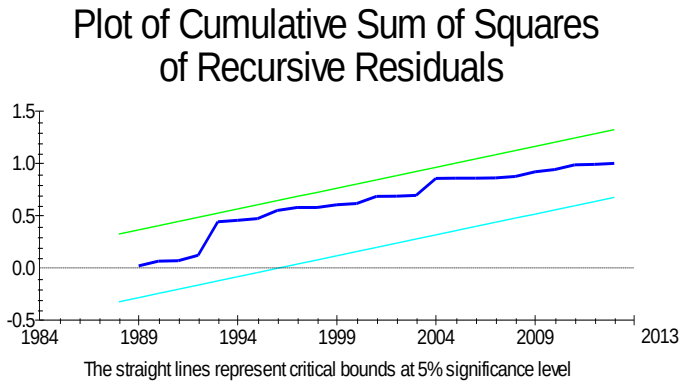


Figure 5.2: Plots of CUSUMQ statistics for coefficients stability Test



These two tests are presented in figure 5.1 and 5.2, the pair of straight lines in each figure indicates the 5 per cent significant level and if the plotted CUSUM and SUSUMSQ graphs remain inside the straight lines the null hypothesis of correct specification of the model can be accepted. Otherwise, the null hypothesis is rejected and it can be concluded that the regression equation is miss-specified. The two figures reveal that the plots of CUSUM and SUSUMSQ stay within the lines, and, therefore, this confirm the equation 4.3 is correctly specified and stable. The selected models adopted in the study seem to be good and robust in estimating the short and long-run relationships between tax revenue and gross domestic product.

5.3 Estimation of Coefficients of ARDL Model

5.3.1 Estimation of the Long-run Coefficients of ARDL Model

Here the task is computing or estimating the long run coefficients of the ARDL model. One of the most important issues in applying ARDL is choosing the order of the distributed lag functions. For this paper Schwarz Bayesian information Criterion is used for opting the lag length. Before running the process of estimation, Microfit 4.1 needs maximum lag of the model and it finds to be 1. Then the optimal number of lags for each of the variables is automatically selected by Schwarz Bayesian information Criterion. The criterion is used other than Akaike information criterion ever since its lag length is lower which in turn enables to get the best model. Accordingly the ARDL model comes up with the following results.

Table 5.4: Estimated Long Run Coefficients using the ARDL Approach

```
            Autoregressive Distributed Lag Estimates
           ARDL(2,0) selected based on Schwarz Bayesian Criterion
*****************************************************************************
 Dependent variable is LNTAX
 30 observations used for estimation from 1984 to 2013
*****************************************************************************
 Regressor              Coefficient       Standard Error         T-Ratio[Prob]
 LNTAX(-1)                  .99765             .17354             5.7487[.000]
 LNTAX(-2)                 -.32916             .16754            -1.9646[.060]
 LNNGDP                     .36284            .093367             3.8862[.001]
 INPUT                     -1.0549             .25722            -4.1011[.000]
*****************************************************************************
 R-Squared                      .99382   R-Bar-Squared                   .99311
 S.E. of Regression             .10169   F-stat.    F(  3,  26)    1394.2[.000]
 Mean of Dependent Variable    8.8277   S.D. of Dependent Variable      1.2251
 Residual Sum of Squares        .26888   Equation Log-likelihood        28.1520
 Akaike Info. Criterion        24.1520   Schwarz Bayesian Criterion     21.3496
 DW-statistic                   2.0274
*****************************************************************************

                              Diagnostic Tests
*****************************************************************************
*    Test Statistics  *        LM Version        *         F Version          *
*****************************************************************************
*                     *                          *                            *
* A:Serial Correlation*CHSQ(   1)=   .29966[.584]*F(   1,  25)=   .25224[.620]*
*                     *                          *                            *
* B:Functional Form   *CHSQ(   1)=   .31347[.576]*F(   1,  25)=   .26398[.612]*
*                     *                          *                            *
* C:Normality         *CHSQ(   2)=  14.5549[.001]*       Not applicable       *
*                     *                          *                            *
* D:Heteroscedasticity*CHSQ(   1)=   1.1120[.292]*F(   1,  28)=   1.0778[.308]*
*****************************************************************************
   A:Lagrange multiplier test of residual serial correlation
   B:Ramsey's RESET test using the square of the fitted values
   C:Based on a test of skewness and kurtosis of residuals
   D:Based on the regression of squared residuals on squared fitted values


            Estimated Long Run Coefficients using the ARDL Approach
            ARDL(2,0) selected based on Schwarz Bayesian Criterion
*****************************************************************************
 Dependent variable is LNTAX
 30 observations used for estimation from 1984 to 2013
*****************************************************************************
 Regressor              Coefficient       Standard Error         T-Ratio[Prob]
 LNNGDP                     1.0945            .083471            13.1125[.000]
 INPUT                     -3.1821             .83030            -3.8325[.001]
*****************************************************************************
```

Estimated coefficients of the long run relationship shows that tax revenue receipts in Ethiopia is substantially explained by the variables included in the analysis. In addition the adjusted R-square also reveals that 99 percent of the variation in tax revenue is explained by the prevailing

explanatory variables. Besides the Durbin Watson statistics shows no presence of serial correlation.

The above result indicates that Nominal Domestic Product (NGDP), own tax lags (2) are significantly determining the tax revenue in Ethiopia. The outcome also assures that the variables have figure out based on their expect sign. Whereas tax policy and enforcement change (the dummy variable), and inflation are insignificant for the determination of tax revenue in Ethiopia. As the purpose of this study is revenue forecasting; firstly the inclusion of insignificant dummy variables have no relevance at all, and secondly inflation is not only insignificant to the estimation but also wrong sign, hence both the dummy variable and inflation has been dropped from regression. Indeed, in the next section, forecasting error has been calculated with inclusion and excluding these variables (inflation); thus the result once again confirms inclusion leads to higher forecasting error significantly, which reinforce the decision to drop this variable from forecasting equation.

5.3.2 The Estimation of the Short-run Coefficients of ARDL Model-Error Correction Model (ECM)

The ECM coefficient shows how quickly/slowly variables return to equilibrium and it should have statistically significant coefficient with negative sign. The error correction term ECM_{t-1}, which measures the speed of adjustment to restore equilibrium in the dynamics model, appear with negative sign and is statistically significant at 1 percent level, ensuring that long run equilibrium can be attained. Bannerjee et al, (1998) holds that a highly significant error correction term is further proof of the existence of stable long run relationship. Indeed he has argued that testing the significance of ECM_{t-1}, which is supposed to carry out a negative coefficient, is relatively more efficient way of establishing co-integration.

Based on the estimated coefficients indicated on the table below tax revenue is substantially explained by all of the variables included in the analysis. Here the adjusted R-Squared reveals that 53 percent of the variation in tax revenue is explained by the prevailing explanatory variables. The F-statistics also indicates that the model is adequate. Moreover the Durbin Watson statistics shows that there is no serial correlation.

Table 5.5: Error Correction Representation for the Selected ARDL Model:

```
            Error Correction Representation for the Selected ARDL Model
            ARDL(2,0) selected based on Schwarz Bayesian Criterion
********************************************************************************
 Dependent variable is dLNTAX
 30 observations used for estimation from 1984 to 2013
********************************************************************************
 Regressor              Coefficient       Standard Error         T-Ratio[Prob]
 dLNTAX1                    .32916             .16754             1.9646[.060]
 dLNNGDP                    .36284            .093367             3.8862[.001]
 dINPUT                    -1.0549             .25722            -4.1011[.000]
 ecm(-1)                   -.33151             .10052            -3.2980[.003]
********************************************************************************
 List of additional temporary variables created:
 dLNTAX = LNTAX-LNTAX(-1)
 dLNTAX1 = LNTAX(-1)-LNTAX(-2)
 dLNNGDP = LNNGDP-LNNGDP(-1)
 dINPUT = INPUT-INPUT(-1)
 ecm = LNTAX   -1.0945*LNNGDP +   3.1821*INPUT
********************************************************************************
 R-Squared                      .58335   R-Bar-Squared                     .53528
 S.E. of Regression             .10169   F-stat.    F(  3,  26)   12.1342[.000]
 Mean of Dependent Variable     .14133   S.D. of Dependent Variable       .14918
 Residual Sum of Squares        .26888   Equation Log-likelihood         28.1520
 Akaike Info. Criterion        24.1520   Schwarz Bayesian Criterion      21.3496
 DW-statistic                   2.0274
********************************************************************************
 R-Squared and R-Bar-Squared measures refer to the dependent variable
 dLNTAX and in cases where the error correction model is highly
 restricted, these measures could become negative.
```

As shown on the table 5.5 the coefficient of the lagged error correction term (-0.33) is negative and statistically significant at the 1 percent level. The negative and significant coefficient is an indication of cointegrating relationship between tax revenue and its determinants. The magnitude of the coefficient implies that more than 0. 33 percent of the disequilibrium caused by previous year's shocks converges back to the long-run equilibrium in the current year; this implies that the adjustments is a bit slow, to correct to the long term equilibrium.

Likewise the long run effect, the short run impact of nominal GDP on tax revenue is positive and significant at the 1 percent level, and the tax lag is also positive and significant at about 5 percent. The accelerated principle effects is further reinforced as 1 percent increase in the nominal GDP growth will induce about 0. 36 percent increase in tax revenue. Also a 1 percent increase in tax revenue this year will have a 0.32 percent increase of the next year . in other words elasticity of tax revenue to GDP equals to 0.36 and elasticity of tax to its own lag equals 0.36 (inertia of tax).

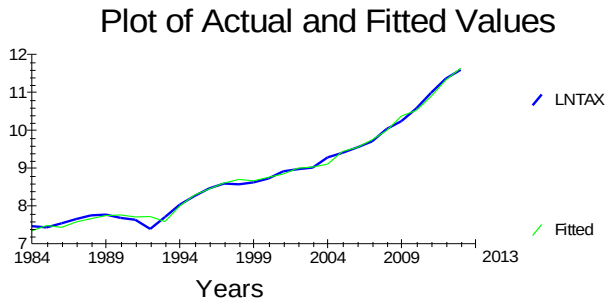
5.4 Forecasting tax revenue results

Building macroeconomic forecasts is an art from involving economic theory, data construction, econometric and statistical forecasting techniques, and much of judgement. Economic theory gives forecasts behavioural relationships and accounting identities that can be used to see how economic variables are linked to one on other and over time. With the help of econometrics and statistical methods, the forecaster calibrates or estimates the parameters of the relationships supplied by economic theory to arrive at values that are reasonable for the country in question. In this process, good judgement plays an important role because economists often do not have complete or clear understanding of the quantitative links between variables.

Typically several forecasts are available for the same variable. One way of selecting between different methods is on the basis of statistical goodness of fit. One strategy is to use the methodologies that one want to assess and compute forecasts of the past values. These forecasts can then be compared with actual realization to compute forecast errors. Models that yield the smallest forecast errors are superior. As average forecast error can be misleading because positive and negative errors tend to offset each other, the mean absolute error (MAE), mean square error (MSE), and others are often used as the best estimate of forecasting errors.

To forecast tax revenue GDP is forecasted before (assumed), it is thus assumed that nominal GDP will grow on average by 18 present. Consequently; using the ARDL model estimates tax revenue for five years (2013-2018) has been forested for Ethiopia. The results of this revenue forecast are presented as follows; firstly as indicated above the forecasts are then compared with actual realization (1982/83-2012/13), and thus the result is presented in figure 5.3. as it is clearly seen form figure 5.3 the fitted value well tracked the actual values.

Figure 5.3: plot of actual and fitted vales



Secondly; tax revenue has been forecasted for 2014-2018, the result is presented in table 5.6. Moreover a summary of statistics for the residual forecasting error are presented (table 5.6). In addition in figure 5.4 residual of forecasting error are plotted. Once again as it can be observed the plotted residual figure 5.4 is oscillates around zero; hence, it confirms that the residuals are stationary.

Table 5.6 medium term tax revenue forecast using ARDL approach, in Ethiopia

Dynamic forecasts for the level of LNTAX

Based on 30 observations from 1984 to 2013.
ARDL(2,0) selected using Schwarz Bayesian Criterion.
Dependent variable in the ARDL model is LNTAX included with a lag of 2.
List of other regressors in the ARDL model:
LNNGDP INPUT

Observation	Actual	Prediction	Error
2014	*NONE*	11.7940	*NONE*
2015	*NONE*	11.9835	*NONE*
2016	*NONE*	12.1671	*NONE*
2017	*NONE*	12.3459	*NONE*
2018	*NONE*	12.5256	*NONE*

Summary Statistics for Residuals and Forecast Errors

	Estimation Period 1984 to 2013	Forecast Period 2014 to 2013
Mean	.0000	*NONE*
Mean Absolute	.070430	*NONE*
Mean Sum Squares	.0089628	*NONE*
Root Mean Sum Squares	.094672	*NONE*

Figure 5.5 plot of residual for forecasts

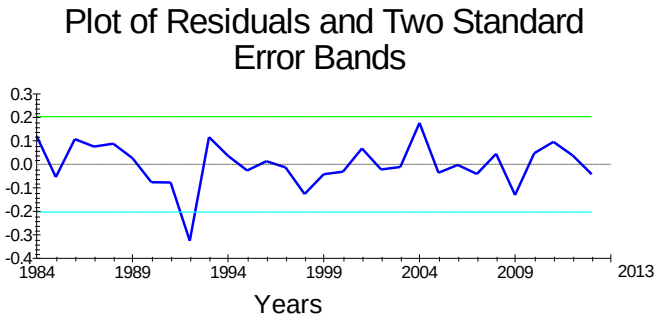
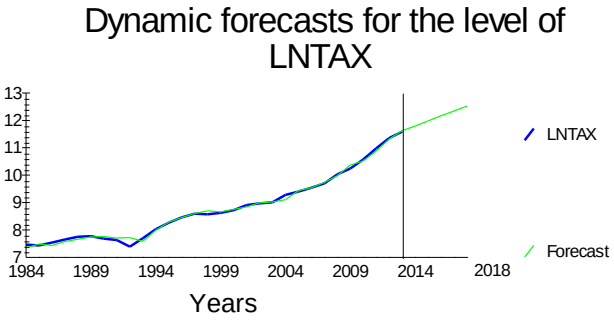


Figure 5.6 shows the tax revenue forecast for 2014-2018, according to this forecast tax revenue in Ethiopia will grow 26 percent in 2014, 21 percent in 2015, and 20 percent in 2016-2018. Hence this result in shows the ARDL forecasting model is robust in tax revenue forecasting in Ethiopia.

Figure 5.6: Dynamic forecasts for the tax revenue



6. CONCLUSIONS AND RECOMMENDATION

6.1. Introduction

In this chapter the first section summarizes the statement on the problem, its scope, methodology and major findings of the study. In addition it also produces the implications of the findings of the study which could recommend for the basic actions to be taken and for further study.

6.2. Conclusions

This study attempted to offer evidence and precise econometric measurement (parameterization) on the causal long-term and short- term relationship between tax revenue and its determinants (the tax base) in Ethiopia. To investigate such relationships a standard and a contemporary econometric methodology has been employed. As the same time by using this econometric relationships or estimates tax revenue forecasting for the medium term has been done for Ethiopia. The forecasting power of the model has been tested and the forecast found to be robust.

Meanwhile, in Ethiopia few research papers are done concerning on the determinants tax revenue and none of them gave especial emphasis in discovering the long term and short determinants. Even some of these papers are worked out based on the traditional static econometric model, which suffer econometric problems, such as serial correlation and endognity problems. Past studies not only use old methodology but also did not include essential variables such as the lagged variables. However; when examine the behavior of tax payers, especially business tax payers, there is strong evidence that they pay based on what they used to pay in the past. This is mainly explained by due to the fact that tax payers do not keep business records, and tend to pay what they used to pay in the previous years.

This paper seeks to identify the basic long run determinants of tax revenue from 1982 until 2013. Unlike to the previous one it examined the analysis based on the newly identified method of computation called an Autoregressive Distributed Lag (ARDL) testing approach which is used for testing the existence of a relationship between variables in levels which is applicable irrespective of whether the underlying repressors are purely I(0), purely I(1) or mutually cointegrated.

The results show that both the current GDP and past performance of tax revenue has influence for the short term and in the long-term tax revenue collection. The end product also provides strong support for the hypothesis that tax revenue in Ethiopia, like in other developing countries, is affected by important tax base.

6.3. Recommendation

Based on the above findings; the nominal output growth and own lag, (the past tax revenue collection) has played a significant and positive role for current time revenue collection. Therefore; this result can be utilized as a applied tool for short and long term tax revenue projection. Thus, the autoregressive distributive lag (ARDL) model can be strongly recommend as a practical and reliable tax revenue analysis and forecasting tool in Ethiopia and LDCs. More over the same procedure and methodology can be employed not only for the general tax level but also for each category of taxes (disaggregated level).

Indeed, the autoregressive distributive lag (ARDL) model of cointegration tool can be applied in public institution in Ethiopia, such as Ministry of Finance and Economic Development (MoFED), and Ethiopian Revenue Authority (ERCA), while resource forecasting and analysis. Particularly some of the areas that this model can be applied are; the annual budget preparation, medium terms resource forecasting, such as Macroeconomic Fiscal Frame work (MEFF). Moreover this tool can be used for a number of cases, such as consumption expenditure analysis and forecasting.

Annex

Annex1: tax revenue, GDP and inflation 1981/82- 2012/13 and GDP forecasts, 2014-18

GCY	tax	lntax	NGDP*	lnngdp	CPI	infl
1981	1,361.86	7.22	12,503.81	9.43	27.08	
1982	1,436.40	7.27	13,194.52	9.49	27.60	0.02
1983	1,558.09	7.35	14,608.36	9.59	29.61	0.07
1984	1,731.50	7.46	13,631.03	9.52	30.73	0.04
1985	1,677.50	7.43	16,160.48	9.69	30.70	0.00
1986	1,876.10	7.54	16,841.07	9.73	36.31	0.18
1987	2,092.20	7.65	17,853.22	9.79	37.99	0.05
1988	2,317.40	7.75	18,572.13	9.83	34.39	-0.09
1989	2,371.00	7.77	19,529.39	9.88	35.13	0.02
1990	2,159.21	7.68	20,873.68	9.95	38.51	0.10
1991	2,053.40	7.63	23,813.36	10.08	40.49	0.05
1992	1,618.20	7.39	25,794.15	10.16	48.93	0.21
1993	2,205.70	7.70	33,088.02	10.41	59.23	0.21
1994	3,076.50	8.03	35,144.29	10.47	65.15	0.10
1995	3,878.59	8.26	42,037.08	10.65	65.91	0.01
1996	4,723.29	8.46	47,064.65	10.76	74.52	0.13
1997	5,358.94	8.59	51,440.80	10.85	77.54	0.04
1998	5,292.23	8.57	55,627.95	10.93	77.65	0.00
1999	5,528.89	8.62	60,544.43	11.01	78.33	0.01
2000	6,130.57	8.72	65,986.25	11.10	78.58	0.00
2001	7,393.06	8.91	67,351.03	11.12	81.35	0.04
2002	7,857.94	8.97	65,895.47	11.10	82.21	0.01
2003	8,194.30	9.01	72,702.75	11.19	77.92	-0.05
2004	10,770.99	9.28	85,800.06	11.36	81.45	0.05
2005	12,036.99	9.40	105,415.06	11.57	86.08	0.06
2006	13,911.84	9.54	130,333.73	11.78	92.23	0.07
2007	16,289.77	9.70	170,280.60	12.05	100.00	0.08
2008	22,649.06	10.03	245,836.04	12.41	101.30	0.01
2009	28,092.16	10.24	332,060.26	12.71	126.90	0.25
2010	38,818.00	10.57	379,134.55	12.85	173.10	0.36
2011	58,980.00	10.98	506,079.14	13.13	177.95	0.03
2012	85,739.00	11.36	736,612.31	13.51	210.20	0.18
2013	108,217.80	11.59	881,675.00	13.69	280.95	0.34
2014			1040166.48			
2015			1227396.45			
2016			1448327.81			
2017			1709026.81			
2018			2016651.64			

Note * GDP on 2010 base year

Annex 2: Ethiopia, General Government Revenue & Grants, 2003/04-2012/13

Fiscal Year ending July 7	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13
	Actual						estimate		
Tax revenue	**12066.8**	**13946.3**	**16332.2**	**22756.9**	**28159.2**	**38910.9**	**59046.6**	**85848.8**	**108283.3**
Annual growth rate (%)	0.1	0.2	0.2	0.4	0.2	0.4	0.5	0.5	0.3
Direct Taxes	**3840.8**	**4543.2**	**4967.2**	**7323.7**	**9684.5**	**14998.9**	**19615.6**	**28965.8**	**37629.3**
	4.0	**18.3**	**9.3**	**47.4**	**32.2**	**54.9**	**30.8**	**47.7**	**29.9**
Income and profits tax	**3474.7**	**3885.9**	**4723.0**	**6888.4**	**9116.6**	**14122.9**	**18874.6**	**27985.8**	**37072.1**
Personal income	1178.6	1539.9	1816.7	2909.7	3585.4	4391.0	5733.0	8900.0	12035.2
Annual growth rate (%)	23.1	30.7	18.0	60.2	23.2	22.5	30.6	55.2	35.2
Rental income tax [1/]	63.9	25.8	32.3	58.9	87.6	142.0	277.0	393.0	631.0
Business profits	1580.5	1641.3	2042.2	3015.2	4335.8	7391.0	10055.0	15540.0	20237.6
Annual growth rate (%)	6.7	3.8	24.4	47.6	43.8	70.5	36.0	54.5	30.2
Agriculture income	144.6	96.3	91.7	70.8	245.0	389.0	311.0	322.0	292.4
Withholding tax on imports	182.0	219.7	272.0	310.0	343.1	1212.0	1488.0	1533.0	2260.1
Interest income tax	22.9	30.1	35.7	97.9	72.7	86.0	152.0	205.0	259.0
Chance winning & dividend&others	43.3	57.2	91.4	78.4	119.2				
Capital gains tax [2/]	23.0	16.7	19.1	108.7	22.8	37.0	43.0	89.0	57.8
Chat Tax	168.1	174.0	228.5	50.5	114.3				
Others	37.9	50.5	51.0	80.6	123.7	382.0	749.0	894.0	1233.5
Rural land use fee	**139.9**	**124.7**	**63.0**	**97.4**	**234.9**	**270.0**	**317.0**	**320.0**	**176.8**
Urban land lease fee [3/]	**226.2**	**532.6**	**181.2**	**337.9**	**333.0**	**606.0**	**424.0**	**660.0**	**380.4**
Domestic indirect taxes	**2445.5**	**2835.5**	**3114.9**	**4453.1**	**6621.0**	**10727.0**	**15705.0**	**23326.0**	**32477.0**
Annual growth rate (%)	**33.5**	**15.9**	**9.9**	**43.0**	**48.7**	**62.0**	**46.4**	**48.5**	**39.2**
Sales/excise taxes [4/]	1797.3	2169.3	2287.5	2993.3	3881.6	5698.0	9829.0	12335.0	16565.0
Services sales tax [5/]	534.1	518.9	684.3	1283.5	2498.4	4717.0	5443.0	10405.0	15268.0
Stamp duties	114.2	147.3	143.1	176.2	241.0	312.0	433.0	586.0	644.0
Import duties and taxes	**5780.6**	**6567.6**	**8250.1**	**10980.1**	**11853.6**	**13185.0**	**23726.0**	**33557.0**	**38177.0**
Annual growth rate (%)	**9.9**	**13.6**	**25.6**	**33.1**	**8.0**	**11.2**	**79.9**	**41.4**	**13.8**
Custom duties	2514.8	2959.6	3354.0	3800.7	3951.0	5852.0	7717.0	11091.0	12761.0
Annual growth rate (%)	3.7	17.7	13.3	13.3	4.0	48.1	31.9	43.7	15.1
Sales/excise taxes [4/]	3265.8	3608.0	4402.9	5068.3	4671.7	3852.0	11539.0	15941.0	17973.0
	15.3	10.5	22.0	15.1	-7.8	-17.5	199.6	38.1	12.7
Surtax on imports			493.1	2111.1	3230.8	3481.0	4470.0	6525.0	7443.0
Non-tax revenue	**3449.9**	**5364.0**	**4512.1**	**7500.3**	**11914.1**	**10541.5**	**10104.1**	**17229.1**	**19189.7**
Annual growth rate (%)	**18.8**	**55.5**	**-15.9**	**66.2**	**58.8**	**-11.5**	**-4.1**	**70.5**	**11.4**
Charges and fees	375.4	327.9	365.8	443.4	493.2	489.0	970.0	1127.0	1145.0
Sales of goods & services	414.5	572.5	623.7	708.4	791.7	1032.0	1775.0	1738.0	1502.0
Government investment income	1090.0	2940.4	2295.3	3645.1	7308.0	6979.0	4476.0	9179.0	8408.0
Annual growth rate (%)	20.1	169.8	-21.9	58.8	100.5	-4.5	-35.9	105.1	-8.4
Pension contributions									
Reimbursement & property sales	182.9	269.6	154.8	751.2	1370.9	108.0	194.0	451.0	161.1
Miscellaneous	765.6	420.6	417.8	1518.6	1025.1	1067.0	1707.0	2456.0	4948.0
Other extraordinary [7/]	18.8								
Privatization proceeds									
Other Revenue	582.6	663.1	676.6	374.8	824.7	871.0	1018.0	2173.0	3034.0
Total revenues	**15516.7**	**19310.3**	**20844.3**	**30257.2**	**40073.2**	**49452.4**	**69150.7**	**103077.9**	**127473.0**
Annual changes (%)	13.4	24.4	7.9	45.2	32.4	23.4	39.8	49.1	23.7
External Grants	**5500.3**	**3760.5**	**11380.9**	**11411.0**	**16130.7**	**12377.0**	**16492.0**	**12795.0**	**13116.0**
	-5.3	**-31.6**	**202.6**	**0.3**	**41.4**	**-23.3**	**33.2**	**-22.4**	**2.5**
Grants in kind/earmarked	2586.7	2052.0	7289.9	5934.0	9802.4	5561.0	6859.0	8089.0	9699.0
Untied cash & CPF/grants /PBS	2913.6	1708.5	4091.0	5477.0	6328.2	6816.0	9633.0	4706.0	3417.0
Total Revenue and Grants	**21017.0**	**23070.8**	**32225.2**	**41668.2**	**56203.9**	**61829.4**	**85642.7**	**115872.9**	**140589.0**

Source: MoFED

Annex 3: Johansson cointegration test

Date: 09/26/13 Time: 11:03
Sample (adjusted): 3 33
Included observations: 31 after adjustments
Trend assumption: Linear deterministic trend
Series: LNTAX LNNGDP
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.295555	16.37507	15.49471	0.0368
At most 1 *	0.162960	5.514395	3.841466	0.0189

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.295555	10.86068	14.26460	0.1613
At most 1 *	0.162960	5.514395	3.841466	0.0189

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

LNTAX	LNNGDP
-5.139415	6.235376
4.412796	-3.464585

Unrestricted Adjustment Coefficients (alpha):

D(LNTAX)	0.060899	-0.010673
D(LNNGDP)	0.027359	0.030294

1 Cointegrating Equation(s): Log likelihood 61.04300

Normalized cointegrating coefficients (standard error in parentheses)

LNTAX	LNNGDP
1.000000	-1.213246
	(0.08286)

Adjustment coefficients (standard error in parentheses)

D(LNTAX)	-0.312985
	(0.09660)
D(LNNGDP)	-0.140607
	(0.08517)

Annex 4: Ordinary least square regression result on tax revenue

Dependent Variable: LNTAX
Method: Least Squares
Date: 09/26/13 Time: 12:40
Sample (adjusted): 3 33
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.036968	0.247951	-4.182150	0.0003
LNNGDP	0.363499	0.091612	3.967815	0.0005
LNTAX(-1)	1.003585	0.169995	5.903623	0.0000
LNTAX(-2)	-0.337934	0.163855	-2.062400	0.0489

R-squared	0.994130	Mean dependent var	8.779476
Adjusted R-squared	0.993477	S.D. dependent var	1.234245
S.E. of regression	0.099682	Akaike info criterion	-1.653751
Sum squared resid	0.268285	Schwarz criterion	-1.468721
Log likelihood	29.63315	F-statistic	1524.100
Durbin-Watson stat	2.043327	Prob(F-statistic)	0.000000

Annex 5: wald test

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	1524.100	(3, 27)	0.0000
Chi-square	4572.301	3	0.0000

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(2)	0.363499	0.091612
C(3)	1.003585	0.169995
C(4)	-0.337934	0.163855

Restrictions are linear in coefficients.

Annex 6: The Unit Root test for tax revenue

Null Hypothesis: D(TAX,2) has a unit root

Exogenous: Constant

Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.703086	0.0097
Test critical values:	1% level	-3.689194	
	5% level	-2.971853	
	10% level	-2.625121	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(TAX,3)

Method: Least Squares

Date: 09/20/13 Time: 12:30

Sample (adjusted): 5 32

Included observations: 28 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(TAX(-1),2)	-0.876550	0.236708	-3.703086	0.0011
D(TAX(-1),3)	0.398678	0.267375	1.491083	0.1485
C	594.3343	513.4263	1.157584	0.2580

R-squared	0.361907	Mean dependent var	-144.7423
Adjusted R-squared	0.310859	S.D. dependent var	3022.243
S.E. of regression	2508.900	Akaike info criterion	18.59403
Sum squared resid	1.57E+08	Schwarz criterion	18.73677
Log likelihood	-257.3165	Hannan-Quinn criter.	18.63767
F-statistic	7.089612	Durbin-Watson stat	1.906451
Prob(F-statistic)	0.003640		

Annex 7: The Unit Root test for nominal GDP

Null Hypothesis: D(NGDP) has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 2 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		5.800470	1.0000
Test critical values:	1% level	-4.309824	
	5% level	-3.574244	
	10% level	-3.221728	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(NGDP,2)

Method: Least Squares

Date: 09/20/13 Time: 17:09

Sample (adjusted): 5 33

Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(NGDP(-1))	0.812406	0.140059	5.800470	0.0000
D(NGDP(-1),2)	-1.115778	0.195694	-5.701643	0.0000
D(NGDP(-2),2)	-2.112421	0.171389	-12.32527	0.0000
C	-6402.590	5807.817	-1.102409	0.2812
@TREND(1)	512.4574	366.1196	1.399699	0.1744

R-squared	0.886001	Mean dependent var	5035.863
Adjusted R-squared	0.867002	S.D. dependent var	31125.55
S.E. of regression	11351.16	Akaike info criterion	21.66761
Sum squared resid	3.09E+09	Schwarz criterion	21.90335
Log likelihood	-309.1804	Hannan-Quinn criter.	21.74144
F-statistic	46.63219	Durbin-Watson stat	2.063578
Prob(F-statistic)	0.000000		

Annex 8: The actual and fitted value of tax revenue

Residuals and Fitted Values of Regression

Based on ARDL regression of LNTAX on:
LNTAX(-1) LNTAX(-2) LNNGDP INPUT
30 observations used for estimation from 1984 to 2013

Observation	Actual	Fitted	Residual
1984	7.4600	7.3391	.12088
1985	7.4300	7.4842	-.054211
1986	7.5400	7.4326	.10741
1987	7.6500	7.5740	.076025
1988	7.7500	7.6620	.087977
1989	7.7700	7.7437	.026277
1990	7.6800	7.7562	-.076159
1991	7.6300	7.7070	-.076956
1992	7.3900	7.7157	-.32573
1993	7.7000	7.5835	.11654
1994	8.0300	7.9935	.036503
1995	8.2600	8.2860	-.025994
1996	8.4600	8.4467	.013256
1997	8.5900	8.6032	-.013224
1998	8.5700	8.6961	-.12611
1999	8.6200	8.6624	-.042398
2000	8.7200	8.7515	-.031520
2001	8.9100	8.8421	.067916
2002	8.9700	8.9915	-.021465
2003	9.0100	9.0214	-.011440
2004	9.2800	9.1033	.17672
2005	9.4000	9.4357	-.035675
2006	9.5400	9.5427	-.0027171
2007	9.7000	9.7409	-.040856
2008	10.0300	9.9850	.044979
2009	10.2400	10.3704	-.13043
2010	10.5700	10.5221	.047885
2011	10.9800	10.8838	.096188
2012	11.3600	11.3221	.037894
2013	11.5900	11.6316	-.041571

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DECLARATION

I, the undersigned, declare that this Research project paper is my original work and has not been presented for a degree in any other university, and that all the sources of materials used for the Project have not been duly acknowledged.

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Date: _____