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THE NEXUSES BETWEEN TAX REVENUE, INFLATION, PRIVATE FINAL CONSUMPTION AND ECONOMIC GROWTH IN ETHIOPIA: CO-INTEGRATED VAR APPROACH

By

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ADDIS ABABA, ETHIOPIA

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This is to certify that the project prepared by Firehiywot Handamo, entitled: *the nexuses between tax revenue, inflation, private final consumption and economic growth in Ethiopia* 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.

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Abstract

The Nexuses between Tax Revenue, Inflation, Private Final Consumption and Economic Growth in Ethiopia: Co-integrated VAR approach

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The study aims at understanding the nexus between tax revenue, private final consumption, inflation and economic growth in Ethiopia. To achieve this objective co-integrated VAR approach was employed. The estimated models enable to understand the long run and short run relationship of the variables for the period 1970–2015 in Ethiopia. The study have the following major findings: First, Real GDP exert negative and significant effect on real tax revenue in the long run while the impact of the real private final consumption is positive and insignificant in the long run. Second, there is a strong evidence that inflation exert negative impact on real tax revenue.

Third, there is evidence of bi-directional causality between real tax revenue, inflation, real private final consumption and real GDP. Fifth, the impulse response function indicates that the variables are at fast movement towards long run time path. The overall findings of the study underlined given the long run negative impact of RGDP on real tax revenue, it will be natural to think of different reforms. Here, Inferences drawn will have implications for all stakeholders in the economy and are particularly useful for fiscal policy makers of the country.

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Acronyms

ADF: Augmented Dickey-Fuller

AIC: Akaiki Information Criteria

AR: Auto Regressive

CSA: Central statistical agency

GDP: Gross Domestic Product

HQ: Hannan-Quinn Information Criteria

INF: Inflation

I(0): Integrated of Order Zero

I(1): Integrated of Order one

IRF: Impulse Response Functions

JB: Jarque-Berra

LM: Lagrange Multiplier

LR: Likelihood Ratio test

MoFED: Ministry of Finance and Economic Development

NBE: National Bank of Ethiopia

OLS: Ordinary Least Square

PP: Phillips-Perron

R&D: Research and Development

RGDP: Real Gross Domestic Product

RPFC: Real Private Final Consumption

RTR: Real Tax Revenue

SIC: Schwarz (Bayesian) Information Criteria

VAR: Vector Auto regression

VDC: Variance Decompositions

VECM: Vector Error Correction Model

WB: World Bank

CHAPTER ONE

1. INTRODUCTION

1.1 Background to the Study

Economic growth is primary concern to policy makers in both developed and developing countries. It is the steady course of action through which the productive and fruitful capacity of an economy is improved in due course to produce increasing levels of national output and income (Todaro and Smith, 2005). Economic growth is commonly measured as the annual rate of increase in a country's gross domestic product.

The process of economic growth and the sources of differences in economic performance across nations are some of the most interesting, important and challenging areas in modern social science. The sources of economic growth is a question of great importance to many economists who are interested to know and search for factors enabling some countries to grow and develop while others are suffering from abject poverty (Tewodros, 2015). Different studies have addressed the issue of economic growth, mostly using either cross-country or panel data approach. In this case, most of these studies utilized the standard neo-classical growth model or its extended version that includes human capital.

Ethiopia has achieved sustained economic growth for a decade in spite of the fact that the country has non-oil exporting and non-mineral economy. Comparing Ethiopia's development experience especially in terms of structural transformation and competitiveness with that of selected Asian countries indicates differences which point to possible adjustments in Ethiopia's development approach. This note argues that for Ethiopia to continue sustaining robust growth, leveraging the transformation power of the private sector is essential (IMF 2014).

Taxation is central to development and provides governments with the funding they require to finance economic development and growth. In any countries, mobilization of resources constitutes a paramount aspect of achieving a higher level of economic growth. And, as a source of resource mobilization, the role of tax revenue is very significant in developing countries especially country like Ethiopia since its development strategy focused on promoting growth through high public investment. On the other hands raising domestic revenues is an important financial policy objective of the government of Ethiopia.

For many years the tax revenue failed to meet government expenditure demand in Ethiopia. This resulted in fiscal imbalance and instability in the economy. On the other side, the tax-to-GDP ratio is an economic measurement that compares the amount of taxes collected by a government to the amount of income that country receives for its products. In this regard, tax revenue to GDP ratio of Ethiopia is far behind Sub-Saharan average. The overall tax system is found to be inelastic. This indicates that an increase in national income or GDP has not been translated to an increase in the tax revenue. At the same time the gaps between domestic revenue and government expenditure have continued to worsen over the years. The main strategy to address this budget deficit is arguably enhancing the capacity of the economy to generate more revenue through increasing in tax base (Tegegn, 2008).

Inflation is one of the measures of macroeconomic performance indicator. In classical economics, it is known to be a general rise in prices measured against a standard level of purchasing power. There are many measures of inflation depending on the specific circumstances. The consumer price index (CPI) measures the percentage change through time in the cost of purchasing a constant basket of goods and service representing the average pattern of purchases made by a particular population group in a specific time period.

The conventional view in macroeconomics holds that permanent and predictable changes in the rate of inflation are neutral: in the long term, they do not affect real activity. However, a substantial body of evidence suggests that sustained high rates of inflation can have adverse consequences for real economic growth even in the long run. Moderate inflation is an inevitable consequence of sustained economic growth. It can enhance economic growth by mobilizing the resources of a country.

Though, Ethiopia has recorded sustaining economic growth, inflation in Ethiopia is beyond the break-even point. Instead of stimulating economic growth, inflationary pressure in Ethiopia seems to be on the verge of distorting the allocation of resources and is likely to be a deterrent to undertaking productive investments (Admasu, 2014).

Consumption is an important concept in terms of economy and many social sciences. The private final consumption expenditure is defined as the expenditure incurred on final consumption of goods and service by the resident households and non-profit institutions serving households. According to Ministry of Finance and Economic Development of Ethiopia (MoFED, 2014),

private final consumption expenditure is typically the largest constituent of final uses of GDP, representing more than 69% of GDP which has interesting implication in economic theory. It is therefore an essential variable for economic analysis of aggregate demand. In general, the main aim of this paper is to empirically analyze the nexus between tax revenue, inflation and private final consumption on Ethiopia's economic growth.

1.2 Statement of the Problem

Macroeconomics is concerned with the structure, performance and behaviour of the economy as a whole. The prime concern of macroeconomists is to analyze and attempt to understand the underlying determinants of the main aggregate trends in the economy with respect to GDP, unemployment, inflation and international transactions. In particular, macroeconomic analysis seeks to explain the cause and impact of short-run fluctuations in GDP, and the major determinants of the long-run path of GDP (Snowdon, 2005).

One of the key area in the economic literature is how major macroeconomic variables relate with each other. For instance, different dimensions of the effect of taxes and other variables on growth, private consumption and inflation; how growth affects tax revenues etc. are generally important areas of research in modern macroeconomics. On the other hands, like many countries, one of the most fundamental objectives of macroeconomic policies in Ethiopia is to sustain high economic growth together with low inflation. So the analysis of relationship between the tax revenue, inflation, private final consumption, and economic growth can contribute some ideas for policy makers of Ethiopia.

There has been considerable debate on the existence and nature of the inflation and growth relationship. The argument is that whether inflation is necessary for economic growth or it is detrimental to growth. According to Kanchan and Chandan, the rate of economic growth depends primarily on the rate of capital formation and the rate of capital formation depends on the rate of savings and investment. Therefore, whether inflation affects economic growth depends on whether it affects savings and investment (Kanchan & Chandan, 2011).

Though it is generally considered that inflation has undesirable consequences, it should not fall below certain level since disinflation negatively affect economic growth due to decreasing motivations of producers. For Ethiopia, the empirical evidence demonstrates that there exists a

statistically significant long-run negative relationship between inflation and economic growth. In addition, the estimated threshold model suggests 16 percent as the threshold level (i.e. structural breakpoint) of inflation above which inflation adversely affects economic growth (Yemane, 2008).

Different researchers have examined the optimal inflation rate in the presence of tax finance. Mankiw (1987), reports a striking positive correlation between tax burdens and inflation rates in the postwar United States, a finding consistent with the predictions of these optimizing government models. Models with and without commitment imply a positive relationship between the inflation rate and tax rates. In both cases, the marginal social cost of raising additional revenue with the inflation tax is an increasing function of the inflation rate. The marginal deadweight burden of tax finance also rises with the tax rate (James M. et al. 1989).

One of the generally discussed issues in the economic literature is how taxes relate to economic growth. Supporters of tax cuts affirm that a decrease in the tax rate will lead to increased economic growth and prosperity (Alesina & Ardagna, 2009). Contrasting argument suggests that lessening taxes accrue all the benefits for rich who should pay the largest share of taxes (Caroll et al. 1998). Theoretically, we can catalogue the different channels through which taxes might affect output growth. First, a higher taxes can depress the investment rate or the net growth in capital stock through high tax on corporate or individual income. Second, tax policy can also affect productivity growth by reducing/increasing research and development activities which potentially affect productivity of existing labour and capital. Third, taxes may reduce the work incentive which may reduce labour force participation and hour of work. Fourth, heavy taxation on labour supply distort the efficient use of human capital by discouraging worker from employment in sectors with high social productivity.

The investigation of the causal long-term relationship between tax revenue and nominal gross domestic product in Ethiopia revealed 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 (Demeke, 2013).

Many people believe that a rise in the tax rate will have a bad effect on aggregate consumption and will weaken economic growth. Similarly, a reduction in the tax rate is sometimes an argument for strengthening economic growth by stimulating aggregate consumption under a

recession. However, some people insist that the effect on aggregate consumption and economic growth is limited. Although there is a decline of aggregate consumption and economic growth after raising the tax rate, there is also an increase of aggregate consumption and economic growth before the raise that will offset the negative effect after the raise. Other economists say that people should not fear the negative effect of the tax rate because the decline is only temporary (Miki, 2011).

Economic growth is expected to move on the same direction as aggregate consumption because the aggregate consumption is a component of GDP. Concurrently, private final consumption is also components of the aggregate consumption so that expected to move like GDP. Taking into account the fact that the negative (or positive) income effect of the rise (or reduction) of the tax rate on the change of private consumption occurs only in the period just after the implementation of the rise (or reduction), the sign of the income effect is the same as the substitution effect. Since economic growth is affected both by the income effect and the substitution effect, its trend is still same.

In general, Ethiopia's development strategy has delivered strong results over the past decade; it has been facing significant challenges in recent years. A model-based analysis of the country's investment program indicates that, despite positive long-run growth effects, transition challenges and macroeconomic trade-offs are associated with different financing strategies. Heavy reliance on domestic bank borrowing may require substantial fiscal and macroeconomic adjustments as well as entail a sharp increase in inflation (IMF, 2014). Hence, an empirical investigation to determine the relationship between key macroeconomic variables is very essential so that this study employs a multivariate time series estimation approach to investigate the nexuses between tax revenue, inflation, private final consumption and economic growth.

1.3 Objective of the Study

The general objective of this study is to investigate the nexuses between tax revenue, inflation, private final consumption and economic growth in Ethiopia. In line with this general objective, the study have the following specific objectives:

- ♣ To investigate the effects of tax revenue, inflation and private final consumption on economic growth;

- ♣ To investigate the effects of tax revenue, inflation and economic growth on private final consumption;
- ♣ To investigate the effects of tax revenue, economic growth and private final consumption on inflation; and,
- ♣ To investigate the effects of economic growth, inflation and private final consumption on tax revenue.

1.4 Significance of the Study

Although a number of studies have been conducted on inflation nexus economic growth as well on tax nexus economic growth, to the best of my knowledge, there is no study on the nexuses between tax revenue, inflation, private final consumption and economic growth in Ethiopia. In this regards, analysis of the relationship among these variables is of interest from a policy and academic perspective. Thus, from a policy point of view, identifying the relationship among these variables is of paramount importance to economic growth since it provides comprehensive evidence for policy makers.

The other significant of the study is its incorporation of the most recent data and employs both qualitative analysis and advanced econometric technique to study the nexus between tax revenue, inflation, private final consumption and economic growth which helps to fill research gap on the area. Furthermore, it will also supposed to provide an explanation for the short run and long run interaction between the variables and this may help as empirical support for the other studies, in that it builds the previous literature further.

1.5 Scope and Limitations of the Study

This study will primarily investigate the nexuses between tax revenue, inflation, private final consumption and economic growth in Ethiopia a using annual data from 1970 to 2015.

While conducting the study, among others, getting of data on different variables for longer period of time can limit its accomplishment. The other thing is the issue of base year which generally understood to be the period with which other periods are compared and whose values provide the weights for a price index. As and when the exercise of base year revision takes place,

it is a general expectation from the user community and researchers to get the revised back series. This sometimes affects accuracy.

1.6 Data and Methodology

The data used in this study are obtained from different sources. Time-series data on GDP and private final consumption are collected from National Plan Commission and data on tax revenue is collected from Ministry of Finance and Economic Cooperation. The data for inflation (CPI, proxy for inflation) is collected from Central Statistical Agency. Both quantitative and qualitative methods of data analysis are used.

The study employed co-integrated vector autoregressive technique or vector error-correction analysis using time series data from 1970-2015. Once the model is fully identified, since all the variables are endogenous, orthogonalized impulse responses are estimated to trace out the effect of different shocks. To substantiate the result, the impulse responses are also estimated using recursive identification based on Cholesky decomposition.

CHAPTER TWO

2. REVIEW OF RELATED LITERATURE

Introduction

This chapter presents the relevant theoretical and empirical literature on the nexus between tax revenue, inflation, private final consumption and economic growth. The first section explores the theoretical framework of the study, the second section examines empirical literature of interest to the topic. In the theoretical literature, the links between the variables to be studied with basic theories have been addressed from perspective of different schools of thought in economics. These schools of thought are selected because of their applicability for investigating the nexus between those selected macroeconomic variables. These are the Classical theory of Economics, the Neoclassical Economic theory, the Keynesian, Monetarist, and Endogenous Growth Model. Finally, the review will be closed by drawing conclusions from both the theoretical and empirical literature. In the summary part, the research gap that was found and the contribution of this paper to the gap have been discussed.

2.1 Review of the Theoretical Literature

2.1.1 Classical Economic Theory

Analysis of the process of economic growth was a central feature of the work of the classical economists, Adam Smith, Thomas Malthus and David Ricardo. A key component of the classical model is the short-run production function. In general terms at the micro level, a production function expresses the maximum amount of output that a firm can produce from any given amounts of factor inputs. The more inputs of labour (L) and capital (K) that a firm uses, the greater will be the output produced (providing the inputs are used effectively). However, in the short run, the classical economists assumed that the only variable input is labour. The amount of capital input and the state of technology are taken as constant (Snowdon, 2005).

On the other hands, when we consider the economy as a whole the quantity of aggregate output (GDP=Y) will also depend on the amount of inputs used and how efficiently they are used. This relationship known as the short-run aggregate production function which can be written in the following form:

$$Y = A\mathrm{F}(\mathrm{K},\mathrm{L}) \quad \text{(2.1)}$$

Where

Y= real output per period,

K= the quantity of capital inputs used per period,

L= the quantity of labour inputs used per period,

A= an index of total factor productivity, and

F= a function which relates real output to the inputs of K and L.

The symbol 'A' represents an autonomous growth factor which captures the impact of improvements in technology and any other influences which raise the overall effectiveness of an economy's use of its factors of production.

The above short-run aggregate production function displays certain properties. Three points are worth noting. First, for given values of A and K there is a positive relationship between employment (L) and output (Y). Second, the production function exhibits diminishing returns to the variable input, labour. Third, the production function will shift upwards if the capital input is increased and/or there is an increase in the productivity of the inputs represented by an increase in the value of A (for example, a technological improvement).

The forces of diminishing returns and technological advancements determine the pace of economic growth. Capital accumulation, which itself is determined by the rate of profits, has two effects: it creates demand for labor and it fosters technological improvements by facilitating the division of labor. The population, which tends to grow rapidly, increases the demand for food. Food production is subject to diminishing returns. Thus, we have two forces working in opposite directions: technological advancements that promote growth and the eventuality of diminishing returns that retard growth. Thus, the long-term trend of the economy depends on the relative strength of these two forces (cited in Alemnesh, 2012). In this regards, counties that experience technological advancement usually go through steady state growth.

The classical theory of inflation explains how the aggregate price level gets determined through the interaction between money supply and money demand. As a matter of fact, because it traces

the behavior of an important economy-wide variable, inflation, back to the most basic forces of supply and demand, the classical theory must qualify as one of the oldest "micro-founded" models in all of macroeconomics.

The classical theory of inflation attributes sustained price inflation to excessive growth in the quantity of money in circulation. The link between the change in overall price levels (inflation), and its "tax" effects on profit levels and output were not specifically articulated in classical growth theories. But, their relationship is expected to be negative as a result of higher wage costs, the firms profit levels will be reduced (Ireland, 2014).

Adam Smith (1776), argues that one's income, a function of one's ability, is a measure of one's benefit from the state. Because he supports benefit based taxation more generally, Smith believes ability is therefore an appropriate basis for taxation. Simply put, Smith endorses benefit-as-ability based taxation. Richard Musgrave (1959) labeled this logic the "classical" view of benefit based taxation (Weinzierl, 2014). This classical view of benefit based taxation was highly influential in the late 18th and early 19^{th} centuries.

Classical economics concern with consumption was peripheral with respect to concern with production and the formation and growth of surplus. The development of classical economic thought in 18^{th} century, Adam Smith in his "An inquiry of the Nature and Cause of Wealth of Nations", declared that consumption was the sole end and purpose of production. Despite the foundational place occupied by consumption, he didn't develop a comprehensive economic theory of consumption.

2.1.2 Neo-classical Economic Theory

The starting point for any study of economic growth is the neoclassical growth model, which emphasizes the role of capital accumulation. This model, first constructed by Solow (1956) and Swan (1956), shows how economic policy can raise an economy's growth rate by inducing people to save more. But the model also predicts that such an increase in growth cannot last indefinitely. In the long run, the country's growth rate will revert to the rate of technological progress, which neoclassical theory takes as being independent of economic forces, or exogenous (Aghion and Peter 2009). These exogenous neoclassical growth models were extended in the late 1980s and early 1990s to endogenous growth models.

The Solow-Swan growth model developed in 1956 is one of the most influential models that has shaped much of modern thinking on the process of economic growth and marks the starting point of conventional economic growth theorization. The model shares some assumptions with the classical growth model such as the law of diminishing returns to scale in the short run and the existence of constant returns to scale in the long run. Additional assumptions include exogenously determined technical progress and substitutability between capital and labor (cited in Alemnesh, 2012).

One simple production function that is often thought to provide a reasonable description of actual economies is the Cobb–Douglas function. The Solow-type model can be depicted by a simple Cobb–Douglas aggregate production function as:

$$Y = (AL)^{1-\alpha}K^{\alpha} \quad \text{(2.2)}$$

Where, A>0 is the level of the technology and α is a constant with 0<α <1.

L is labor force,

K is capital,

AL is the effective labor force

This way of writing the production function makes technological progress equivalent to an increase in the "effective" supply of labor AL, which grows not at the rate of population growth n, but at the rate of growth of population plus the growth rate of productivity, n + g.

A steady state in terms of capital per efficiency unit is given by:

$$k = \frac{\mathrm{K}}{\mathrm{AL}}$$

The rate at which new saving raises k is the rate of saving per efficiency unit sk^{α}. The rate at which depreciation causes k to fall is the amount of depreciation per person δk. In addition growth in the number of efficiency units, at the rate n + g, causes k to fall at the annual rate (n + g) κ. The net rate of increase in k is the resultant of these three forces:

$$\dot{k} = sk^{\alpha} - (\mathrm{n} + \mathrm{g} + \delta)\, k \quad \text{(2.3)}$$

The proposed equation above depicts that the growth of the capital per effective labour ratio k, and shows that the growth of k depends on savings sk^{α}, depreciation δκ and the new workers joining the labour force n.

The growth rate of output per person does not fall to zero because as capital accumulates, the tendency for the output/capital ratio to fall because of diminishing returns to capital is continually offset by technological progress. The economy approaches a steady state in which the two conflicting forces of diminishing returns and technological progress exactly offset each other and the output/capital ratio is constant. Although the height of the steady-state growth path will be determined by such parameters as the saving rate s, the depreciation rate δ, and the rate of population growth n, the only parameter affecting the growth rate is the exogenous rate of technological progress g (Aghion & Howitt, 2009).

The above analysis suggests that economic growth can occur when savings and capital levels increase, but that, Solow asserted this will only be a short-run improvement and therefore argued that technological progress is the major determinant of long run growth.

Mundell (1963) was one of the first to articulate a mechanism relating inflation and output growth separate from the excess demand for commodities. According to Mundell's model, inflation expectations immediately reduce people's wealth. This works on the premise that the rate of return on individual's real money balances falls. To accumulate the desired wealth, people save more by switching to assets, increasing their price, thus driving down the real interest rate. Greater savings means greater capital accumulation and thus faster output growth (Admasu, 2014). The Tobin effect suggests that inflation causes individuals to substitute money for interest earning assets, which leads to greater capital intensity and promotes economic growth. In effect, inflation exhibits a positive relationship with economic growth.

Stockman (1981) developed a model that shows the relationship between inflation rate and steady state level of output. Accordingly, he has shown that there is a negative relationship between the rate of inflation and the steady state level of output as well as peoples' welfare. Stockman's insight is prompted by the fact that firms put up some cash in financing their investment projects. Sometimes the cash is directly part of the financing package, whereas other times, banks require compensating balances. Stockman models this cash investment as a cash-in-advance restriction on both consumption and capital purchases. Since inflation erodes the

purchasing power of money balances, people reduce their purchases of both cash goods and capital when the inflation rate rises. Correspondingly, the steady-state level of output falls in response to an increase in the inflation rate (Admasu, 2014). Thus, the neoclassical framework can yield very different results with regard to inflation and growth. An increase in inflation can result in higher output (Tobin Effect) or lower output (Stockman Effect).

2.1.3 Endogenous Growth Models

In the mid-1980s it became increasingly clear that the standard neoclassical growth model was theoretically unsatisfactory as a tool to explore the determinants of long-run growth. The model without technological change predicts that the economy will eventually converge to a steady state with zero per capita growth. The fundamental reason is the diminishing returns to capital (Barro & Martin, 2004). The endogenous growth models developed by Lucas-Romer challenged the old neoclassical model by emphasizing the role of endogenous factors. To model the accumulation of knowledge, we need to introduce a separate sector of the economy where new ideas are developed. We then need to model both how resources are divided between the sectors where conventional output is produced and this new research and development (R&D) sector, and how inputs into R&D produce new ideas (Romer, 2012). The early neoclassical models assumed total factor productivity growth (or technical progress) as exogenously given, the newer endogenous growth models, however attributed this component of growth to the "learning by doing" effect that occurs between physical and human capital, which results in increasing returns to scale in production technology.

Neoclassical Economists are generally assuming that the production function $F(K, L, A)$ exhibits constant returns to scale in capital and labor (K & L). However, Romer argues that endogenizing 'A' naturally leads to increasing returns to scale to all three inputs, K, L, and A (Acemgelu, 2009). Making the assumption of increasing returns to scale provides a possible path to long-run sustained growth in endogenous growth theories. These endogenous economic growth theories emphasize that opening investment opportunities under a liberalized market friendly economy results in high economic growth.

Endogenous growth economists believe that improvements in productivity can be linked to a faster pace of innovation and extra investment in human capital. The endogenous growth literature has produced two distinct approaches on how to incorporate human capital into models

of economic growth. The first, which is due to Lucas, regards the accumulation of human capital as the engine of growth. The second approach emphasizes the role of the human capital stock in the process of innovation and adoption of new technologies. In the model formulated by Lucas, human capital enters into the production function similarly to the way in which technology does in the Solow model, that is, in labour-augmenting form (Acemgelu, 2009).

Lucas proposes the following production technology:

$$Y_t = AK_t^{\beta}(u_t h_t L_t)^{1-\beta}$$

where Y, A, K and L are output, technology, capital and labour, while u is the fraction of an individual's time allocated to work, h is the skill level or human capital of the representative agent, and h_t is the average human capital in the economy. The level of technology, A, is assumed to be constant.

The endogenous growth model enables countries to continue to grow quickly for long periods of time, even when they have already achieved relatively high income without an increase in the theory of per capita income between poor and rich countries by disregarding the implicit assumptions of the neoclassical growth model. In other words, the endogenous growth model broke the link between the rate of economic growth and the law of diminishing returns and removed the maximum limit on income per person for any particular rate of savings and investment.

In endogenous growth theory, the economic growth rate depends on the return to capital. A variable such as inflation reduces returns to capital which on the other hand reduces accumulation of capital and hence reduces economic growth. Inflation tax reduces income from both physical capital and human capital and this reduces economic growth. According to this growth theory, a tax on capital income directly reduces the growth rate, while a tax on human capital would cause labour to leisure substitution that lowers the rate of return on human capital and can also lower the growth rate.

According to Mashkoor et al (2010), tax policy can discourage productivity growth by reducing research and development and if there would be any subsidy it will boost the research activities whose spillover effects can potentially enhance the productivity of existing labour and capital. Thus, endogenous theory by Romer emphasizes factor such as 'spillover' effect and 'learning by

doing' by which firms' specific decision to invest in capital and R&D, or individual investment in human capital can yield positive external effect that benefit the rest of the economy consequently government tax policy can have long-run permanent growth effect.

Easterly and Fischer (2001) have shown that inflation damages the well-being of the poorest groups. They tried to associate higher inflation and macroeconomic instability with less rapid growth of average income and lower equality. Finally, they conclude that a low inflation economic environment is likely to result in higher income for poor overtime due to its favorable effects on long run growth of which is adversely affected by high and variable inflation.

2.1.4 The Keynesian Economic theory

According to the Keynesian theory of growth, demand from consumer and state were the prerequisite for economic growth. This assumption means that changes in income, especially disposable income, is the primary factor that influences consumption expenditures. If the household sector has more income because of the economy is expanding, then they increase consumption expenditures. If the household sector has less income because the economy is contracting and a large group of workers is unemployed, then they decrease consumption expenditures (Tewodros, 2015).

The Keynesian model consists of overall demand and supply curves. This relationship is appropriately shows the relationship between inflation and growth. Since Keynesian theory focus on short-run phenomena, the aggregate supply is upward sloping unlike the classical economists who assume that aggregate supply is vertical. If the aggregate supply were in the way classical economists assume, only prices were affected. But if aggregate supply were in the way Keynesians assumes, both output and prices will be affected. So, according to Keynesian theory, factors that affect inflation can affect output in the short-run (cited in Feyera, 2015). In Keynesian theory, the upward sloping curve shows that the increase in demand due to government intervention not only increases inflation but also output. Hence, there is positive relationship between inflation and economic growth in Keynesian theory.

The consumption decision is crucial for long-run analysis because of its role in economic growth and crucial for short-run analysis because of its role in determining aggregate demand in Keynesian theory (Mankiw, 2001). During 1930s, Keynes made conjectures about the

consumption function based on introspection and casual observation. These are, first the marginal propensity to consume, the amount consumed out of an additional dollar of income, is between zero and one. Second, the ratio of consumption to income, called the average propensity to consume, falls as income rises. Third, income is the primary determinant of consumption and that the interest rate does not have an important role (Snowdon, 2005).

On the basis of these three conjectures, the Keynesian consumption function is often written as

$C = a + cY$, $\quad C > 0, 0 < c < 1,$

Where C is consumption, Y is disposable income, 'a' is a constant, and c is the marginal propensity to consume.

Notice that this consumption function exhibits the three properties that Keynes posited. It satisfies Keynes's first property because the marginal propensity to consume c is between zero and one, so that higher income leads to higher consumption and also to higher saving. This consumption function satisfies Keynes's second property because the average propensity to consume APC is

$$\text{APC} = \frac{C}{Y} = \frac{a}{Y} + c$$

As Y rises, a/Y falls, and so the average propensity to consume C/Y falls. And finally, this consumption function satisfies Keynes's third property because the interest rate is not included in this equation as a determinant of consumption.

In Keynesian model, current real income is the primary determinant of consumption and the relationship between income and consumption is determined by Absolute Income Hypothesis. According to Keynes interest rate, as one of the explanatory variables of consumption, has no effect on consumption decisions due to the reason that income and substitution effect of interest rate eliminate each other. In absolute income hypothesis, consumers take their decisions by taking into account the current disposable income and consumption is an increasing function of the real disposable income. As the disposable income increases, so will the consumption expenditures, but it will lead to a decreasing proportion of income (Keynes, 1936).

The Traditional Keynesian model comprises of the Aggregate Demand (AD) and Aggregate Supply (AS) curves, which appropriately illustrates the inflation-growth relationship. According

to this model, in the short run, the (AS) curve is upward sloping rather than vertical, which is its critical feature. If the AS curve is vertical, changes on the demand side of the economy affect only prices. However, if it is upward sloping, changes in AD affect prices and output (Cited in Admasu, 2014). For this reason, many factors drive the inflation rate and the level of output in the short-run.

Following the publication of Keynes's General Theory in 1936, some economists sought to incorporate dynamism on Keynes's static short-run theory in order to investigate the long-run dynamics of capitalist market economies. In the period 1939-56 growth theory was dominated by the neo-Keynesian contributions of Roy Harrod and Evsey Domar. They were developing the growth model independently that relate an economy's rate of growth to its capital stock. However, the assumptions and results are, basically the same. While Keynes emphasized the impact of investment on aggregate demand, Harrod and Domar emphasized how investment spending also increased an economy's productive capacity (Snowdon, 2005). A major strength of the Harrod-Domar model is its simplicity. The model assumes an exogenous rate of labour force growth, a given technology exhibiting fixed factor proportions (constant capital labour ratio) and a fixed capital-output ratio.

2.1.5 The Monetarists

Economists like Milton Friedman assumed that the interest sensitivity of investment is very high so that the IS curve is very flat. Consequently, fiscal policy leads to strong crowding out of private investment. Furthermore, the monetarists, like the classical economists, had strong sympathy for the quantity theory of money which implies a steep or vertical LM curve. In contrasts to the classical economists, Friedman does not accept the rational expectation hypothesis. Instead, he adopted the adaptive expectation hypothesis. Therefore, according to monetarist fiscal policy is unable to influence employment and output. This is why the monetarists were so vehemently against the Keynesians who believed in pump priming the economy in recessions (Heidjira, 2009).

Monetarism has several essential features, with its focus on the long-run supply-side properties of the economy. Friedman coined the term "Monetarism", with Quantity Theory of Money and the Neutrality of Money. The Quantity Theory of Money linked inflation and economic growth by simply equating the total amount of spending in the economy to the total amount of money in

existence. Friedman proposed that inflation was the product of an increase in the supply or velocity of money at a rate greater than the rate of growth in the economy.

According to Friedman, individuals anticipate the rate of future inflation and incorporate its effects into their behavior so that employment and output is not affected. Neutrality holds if the equilibrium values of real variables including the level of GDP are independent of the level of the money supply in the long-run. Super neutrality holds when real variables including the rate of growth of GDP are independent of the rate of growth in the money supply in the long-run. If inflation worked this way, then it would be harmless. In reality however, inflation does have real consequences for other macroeconomic variables. Through its impact on capital accumulation, investment and exports, inflation can adversely impact a country's growth rate (Admasu, 2014).

According to Gokal and Hnif (2004), the idea of the monetarist is that inflation is prejudicial to economic growth in the long-run even though it has positive impact in the short run. Inflation leads to distortions in the allocation of resources. In an inflationary setting there is a tendency for saving to be put into unproductive investments like accumulation of inventories, real estate or house building. All these are assets that best protect the saver against price increases or these techniques hedges against inflation attacks.

Milton Friedman theory of the consumer argue that consumption should not depend on current income alone. But unlike the life-cycle hypothesis, which emphasizes that income follows a regular pattern over a person's lifetime, the permanent-income hypothesis emphasizes that people experience random and temporary changes in their incomes from year to year.

Friedman (1957) showed that current income Y as the sum of two components, permanent income Y^P and transitory income Y^T i.e.

$$Y = Y^P + Y^T$$

Permanent income is the part of income that people expect to persist into the future while transitory income is the part of income that people do not expect to persist.

In summary, a wide range of studies have investigated the nexus between key macroeconomic variables. Using different conceptual and methodological viewpoints, these studies have placed emphasis on a different set of explanatory variables and offered various insights to the sources of

economic growth. There is controversy among theorists especially about the link between inflation, income and tax revenue. Classical economists and monetarists propound that there is negative relationship between inflation and economic growth or per capita output. Keynesians hypothesize that there is positive relationship between inflation rate and per capita output. Neo-classical ideas about the relationship between inflation and economic growth are mixed. For instance, according to Mundell (1963) and Tobin (1965), there is positive relationship between inflation and economic growth, whereas Sidrauski (1967) stated neutrality of inflation on output. Endogenous growth theory by Romer-Lucas stated the existence of the negative relationship between inflation and capital accumulation.

The disagreement among theorists about the relationship between inflation, economic growth, tax revenue etc. may be due to the cross countries growth and development level and heterogeneity problems that may cause difference in hypothesis.

2.2 Empirical literature

This sub-section examines related empirical studies on the relationship between inflation and economic growth, tax revenue and economic growth, private final consumption and economic growth, tax revenue and consumption etc. with particular interest on data used, methodology adopted and nature of the relationship.

2.2.1 The Relationship between Inflation and Economic Growth

The relationship between inflation and economic growth is one of the most important macroeconomic controversies among the macro economists, policy makers and central monetary authorities of all the nations. Specifically the bone of contention is that whether inflation is necessary for economic growth or it is detrimental to growth. In this regards, there is much less agreement about the precise relationship between inflation and economic performance, and the mechanism by which inflation affects economic activities.

Some economists hold that the view that inflation is conducive to economic growth and there is positive relationship between inflation and economic growth. According to their logic, during the period of inflation there is a time lag between the rise in output prices and the rise in input prices, particularly the wage rate that is known as wage-lag. When the wage lag persists over a long-period of time, it enhances the profit margin. The enhanced profits provide incentive and

investment funds to the firms. This can result in an increase in investment, production capacity and a higher level of output. Beside to these, inflation tends to redistribute incomes in favour of higher income groups whose incomes consist mostly of profits and non-wage incomes. This kind of inflation induced redistribution of incomes increases total savings, since upper income classes have a higher propensity to save. The increase in saving increases the supply of investible funds and lowers the interest rate which stimulates investment as well as economic growth (Datta & Kumar, 2011).

On the other side, the Monetarists claim that inflation inhibits growth. It can lead to uncertainty about the future profitability of investment projects. This problem becomes highly pronounced when high inflation is associated with increased price variability which leads to more conservative investment strategies eventually resulting in lower levels of investment and economic growth (Yemane, 2008). Inflation can reduce a country's international competitiveness by making its exports relatively more expensive thus impacting on the balance of payment. There is a term in economic literature that is stagflation, which is an empirical phenomenon. It is a situation of rising inflation with falling or stable output. So the positive relationship is not the only case in practice.

In particular, the best and most convincing evidence in support of the classical theory is presented in famous studies like Sargent's (1982), which focus on the hyperinflationary episodes that have occurred in various places in various times throughout world economic history. In each and every one of these episodes, where inflation rates in excess of 100 percent per year can be observed, these high rates of inflation are inevitably accompanied by equally high rates of growth in the money supply. And in each and every one of these episodes, the hyperinflation is seen to stop as soon as the central bank takes decisive action to restrain the monetary expansion. Thus, these episodes come close to being controlled, laboratory experiments in which the independent variable, money growth, is deliberately manipulated holding all else constant and the dependent variable, inflation, changes in accordance with the predictions of theory.

Andres and Hernando in an NBER working paper entitled "Does Inflation Harm Economic Growth?" analyze the correlation between inflation and growth in OCED countries during the 1960-1992 period and found that even low or moderate inflation rates have a temporary negative impact on growth rates leading to significant and permanent reductions in per capita income. The

estimated benefit of a permanent reduction in the inflation rate by a percentage point is an increase in the steady state level of per capita income that ranges from 0.5 to 2 percent (Andres & Hernando, 1999).

The other study which was conducted by Robert Barro (1997) on the impact of inflation on real gross domestic product (GDP) using the macro-panel study of about 100 countries over three decades. The result reveals that inflation rates above 15 percent were definitely harmful for real growth. However, for countries and periods with average inflation rates below 15 percent, he could not detect any significant effect of inflation on real GDP. Beside this, other country-panel studies conducted, for example, by Levine and Renelt, 1992; Sarel (1996), Sala-i-Martin1997 found similar result. The results show that there is no statistically reliable effect of inflation in real GDP in periods of low to moderate inflation (Yemane, 2008).

Yemane (2008) examined inflation and growth in Ethiopia using annual time series data for the periods 1971-2006. The results of the estimated equation revealed that at low inflation levels that is below 16 percent, there is a statistically insignificant negative relationship between the level of inflation and economic growth (at 5% level of significance). The threshold level of inflation is derived at 16 percent level which maximizes the value of R^2. Inflation rates below this level have an insignificant negative effect on economic growth (at 5% level). Finally, inflation rates about 16% hamper economic growth rather than enhancing it. Hence, the empirical results suggest that high inflation rate above 16% could negatively affect economic growth and its performance implying that inflation should be kept in control. However, Yemane (2008) affirm that the results in his study are not robust and should be interpreted with care. The lack of robustness could be attributed to the methodology used, which is linear estimation technique in his case and he suggested for further research needs to be conducted in the topic. In this regard, many research suggest that non-linear model could best perform than linear one to estimate the relationship between inflation and growth.

The other study conducted by Admasu (2014) also found some evidence that inflation has a threshold effect on economic growth. Estimated threshold model indicate that there is non-linear relationship between economic growth and inflation in the Ethiopian economy and the threshold level of inflation for GDP growth is 10 percent.

2.2.2 The relationship between Tax Revenue and Economic Growth

One of the largely discussed issues in the economic literature is how taxes relate to economic growth. Supporters of tax cuts affirm that a decrease in the tax rate will lead to increased economic growth and prosperity. Contrasting argument suggests that lessening taxes accrue all the benefits for rich who should pay the most taxes. According to Easterly and Rebelo, most growth model predict that tax on investment and income has detrimental effect on growth. This tax affect the role of growth through a simple, direct, channel: they reduce the private return to accumulation which in turn reduce the growth rate (Easterly and Rebelo, 1993).

According to tax cut supporters, as taxes increased, (i) productivity declines because people opt to work less; (ii) people evade taxes and become less productive. So, the lower the tax rate, the higher the value of all the goods and services produced; and (iii) it is also observed that government tax revenue does not increase as the tax rate increases (Caroll et al., 1998). Many economists would agree with the proposition that high taxes are bad for economic growth and use the tax multiplier to analyze this negative correlation frequently. The supply-side economists believe that high marginal tax rate reduces the level of economic activity and the rate of economic growth, thus supporting strongly the point of view to decrease the marginal tax rate. The economic growth theory also supports the tax revenue will reduce the level of path of production and the economic growth rate in the economic restructuring.

Economic theory has underlined the negative impact which taxes have on economic growth, as a result of the fact that taxation increases the cost of products or decreases consumer income. However, until the 1980s there was relatively little empirical research focused on the relationship between taxation level and economic growth. In recent years, such studies have begun to emerge at the same time that the methods of analysis have become more diverse and accurate. Most of the studies testing empirically the relationship between taxation and economic growth have found a negative impact of the aggregate tax rate on economic growth, but there are some articles that do not find such results.

A pioneer study which was conducted by Robert Solow implies that taxes do not affect the steady-state growth. In other word, tax policy though distortionary, yet has no impact on long-term economic growth rate and total factor productivity. On the other side, endogenous growth theory emphasis factors such as ‘spillover’ effect and ‘learning by doing’ by which firms specific

decision to invest in capital and R&D or individual investment in human capital, can yield positive external effect that benefit the rest of the economy, thus, tax policy can have long-run permanent growth effect (Mashkoor et al., 2010).

Karras and Furceri (2009), using a panel methodology that analyzes annual data from 1965 to 2003 for 26 OECD economies, find that higher taxes do indeed result in a reduction of GDP per capita that is sizable and persistent. While the exact size of the effect depends on how the "tax shock" is measured, the estimates of the authors suggest that an increase in the total tax rate by 1% of GDP will have a long-run effect on GDP per capita of -0.5% to -1.2%.

An important contribution to the relevant literature is made by Padovano and Galli (2002) who based on a panel of 25 industrialized countries from 1970 to 1998, have shown that effective marginal tax rates and tax progressivity have a negative influence on economic growth. The study demonstrates that an increase of 10 percent in marginal tax rates leads to a decrease in the annual rate of economic growth by 0.23 percent.

Other studies that took the average tax rate into account highlight the impact of taxation on economic growth. In an article about models of growth, Ireland (1994) underlines that there are studies which suggest that average tax rates are significantly and negatively related to growth in real income per capita (such as Cebula and Scott (1992), Marsden (1983), Skinner (1987), Martin and Fardmanesh (1990), Engen and Skinner (1992)), as well as studies that suggest that tax rates do not have important growth effects (such as Garrison and Lee (1992), Koester and Kormendi (1989), Easterly and Rebelo (1993)). Most of these studies are based on cross-section regression or time-series regression. The majority of studies that take into account average tax rate have found that higher taxes are strongly correlated with reduced economic growth.

Generally, the effects of tax on economic growth and on related activity such as entrepreneurship and employment have proven to be both persistent and controversial issues in academic and policy circles. Governments do change the tax rate to enhance the economic efficiency to promote economic growth. The effectiveness of tax structure depends majorly on the assignment of appropriate expenditures to different sectors, the appropriate tax rate to generate revenues and the efficient design of a system of transfers.

2.2.3 The Relationship between Tax Revenue and inflation

A government can satisfy its budget constraint either by printing money or by levying taxes. Each method of finance has efficiency costs. Higher inflation rates may adversely affect the economy's transaction mechanism and lead to inefficiencies in contracting. Higher taxes may distort labor supply, saving, and investment decisions. Numerous authors have examined the optimal inflation rate in the presence of tax finance, describing the behavior of governments concerned only with minimizing the deadweight burden of raising given revenue, whether these prescriptions are consistent with actual government behavior is an unresolved and relatively unstudied issue. Mankiw (1987) reports a striking positive correlation between tax burdens and inflation rates in the postwar United States, a finding consistent with the predictions of these optimizing government models.

A large literature on the effects of inflation on taxation emerged in the 1970s and early 1980s when inflation was high. However, the topic has received much less attention since the widespread decline of inflation rates in the mid-1980s. It is largely still true that the effect of inflation on the progressivity of the income tax system is important and noteworthy, but usually overlooked (Bailey, 1976).

An empirical work by James et al revealed that the marginal social cost of raising additional revenue with the inflation tax is an increasing function of the inflation rate. The marginal deadweight burden of tax finance also rises with the tax rate. An optimizing government which equates the marginal social costs of obtaining revenue from inflation and taxation will therefore raise both the inflation rate and tax rates in response to higher revenue demands (James & Julio, 1989). Moreover, inflation can interact with the tax system to distort borrowing and lending decisions.

Inflation can alter the characteristics of tax and contribution systems in numerous ways; Immervoll, H. in 2000, showed in his research that if the tax values are computed in a nominal fractional change, inflation will lead to increasing effective tax rates. A tax base is not affected by inflation if the tax is a fraction of a transaction's value at the time of the transaction. For changing general price levels, the tax changes in line with the nominal value of the underlying transaction. Thus, the real value of the tax liability remains unchanged. However, Robert C. et al

(2006) concluded that the effect of taxes on economic behavior is based on behavioral response of tax payers, economic efficiency and short-run macroeconomic consequences of tax changes on aggregate demand and employment.

According to James M. et al (1989) estimation made using annual data for five countries: the United States, Britain, France, Germany, and Japan confirmed that the tax rate is positively correlated with the inflation rate for all of the sample periods, but the strength of this correlation is strongest for the post-World War II period. For the entire 1891-1986 period, a ten percentage point increase in the share of taxes in GNP predicts a one half of one percentage point increase in the inflation rate. The tax rate and trend, however, explain less than six percent of the variation in inflation rates. The estimates in the AR(1) with trend and the differenced equations are similar, with slightly larger effects of the tax rate on inflation.

For the period since 1919 but excluding World War II, the coefficient estimates are close to those for the full sample, although the null hypothesis of no tax effect on inflation cannot be rejected at standard levels. This conclusion is reversed when the sample is restricted to the post-war-period II. A ten percent of GNP increase in taxes now raises the inflation rate by approximately 3.4 percent, and the impact coefficient is estimated much more precisely than for the longer sample periods. A ten percentage point rise in the marginal tax rate raises the inflation rate by just under two percentage points (James M. et al 1989).

The failure to find a positive association between tax rates and inflation might be due to an incorrect specification. The view that governments use both taxes and inflation to raise revenue while attempting to minimize total deadweight loss cannot explain the finding that higher taxes are just as often associated with lower as with higher inflation. The positive association between inflation and tax rates in U.S. using time series data which has been cited as support for the optimizing government model of monetary and fiscal policy does not recur in other nations.

According to Feldstein et al (1983) and others who view the effects of inflation on tax burdens is largely accidental and unanticipated. Even when tax rules are costly to change, however, policy makers could implement the links between taxes and inflation. An unindexed tax system which raises corporate tax burdens during inflationary periods because depreciation is based on historic cost, for example, generates a positive association between tax rates and inflation.

2.2.4 The relationship between Tax Revenue, Consumption and Economic Growth

The Private Final Consumption Expenditure (PFCE) is defined as the expenditure incurred on final consumption of goods and services by the resident households and non-profit institutions serving households. In macroeconomic theory, aggregate demand is considered as aggregate planned expenditure and actual expenditure is equal to output. During a business cycle, output fluctuates around its natural level. The key issue is the reciprocal relationship between output and expenditure. According to Keynesian model, planned real expenditure depends on real income and government expenditures positively on real interest rate and taxes negatively (Romer, 2012).

For OECD countries for instance, the household final consumption expenditure is typically the largest constituent of final uses of GDP, representing in general around 60% of GDP (OECD, 2009). According to Ministry of Finance and Economic Development of Ethiopia, private final consumption expenditure constituent more than 69% of final uses of GDP, which has interesting implication in economic theory (MoFED, 2014).

Most economists believe that consumer spending decisions follow the broad criteria set out in the life cycle and permanent income theories too closely related hypotheses that are treated as a single theory. This theory holds that consumers wish to maintain a smooth flow, or "growth path," of spending over their lifetimes. Thus, consumers will be reluctant to increase or reduce spending in response to a change in income unless they believe that the income change will persist. The shorthand formulation of this idea is that spending responds to changes in "permanent" income. Applying this theory to tax changes, we conclude that consumers will be more likely to alter their spending behavior if they perceive a tax change to be lasting. For instance, a reduction in income tax rates or increase in personal exemptions that is placed permanently in the tax code should have a larger effect on consumer spending than a temporary rate reduction or increase in exemptions (Steindel, 2001).

Another component of the theory that bears on tax changes and spending is the premise that consumers are forward looking. This premise suggests that consumers not only distinguish permanent from temporary changes in taxes, but also anticipate the impact of a tax change on their incomes even before it takes effect. Thus, consumers might begin to adjust their spending immediately after a tax change is passed into law. Indeed, if consumers do take the long view,

then changes in the legal structure of tax liabilities should influence their spending decisions more than changes in the timing of tax payments. After all, one would expect a shift in the structure of annual liabilities to have a greater effect on permanent after tax income than a revision in withholding schedules or a change in requirements for quarterly non-withheld tax payments.

Generally, a simple way to observe the impact of tax changes on spending is to look at the behavior of the personal saving rate around the time a tax change becomes effective. On the other hands, goods that are levied with high tax can result to a lower demand for that good.

Consumption is basic economic activity that individuals encounter in their everyday lives. Economists have found it very exciting to identify whether consumption expenditure is a result of economic activity or consumption expenditure drives the economic growth being an essential component in the national income identity across the globe. The relationship between consumption expenditure and economic growth has occupied a great deal of interest among the policymakers and economists in macroeconomic research.

Researchers take different positions on relationship between consumption expenditure and economic growth according to their empirical findings and theoretical motivations. On one side, there are Keynesian economists who consider consumption expenditure as a dependable function of income and on the other side there are substantial numbers of economists who believe that higher consumption can stimulate economic growth. Other economists take positions based on their criticisms on these two views (Sakib, 2011).

Economic growth is expected to move on the same direction as aggregate consumption because the aggregate consumption is a component of GDP. Concurrently, private final consumption is also components of the aggregate consumption so that expected to move like GDP. Taking into account the fact that the negative (or positive) income effect of the rise (or reduction) of the tax rate on the change of private consumption occurs only in the period just after the implementation of the rise (or reduction), the sign of the income effect is the same as the substitution effect. Since economic growth is affected both by the income effect and the substitution effect, its trend is still same.

The first objection to Keynesian Theory came from Kuznets (1952), who analyzed the long-run relationship between consumption and income in US and he found contradictory results with Keynes. According to the results of his study, consumption does not decline as income increases. These findings revealed the existence of short run and long-run consumption functions. In the short-run, Keynesian consumption function gives accurate results but in the long run consumption function has a constant average propensity to consume (Mankiw, 2010). During the period of a business cycle or in the short-run, because of the fluctuations in income, marginal propensity to consume is smaller than average propensity to consume as Keynes indicated. But in the long run average propensity to consume is constant and equals to marginal propensity to consume. Economists have attempted to explain how these two different consumption function to be compatible each other (Mankiw, 2010).

Alimi R. Santos (2013), investigates the relationship between consumption expenditure and income according to Keynes' Absolute Income Hypothesis (AIH) in Nigeria. The model was tested by ordinary least squares for the period of 1970-2011. In the study MPC and APC were estimated both in the short and long-run. Results show that as income increases, the average propensity to consume is reduced as Keynes indicated. But in the long-run although MPC is less than one; it is not stable.

Mishra, P.K. (2011), investigated the relationship between real consumption expenditure and economic growth in India with the co-integration test and the vector error correction regression for the years of 1950-51 to 2008-09. Results indicate that there is long-run equilibrium relationship among variables. According to the results of causality test in the error correction model, it has been found that there is unidirectional causal relationship from real private consumption expenditure to economic growth in the long-run. But in the short-run applied Granger causality test indicated that there is no causality between them.

Sakib-Bin-Amin (2011), investigated the causal relationship between consumption expenditure and economic growth in Bangladesh using annual data from1976-2009. The method used in the study is Johansen and ARDL co-integration tests. The results put forth that there is co-integration between consumption expenditure and economic growth in the long-run. Granger causality test used in the study revealed along run unidirectional causal relationship running from economic growth to consumption expenditure.

To summarize, the theoretical and empirical evidence about the causal relation between tax revenue, inflation, private final consumption and economic growth are mixed and sometime uncertain. Some studies found that one variable exerts negative impact on the other one while the other study found the same variable exerts positive impact on that variable. The causality between the variables is different for different studies and there is wide disagreement among different economists. This might be because of the existence of difference among countries in policy issues, political stabilities, and growth or development levels. The other reason for mixed result is might be the kind of data used, methodology and procedural errors. Therefore, this study is focus on analysis of the short run and long run relationship between the variables in Ethiopia using co-integrated VAR/VECM approach.

CHAPTER THREE

3. MODEL SPECIFICATION, VARIABLE DEFINITION AND ESTIMATION TECHNIQUE

The empirical framework of this study consists of four models. The first model tests the effects of tax revenue, inflation and private final consumption on economic growth. The second model tests the effects of tax revenue, inflation and economic growth on private final consumption. The third model tests the effects of tax revenue, economic growth and private final consumption on inflation and the fourth model tests the effects of economic growth, inflation and private final consumption on tax revenue of Ethiopia.

3.1 Variable Definition

The real gross domestic product (RGDP), which is the gross domestic product deflated by GDP deflator, is used as a proxy for economic growth. The GDP is expected to have a positive impact on tax revenue and private final consumption while an ambiguous effect on inflation.

The real private final consumption (RPFC) expenditure is defined as the expenditure incurred on final consumption of goods and services by the resident households and non-profit institutions serving households (NPISH) which is deflated by implicit GDP deflator. It constitutes the largest share of GDP and expected to have a positive impact on tax revenue, growth and inflation.

Real tax revenue is the income that is gained by governments through taxation which is deflated by implicit GDP deflator. It is compulsory transfers to the government for public purposes. Tax revenue is expected to have a negative impact on consumption while an ambiguous effect on GDP and inflation. Accordingly, different economic schools of thought have different perspective about the relationship between growth and tax revenue and inflation and tax revenue so that the expected sign cannot be predetermined.

In classical economics, inflation is defined as a sustained increase in the general level of prices for goods and services and it is measured as an annual percentage increase. There are many measures of inflation depending on the specific circumstances. The consumer price index (CPI) measures the percentage change through time in the cost of purchasing a constant basket of goods and service representing the average pattern of purchases made by a particular population

group in a specific time period. The expected impact of inflation on tax revenue, consumption and growth cannot be predetermined.

3.2 Model specification

The empirical framework of this study is focused on modeling the nexus between tax revenue, inflation, private final consumption and economic growth. The presence of endogenous variables on both left and right hand side of the equation makes is difficult the estimation and inference process. However, the Vector Auto Regressive (VAR) approach circumvents this complexity by treating every variable as endogenous in the system as a function of the lagged values of all endogenous variables in the system.

Depending up on the theoretical grounds, some of the relevant factors that affect tax revenue, inflation, private final consumption and GDP can be specified respectively as:

$$\mathbf{y}_t = \boldsymbol{C} + \Phi_1 \mathbf{y}_{t-1} + \Phi_2 \mathbf{y}_{t-2} + \cdots + \Phi_p \mathbf{y}_{t-p} + \grave{\mathbf{o}}_t$$

$$\text{where} \quad \mathbf{y} = \begin{pmatrix} TR \\ INF \\ PFC \\ GDP \end{pmatrix}$$

TR = F(INF, PFC, GDP)…….. ***(3.1)***

INF = F(TR, PFC, GDP)…….. ***(3.2)***

PFC = F(INF, TR, GDP)…….. ***(3.3)***

GDP = F(INF, PFC, TR)…….. ***(3.4)***

Where, *TR = Tax Revenue*

INF = Inflation

PFC = Private Final Consumption

GDP = Gross Domestic Product

For economic analysis, many variables are used in logarithm (log). In time series analysis, this transformation is often considered to stabilize the variance of a series (Gujarati, 2004). Thus, from the beginning, the variables are transformed into log data to avoid hetroscedasticity and to show elasticity of the variables. In this regards, the above functions of equation can be written in logarithmic form as:

$$lnTR = \alpha_1 + \sum_{s=1}^{p} \beta_1 lnTR_{t-s} + \sum_{s=1}^{p} \beta_2 lnINF_{t-s} + \sum_{s=1}^{p} \beta_3 lnPFC_{t-s} + \sum_{s=1}^{p} \beta_4 lnGDP_{t-s} + \varepsilon_{1t}$$

$$lnINF = \alpha_2 + \sum_{s=1}^{p} \theta_1 lnINF_{t-s} + \sum_{s=1}^{p} \theta_2 lnTR_{t-s} + \sum_{s=1}^{p} \theta_3 lnPFC_{t-s} + \sum_{s=1}^{p} \theta_4 lnGDP_{t-s} + \varepsilon_{2t}$$

$$lnPFC = \alpha_3 + \sum_{s=1}^{p} \gamma_1 lnPFC_{t-s} + \sum_{s=1}^{p} \gamma_2 lnINF_{t-s} + \sum_{s=1}^{p} \gamma_3 lnTR_{t-s} + \sum_{s=1}^{p} \gamma_4 lnGDP_{t-s} + \varepsilon_{3t}$$

$$lnGDP = \alpha_4 + \sum_{s=1}^{p} \mu_1 lnGDP_{t-s} + \sum_{s=1}^{p} \mu_2 lnINF_{t-s} + \sum_{s=1}^{p} \mu_3 lnPFC_{t-s} + \sum_{s=1}^{p} \mu_4 lnTR_{t-s} + \varepsilon_{4t}$$

Where: α_i are constant

$\beta_i, \mu_i, \gamma_i, \theta_i$, represent parameters to be estimated.

3.3 Estimation Procedures

3.3.1 Stationarity Test

A stochastic process said to be weakly stationary if its mean and variance are constant over time and the value of the covariance between the two-time periods depends only on the distance or gap between the two-time and not the actual time at which the covariance is computed. And according to Gujarati (2003), a time series is strictly stationary if all of the moments of its probability distribution are invariant over time. However, the normal stochastic process is fully specified by its two moments, the mean and the variance. According to Davidson and Mackinnon (1999), empirical work based on time-series data assumes that the underlying time series is stationary. If a time series is not stationary in the sense just defined, it is called a non-stationary time series. In other words, a non-stationary time series will have a time-varying mean or a time-varying variance or both. If a time series is non-stationary, we can study its behavior only for the time period under consideration. Each set of time series data will therefore be for a particular episode. As a consequence, it is not possible to generalize it to other time periods.

Since the majority of economic theory built upon the assumption of stationarity, it is typically required to check that the various variables are stationary before applying standard estimation or testing procedures in a dynamic time series model whether the variables in the model are stationary and their orders of integration should be evaluated. Otherwise regression of a non-stationary variable upon a non-stationary variable may lead to the so-called spurious regression in which estimators and test statistics are misleading.

3.3.1.1 Testing for Unit Roots

The unit root test has become the most common method to test for stationarity. It is fundamental to test for the statistical properties of variables when dealing with time series data. For a number of reasons, it can be important to know whether or not an economic time series has a unit root. According to Davidson and Mackinnon (1999) a non-stationary time series is said to be integrated of order one, or I(1), if its first difference, $\Delta y_t = y_t - y_{t-1}$, is I(0). More generally, a series is integrated of order d, or I(d), if it must be differenced d times before an I(0) series results. A series is I(1) if it contains what is called a unit root. It is therefore very important to be able to detect the presence of unit roots in time series, normally by the use of what are called unit root tests. For these tests, the null hypothesis is that the time series has a unit root and the alternative is that it is I(0).

There are several ways of testing for the presence of a unit root. The Dickey-Fuller (DF) test, the Augmented Dickey-Fuller (ADF) test and the Phillips-Peron test are the most widely used tests. This study employs the ADF and Phillips-Peron tests to determine the existence of a unit root.

Augmented Dickey-Fuller (ADF) tests

The original Dickey-Fuller (DF) test is based on a simple autoregressive of order one, AR (1) process with a white-noise disturbance. However, because the Dickey-Fuller test regression does not include values of variables beyond one lag, there may be serial correlation among error terms so that results based on such tests may be biased and as a result not valid. The Augmented Dickey-Fuller test avoids this problem because it corrects for serial correlation by adding lagged-difference terms (Greene, 2003).

Assuming the random walk model with drift around the stochastic trend as correctly specified by augmenting the lagged values of the explained variables Δy_t, the ADF test can be estimated using the following three cases.

Case one: When there is only intercept term

$$\Delta y_t = \alpha_0 + \gamma y_{t-1} + \beta_1 \Delta y_{t-1} + \cdots + \beta_p \Delta y_{t-p} + \epsilon_t \ldots\ldots\ldots\ldots\ldots\ldots \textbf{(3.5)}$$

In this regards, t-statistics can be used on the γ coefficients to test whether we need to difference the data to make it stationary.

In this case, the null and alternative hypothesis of the ADF t-test can be:

H_o: γ = 0 (the data has a unit root i.e. the data need to be differenced to make it stationary)

H_1: γ < 0 (i.e. the data is stationary and does not need to be differenced)

Case Two: When there is intercept and trend

$$\Delta y_t = \alpha_0 + \alpha_t t + \gamma y_{t-1} + \beta_1 \Delta y_{t-1} + \cdots + \beta_p \Delta y_{t-p} + \epsilon_t \ldots\ldots\ldots\ldots\ldots\ldots \textbf{(3.6)}$$

Here also one can use the t-statistics on the γ coefficients to test whether differencing the data to make it stationary or we need to put a time trend in the regression model to correct for the variables deterministic trend.

Thus, the null and alternative hypothesis of the ADF t-test can be:

H_o: γ = 0 (the data has a unit root i.e. the data need to be differenced to make it stationary)

H_1: γ < 0 (i.e. the data is trend stationary and needs to be analyzed by means of using a time trend in the regression model instead of differencing the data).

Case Three: when there is no intercept and trend

$$\Delta y_t = \gamma y_{t-1} + \beta_1 \Delta y_{t-1} + \cdots + \beta_p \Delta y_{t-p} + \epsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \textbf{(3.7)}$$

In this case, the null and alternative hypothesis of the ADF t-test can be:

H_o: γ = 0 (the data has a unit root i.e. the data need to be differenced to make it stationary)

H_1: γ < 0 (i.e. the data is stationary and does not need to be differenced)

Where, ϵ_t represents the white noise.

The appropriate critical values to be used to test for the presence of a unit root are provided by the Dickey-Fuller. After estimating the equations with ordinary least square method, the resulting t-statistics are compared with the respective critical values given in the Dickey-Fuller tables.

Phillips-Perron Test

According to Davidson and Mackinnon (1999), many alternatives to augmented Dickey-Fuller tests have been proposed. Among the best known are the tests proposed by Phillips and Perron (1988). These Phillips-Perron (PP) tests have the same asymptotic distributions as the corresponding ADF tests, but they are computed quite differently. In contrast to the ADF, the PP test does not add lagged difference terms to account for a potential serial correlation in the error terms; rather, it uses non-parametric statistical methods. This test's statistic follows the same asymptotic distribution as the ADF test statistic (Gujarati, 2004).

The Phillips and Perron test solve the serial correlation problem among error terms by using a correction factor which estimates the long-run discrepancy of error process with modification of the Newey-West formula. The Perron test does not require the disturbance term to be serially uncorrelated or to be homogeneous. Because of the asymptotic distribution of the Phillips and Perron test is the same as Dickey-Fuller test, the same critical values are used for both ADF and Phillips Perron test. Thus, although there are some demerits of using it, Augmented Dickey Fuller and the Phillips Perron tests are going to be employed in this study.

3.3.2 Econometric Method

3.3.2.1 Vector Autoregressive (VAR) Modeling and Co-Integration Analysis

Vector auto regression (VAR) was introduced by Sim (1980) as a technique that could be used by macroeconomists to characterize the joint dynamic behavior of collection of variables without requiring strong restrictions of the kind needed to identify underlying structural parameters. It has become a prevalent method of time series modeling.

Co-integration test is employed to check long run linear relationships among variables in the presence of short-run deviations from the long run equilibrium. Basically where there is non-stationary series with a unit root, first differencing appears to provide the appropriate solutions to

ensuring series are weakly stationary, though first differencing does possess a major limitation in that it tends to ignore the long run properties of the data.

The procedure used for co-integration testing and estimation of the VAR for this study is based methodology developed and used by Johansen (1988, 1991), and Johansen and Juselius (1990). This method is preferred to the single equation based Engel-Granger two step procedure for the reason that it allows testing for the presence of more than one co-integration vector. Moreover, it permits to estimate the model without priority restricting the variables as endogenous and exogenous.

Thus, the VAR approach has, in recent years, become quite a common tool for macroeconomic analysis. Alemnesh (2012) used co-integrated VAR approach to analyze the nexus between public investment, trade openness, private investment and economic growth in Ethiopia. Similarly, Feyera (2015) used the same approach to analyze the nexus between inflation rate, gross national saving and per capita income in Ethiopia. Hence analysis of the nexus between tax revenue, inflation, private final consumption and economic growth using co-integrated VAR approach is appropriate.

A VAR system contains a set of m variables, each of which is expressed as a linear function of p-lags of itself and of all of the other m-1 variables, plus an error term. With two variables, x and y, an order p VAR would be the two equations:

$$y_t = \beta_{y0} + \beta_{yy1} y_{t-1} + \cdots + \beta_{yyp} y_{t-p} + \beta_{yx1} x_{t-1} + \cdots + \beta_{yxp} x_{t-p} + v_t^y \quad \text{(3.8)}$$

$$x_t = \beta_{x0} + \beta_{xy1} y_{t-1} + \cdots + \beta_{xyp} y_{t-p} + \beta_{xx1} x_{t-1} + \cdots + \beta_{xxp} x_{t-p} + v_t^x \quad \text{(3.9)}$$

We adopt the subscript convention that β_{xyp} represents the coefficient of y in the equation for x at lag p. A key feature of the above equations is that no current variables appear on the right-hand side of any of the equations.

A key distinction in understanding and applying VARs is between the innovation terms v in the VAR and underlying exogenous, orthogonal shocks to each variable, which we shall call ε. The innovation in y_t is the part of y_t that cannot be predicted by past values of x and y. Some of this unpredictable variation in y_t that we measure by v_t is surely due to ε_t^y, an exogenous shock to

y_t that is has no relationship to what is happening with x or any other variable that might be included in the system.

3.3.2.2 The Vector Error Correction Model (VECM)

The vector autoregressive (VAR) model is a general framework used to describe the dynamic interrelationship among stationary variables. It contains information on both the short-run and long-run properties of the model, with disequilibrium as a process of adjustment to the long run model. The vector error correction (VEC) model is just a special case of the VAR for variables that are stationary in their differences.

When the variables of a VAR are co-integrated, we use a vector error-correction (VEC) model. A VEC for two variables (equation 3.8 and 3.9) might look like:

$$\Delta y_t = \beta_{y0} + \beta_{y1}\Delta y_{t-1} + \cdots + \beta_{yp}\Delta y_{t-p} + \gamma_{y1}\Delta x_{t-1} + \cdots + \gamma_{yp}\Delta x_{t-p} - \mathrm{l}_y(y_{t-1} - \alpha_0 - \alpha_1 x_{t-1}) + v_t^y$$

$$\Delta x_t = \beta_{x0} + \beta_{x1}\Delta y_{t-1} + \cdots + \beta_{xp}\Delta y_{t-p} + \gamma_{x1}\Delta x_{t-1} + \cdots + \gamma_{xp}\Delta x_{t-p} - \mathrm{l}_x(y_{t-1} - \alpha_0 - \alpha_1 x_{t-1}) + v_t^x$$

Where $y_t = \alpha_0 + \alpha_1 x_t$ is the long-run co-integrating relationship between the two variables and λ_y and λ_x are the error-correction parameters that measure how y and x react to deviations from long-run equilibrium.

Johansen Co-integration Test

The Johansen test can be seen as a multivariate generalization of the augmented Dickey-Fuller test. The generalization is the examination of linear combinations of variables for unit roots. The Johansen test and estimation strategy, maximum likelihood, makes it possible to estimate all co-integrating vectors when there are more than two variables. If there are three variables each with unit roots, there are at most two co-integrating vectors. More generally, if there are n variables which all have unit roots, there are at most $n-1$ co-integrating vectors. The Johansen test provides estimates of all co-integrating vectors.

In the Johansen (1988) procedure, determining the rank (r) of the long run matrix (Π) provides the number of co-integrating vector between the variables. To determine the rank of the long-run matrix and hence the number of co-integrating vectors, the two likelihood ratio tests (the trace), and the maximal eigenvalue (λ maximum) statistics are used. For both test statistics, the initial

Johansen test is a test of the null hypothesis of no co-integration against the alternative of co-integration.

Maximum Eigenvalue Test

The maximum eigenvalue test examines whether the largest eigenvalue is zero relative to the alternative that the next largest eigenvalue is zero. The first test is a test whether the rank of the matrix Π is zero. The null hypothesis is that rank (Π) = 0 and the alternative hypothesis is that rank (Π) = 1. For further tests, the null hypothesis is that rank (Π) = 1, 2… and the alternative hypothesis is that rank (Π) = 2, 3…

The test of the maximum (remaining) eigenvalue is a likelihood ratio test. The test statistic is

$LR(r_0, r_0 + 1) = -Tln(1 - \lambda_{r0+1})$

Where, $LR(r_0, r_0 + 1)$ is the likelihood ratio test statistic for testing whether rank (Π) = r_0 versus the alternative hypothesis that rank (Π) = $r_0 + 1$

Trace Test

The trace test is a test whether the rank of the matrix Π is r_0. The null hypothesis is that rank (Π) = r_0. The alternative hypothesis is that r_0< rank (Π) ≤ n, where n is the maximum number of possible co-integrating vectors. For the succeeding test if this null hypothesis is rejected, the next null hypothesis is that rank (Π) = $r_0 + 1$and the alternative hypothesis is that $r_0 + 1$< rank (Π) ≤ n. Testing proceeds as for the maximum eigenvalue test.

The likelihood ratio test statistic is

$LR(r_0, n) = -T \sum_{i=r_0+1}^{n} ln\,(1 - \lambda_i)$

Where, $LR(r_0, n)$ is the likelihood ratio statistic for testing whether rank (Π) = r_0 versus the alternative hypothesis that r_0<rank (Π) ≤ n.

According to Davidson and Mackinnon (1999), the estimation of the VECM requires the determination of the appropriate lag length because the co-integration result may be sensitive to the number of lags included in the VAR. Thus, prior to co-integration testing and estimation of the VECM, we need to determine the appropriate lag length, which is determined using the well-known model selection criteria, the Akaiki Information Criteria (AIC), the Final Prediction Error

(FPE), the Hannan-Quinn Information Criteria (HQ), and the Schwarz (Bayesian) Information Criteria (SIC). The objective of the information criteria (IC) method is to select the number of parameters, which minimize the value of the information criteria.

3.3.2.3 Granger causality Test

One of the first, and undeniable, maxims that every econometrician or statistician is taught is that "correlation does not imply causality." Correlation or covariance is a symmetric, bivariate relationship; cov (x, y) = cov (y, x). We cannot, in general, infer anything about the existence or direction of causality between x and y by observing non-zero covariance. Even if our statistical analysis is successful in establishing that the covariance is highly unlikely to have occurred by chance, such a relationship could occur because x causes y, because y causes x, because each causes the other, or because x and y are responding to some third variable without any causal relationship between them.

The formal definition of Granger causality asks whether past values of x aid in the prediction of y_t, conditional on having already accounted for the effects on y_t of past values of y. If they do, then x is said to Granger cause y. The VAR is a natural framework for examining Granger causality. From the two variable system in equations (3.8 & 3.9), if x Granger causes y, then some or all of the lagged x values have non-zero effects. Testing for Granger causality amounts to testing the joint blocks of coefficients and β_{yxp}, to see if they are zero. The null hypothesis x does not Granger cause y in this VAR is

H_o: $\beta_{yx1} = \beta_{yx2} = \ldots = \beta_{yxp} = 0$, which can be tested using a standard Wald r $\chi 2$ of F test.

The null hypothesis y does not Granger Cause x in this VAR is

H_o: $\beta_{xy1} = \beta_{xy2} = \ldots = \beta_{xyp} = 0$,

According to Granger (1988), the existence of co-integration between X and Y must be evaluated before performing a causality test. If a co-integrating relationship is identified, then causality must exist in at least one direction. Causality can be unidirectional, that is, it can run only from X to Y. On the other hands, when causality runs from one variable to the other and, in turn, runs from that variable to the other, then the causality that exists is called feedback effects.

To summarize, we must be very careful in interpreting the result of Granger causality tests to reflect true causality in any non-econometric sense. Only if we can rule out the possibility of the future causing the present and strictly immediate causal effects can we confidently think of "Granger causality" as "causality."

3.3.2.4 Diagnostic Checks

Once the VAR models are estimated we should make some diagnostic tests which are important in order to make sure that the results obtained from VAR estimation can be used for forecasting or policy purposes. These post-estimation tests are mostly performed on the residual of the VAR.

Tests for Normality of a Vector White Noise Process

The Jarque-Bera normality test is used to determine whether the regression errors are normally distributed. The idea is to compare the third and fourth moments of the transformed process with the theoretical values obtained for a Gaussian process. It is a joint asymptotic test whose statistic is calculated from the skewness and kurtosis of the residuals as follows:

JB= $S_3^2+S_4^2$ where, $S_3^2 and\ S_4^2$ computed as

$S_3^2 = Tb_1'b_1/6$

$S_4^2 = T(b_2 - 3_k)'(b_2 - 3_k)/24$

Where, b_1 and b_2 are the third and fourth non-central moment vectors of the standardized residuals and T is the number of observation.

The joint test is based on the null hypothesis that the residuals are normally distributed. Non rejection of the null hypothesis at the standard critical values indicates normality of the residuals.

Error Vector Autocorrelation Test

Autocorrelation normally occurs while employing time series data. This occurs when two or more consecutive error terms are correlated, and we say that the error term is subject to autocorrelation or serial correlation. This study uses the Breusch-Godfrey Lagrange Multiplier (LM) test, which is a multivariate test for residual serial correlation up to some specified lag order.

The null hypothesis of the LM test for autocorrelation is that the residuals are not serially correlated, while the alternative is that the residuals are serially correlated. If the p-value is less than 0.05 then we reject the null hypothesis. The test statistic is given by:

$LM = (T - q)R_{\varepsilon}^{2}$

Where, q is the degrees of freedom and R_{ε}^{2} is the coefficient of determination obtained from the auxiliary regression; and the LM test statistic is chi-square distributed.

Heteroskedacity Test

The test for heteroscedasticity investigates whether the variance of the errors in the model are constant or not. White's test is used to check whether the residuals are both homoskedastic and that there is no problem of misspecification. It tests the null hypothesis that the residuals are homoskedastic i.e. $\mathrm{E}(u_i^2) = \sigma^2$. The test regression is run by regressing each cross product of the residuals on the cross products of the regressors and testing the joint significance of the regression. If the White test statistic is significant, that is, p-value is less than 0.05; the null hypothesis of homoscedasticity and no misspecification will be rejected.

3.3.2.5 Impulse Response Function and Variance decomposition

3.3.2.5.1 Impulse Response Function (IRF)

Impulse response functions show the effects of shocks on the adjustment path of the variables. It tracks the impact of any variable on others in the system. It is an essential tool in empirical causal analysis and policy effectiveness analysis. Impulse response functions are interpreted under the assumption that all the other shocks are held constant. Thus, we need to orthogonalize the shock through Cholesky decomposition. The persistence of a shock illustrates how rapidly the system returns to equilibrium. The response is measured in terms of the standard deviation. It traces the cross effect on current and future values of the endogenous variables of one standard deviation shock to the variables. The impulse response functions show the sign, magnitude, and persistence of real and nominal shocks to the dependent variable.

Cholesky decomposition therefore, more conveniently shown using vector moving average form of the model as,

$y_t = \sum_{s=0}^{\infty} \delta_s \epsilon_{t-s}$

The problem for interpretation is when the error terms are correlated, because then an exogenous shock to variable j is simultaneously correlated with a shock to variable k, for example. To eliminate this, we can use a Cholesky decomposition which orthogonalizes the innovations. Let's suppose that the covariance matrix of the errors is Ω. We decompose it as $\Omega=PP'$ and introduce $v_t = P^{-1}\epsilon_t$ which are error terms with the identity matrix as covariance matrix. After some manipulation:

$y_t = \sum_{s=0}^{\infty} \delta_s \epsilon_{t-s} = \sum_{s=0}^{\infty} \delta_s PP^{-1}\epsilon_{t-s} = \sum_{s=0}^{\infty} \delta_s^* v_{t-s}$

Where, $\delta_s^*=\delta_s P$

Consider now the response to an orthogonalized shock:

$\frac{\partial y_{t+h}}{\partial v_{j,t}} = \frac{\partial}{\partial v_{j,t}} (\sum_{s=0}^{\infty} \delta_s^* v_{t+h-s}) = \delta_h^* e_j$. But in order to calculate this in practice, we need to first find the moving average matrices ɗ through recursively.

In this study therefore, there is no exogenous variables i.e. all the variables are endogenous. A shock to a variable in a VAR not only directly affects that variable but is also transmitted to all other endogenous variables in the system through the dynamic structure of the VAR. It trace for instant, how tax revenue, responds overtime to a shock in another variable (inflation, private final consumption or GDP in the country) and compares this response to shocks from other variables. Therefore in a system of two variables, there are four impulse response functions and with three variables there are nine response functions. The shock occurs through the error term and affects the dependent variables over time. If the time path of the impulse response function becomes zero over time, the system of the equations is stable, however they can explode if unstable.

3.3.2.5.2 Variance Decomposition

Variance decomposition refers to the breakdown of the forecast error variance for a specific time horizon. Variance decomposition can indicate which variables have short-term and long-term impacts on another variable of interest. Basically, variance decomposition can tell a researcher the percentage of the fluctuation in a time series attributable to other variables at select time horizons. In this study, decomposing the forecast-error variance yields additional information concerning how the tax revenue and growth, private final consumption and growth, inflation and growth etc. are linked.

Variance decomposition function provides a different method of depicting the system dynamics. It decomposes variation in an endogenous variable in to the component shocks to the endogenous variables in the VAR system whereas impulse response function traces the effect of a shock to endogenous variable in VAR system. The variance decomposition gives information about the relative importance of each random innovation to the variables in the VAR.

CHAPTER FOUR

4. DATA ANALYSIS AND INTERPRETATION OF RESULTS

4.1 Time series properties of the data

4.1.1 Unit Root Tests

The time series variables have to be tested for unit roots before drawing any meaningful inference about the nexuses between macroeconomic variables. Testing for stationarity of the time series ensures that the variables used in the regressions are not subject to spurious correlation/ regressions. In order to avoid the problem of spurious correlations in the regression analysis, the time series of the variables used in the regression analysis are investigated using the standard Augmented Dickey-Fuller (ADF) and the Phillips-Perron unit root tests. The test with these methods is performed with different trend assumptions such as only intercept, both linear trend and intercept, and no intercept and no trend. Performing the tests under all three alternatives will identify whether only the intercept or both the trend and intercept are significant.

Table 4.1: Augmented Dickey-Fuller Stationarity Test Result

Variable	Tests statistics under different case			Order of Integration
	Intercept	Trend and Intercept	No Trend No Intercept	
LCPI	-0.662741	-2.955928	1.896826	I(1)
D(LCPI)	-7.942269*	-7.849172*	-7.015766*	
LRGDP	2.869161	-0.002380	5.777171	I(1)
D(LRGDP)	-5.914093*	-7.095504*	-1.352614	
LRPFC	-1.221635	-3.354091	1.056967	I(1)
D(LRPFC)	-8.455016*	-8.371743*	-8.215911*	
LRTAX	1.913734	-0.041061	5.291661	I(1)
D(LRTAX)	-5.233622*	-5.597199*	-3.810973*	

Note: D shows the variable is differenced once. MacKinnon (1996) one-sided critical values for rejection of a unit root are used here. * shows significance at 1%.

The time series behaviour of each series using the ADF test is presented in above table (4.1). The ADF demonstrates that an intercept must be included in LRGDP and both trend and intercept must be added in LCPI and LRPFC in testing for stationarity, while and LTAX are tested without intercept and trend. The ADF test results at level shows that all the critical values are greater than the ADF test statistics; therefore we fail to reject the null hypothesis a unit root and all of the variables included in the model are integrated of order 1.

The Phillips-Perron test result is almost similar, consistent and supports the result of Augmented Dickey Fuller Test (appendix 1). Hence both Augmented Dickey Fuller and Phillips-Perron test results are harmonious with each other and shows that all variables contained within the model are integrated of order 1 or I(1).

4.2 Econometric Analysis

4.2.1 Co-Integration Test Result

Lag Order Selection for Endogenous Variables

A crucial aspect of empirical research based on the vector autoregressive (VAR) model is the choice of the lag order, since all inference in the VAR model is based on the correct model specification. The literature has shown how to select an adequate lag order when the vector autoregressive model is subject to restrictions of co-integration. Among the classical procedures, the information criteria such as Likelihood Ratio (LR), Akaike (AIC), Schwarz (SC) and Hannan-Quinn (HQ) and Forecast Prediction Error (Lutkepohl, 1993) have been used to decide lag length that helps to estimate VAR model. As indicated by the table 4.2 below, the LR, FPE, AIC, SC and HQ propose an optimal lag of two at a 5% level of significance.

Table 4.2: Optimal lag order selection criteria

Lag	Log L	LR	FPE	AIC	SC	HQ
0	-92.43420	NA	0.001042	4.485312	4.649144	4.545728
1	80.77933	306.1448	6.99e-07	-2.826945	-2.007783	-2.524863
2	114.8131	3.82092*	3.08e-07*	-3.665728*	-2.191235*	-3.121980*
3	122.5568	10.80511	4.77e-07	-3.281712	-1.151889	-2.496299

Note: * indicates lag order selected by the criterion

Granger Causality Test

One important thing of time series vector auto regression is that we could test causality in some sense. This test is first proposed by Granger (1969), and therefore we refers it Granger causality. The Granger causality test was performed to examine the presence of bidirectional causality as described by Granger. Granger-causality/Block Exogeneity Wald/ test result shows that the lagged values of the variables have significant roles in explaining the current and future values of the variables, and this effect occurs in both directions in some of the cases.

Table 4.3 below shows the existence of bidirectional causality among some variables. Real GDP Granger-causes real PFC and real tax revenue while doesn't Granger-causes CPI. On the other hand, while real PFC Granger-causes CPI, but CPI doesn't Granger-causes real tax revenue and real GDP.

Table 4.3 Results of the Granger Causality/Block Exogeneity Wald Tests.

Equation / Excluded	LCPI	LRPFC	LRGDP	LRTAX
LCPI		2.512008 (0.2848)	1.101972 (0.5764)	0.932700 (0.6273)
LRPFC	29.68932 (0.0000)		3.545593 (0.1699)	0.745030 (0.6890)
LRGDP	2.381443 (0.3040)	34.26934 (0.0000)		8.789767 (0.0123)
LRTAX	0.846094 (0.6550)	6.357877 (0.0416)	2.574025 (0.2761)	

Note: The numbers in parenthesis show the p-values for the corresponding Chi-square statistics

This finding implies that the lagged values of the variables have significant roles in explaining the current and future values of some other variables.

The Johansen Co-integration Test Result

ADF and PP tests found that the series are non-stationary at level and stationary at first difference. To capture the existence of long run relationship among the variables, this study

employs the Johansen system framework to detect the existence of co-integrating relationships by the use of trace and maximum eigenvalue statistics. The number of lags of endogenous variables and trend assumption determine the results of Johansen co-integration test in the VAR environment. Because the results may vary with the alternatives, a decision must be made as to which one to choose for the purpose of further analysis. Thus, case 2 is chosen as appropriate for this case in the Eviews because except LRGDP, the series doesn't appear to exhibit a linear trend and the VECM is estimated based on the number of co-integration rank obtained from case 2.

Table 4.4: Unrestricted Co-integration Rank Test

Test	Null Hypothesis	Alternative Hypothesis	Eigenvalue	Co-integration Test Statistics	Critical Value (5%)
Trace statistics	H_0: r = 0	H_1: r > 0	0.521772	58.97727*	54.07904
	H_0 : r ≤ 1	H_1: r > 1	0.255247	27.25755	35.19275
Maximum Eigenvalue	H_0: r = 0	H_1: r > 0	0.521772	31.71973*	28.58808
	H_0 : r ≤ 1	H_1: r > 1	0.255247	12.67221	22.29962

Note: * denotes rejection of null hypothesis at 5 percent level.

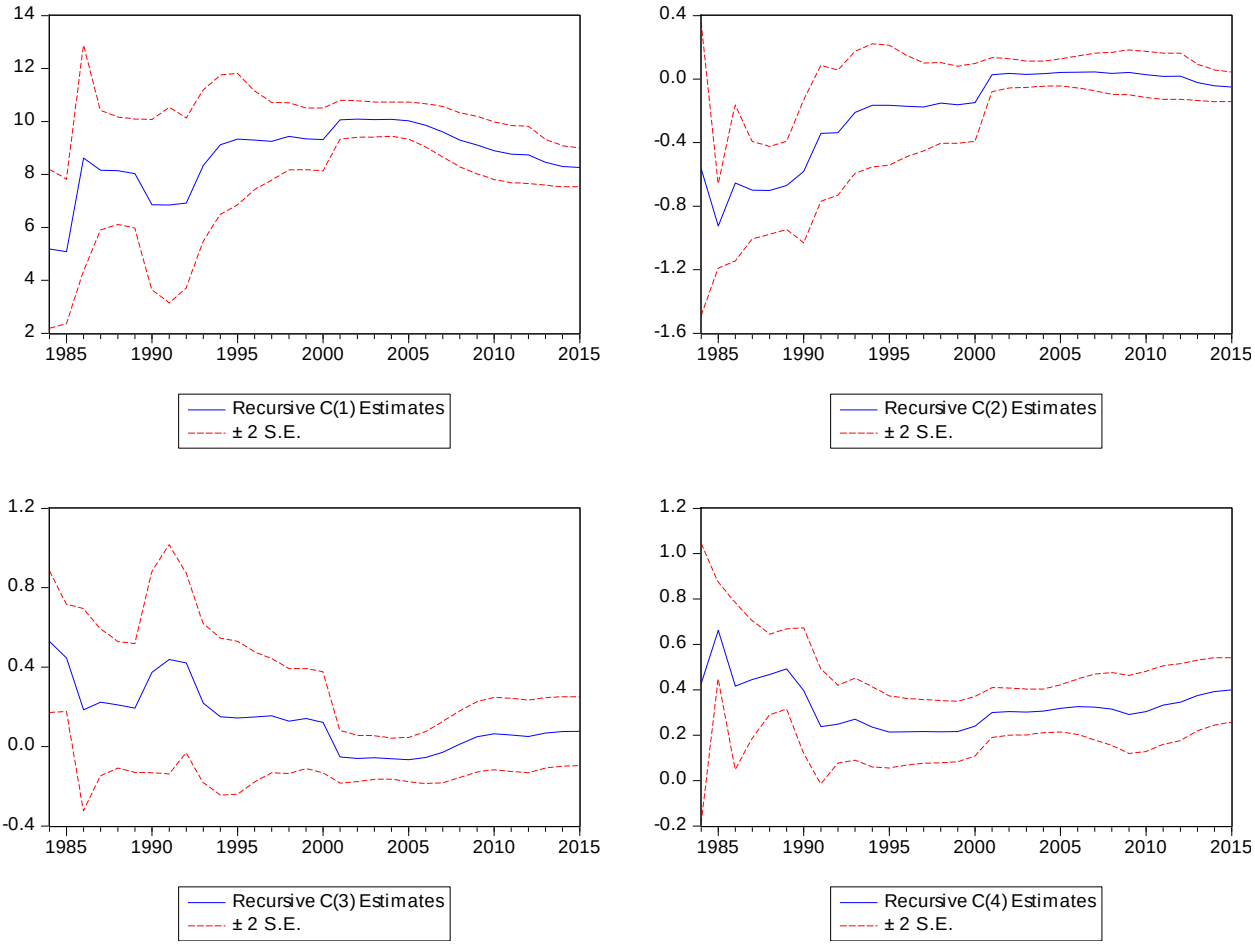
Both the trace and the maximal Eigenvalue tests identified one co-integrating relationships at the 5% level of significance. This is evidence show that there is a long-run relationship among economic growth, tax revenue, private final consumption and inflation. The results also legitimize the use of the VAR and the Johansen method instead of the single-equation-based Engle-Granger two-step procedure.

Model Stability Test

According to Lütkepohl (2005), because stability implies stationarity, the stability condition is often referred to as stationarity condition in the time series literature. However, the converse may be not true. In other words, an unstable process is not necessarily non stationary. The estimated VAR is stable if all roots have modulus less than one and lie inside the unit circle. If the VAR is not stable, certain results such as impulse responses and standard error are not valid. This result can also be visualized from the graph of the recursive coefficient test (fig 4.1). The figure shows

that all of the blue line lies inside the red lines. Therefore, the results suggest that the VAR model satisfies the stability condition.

Figure 4.1: Recursive Coefficient Test for Stability.



* The red lines represent critical bounds at 5% significance level

4.2.2 Vector Error Correction Model (VECM)

The vector error correction (VEC) model is just a special case of the VAR for variables that are stationary in their differences (i.e.in our case, I(1)). The VEC can also take into account any co-integrating relationships among the variables. Thus, in this analysis the optimum lag of two is chosen for the VAR using information criteria results. The VECM model consist the dynamics of both short run and long run adjustments.

Long-run Relationship

The result of ADF and Johansen co-integration tests supported the existence of long-run equilibrium relationships among the CPI, RGDP, RPFC and RTAX. In this regards, this study aimed to examine: the impact of inflation, tax revenue and private final consumption on economic growth; the impact of economic growth, tax revenue and private final consumption on inflation; the impact of tax revenue, economic growth and inflation on private final consumption and the impact of inflation, economic growth and private final consumption on tax revenue. The Johansen co-integration test however, confirms that there is only one co-integration equation so that there will be single long-run relation among the variables.

The result of the single long-run relationship after estimating the unrestricted co-integrating vector with ad-hoc normalization on LRTAX is given by:

Table 4.5: The Estimated Long-Run Model for LRTAX

Variable	LCPI	LRPFC	LRGDP	C
Coefficient	-0.489892 (-2.1642)	0.039257 (0.1734)	-0.809026 (-3.8342)	0.940708 (0.4882)

Note: Values in parentheses are t-Statistics

$$\boldsymbol{LRTAX_t - 0.9407 - 0.0392LRPFC_t + 0.8090LRGDP_t + 0.4898LCPI_t = ECM}$$

The above long-run equilibrium equation show that, citrus paribus, economic growth (RGDP) and inflation (LCPI) have significant negative long-run impact on real tax revenue (RTAX) while the long run impact of real private final consumption on real tax revenue is positive but insignificant. This result shows that 1 percent point increase in real private final consumption increases real tax revenue by 0.039 percent point. The result is consistent with Keynesian theory of consumption since increase in consumption of taxable good and service will increase tax revenue. On the other hands, Ethiopia has experienced an increased share of revenues from general consumption taxes and recently, the governments have become interested in using a VAT as one of the main sources of financing its spending. Therefore, it is an automatic that as the amount of the consumption of those goods or service with value added tax increase, tax revenue will increase.

The impact of inflation rate on real tax revenue is negative and significant. The result shows that 1 percent point increase in inflation rate decrease real tax revenue by 0.48 percent points in the long run in the country. This is might be because of the effect of the inflation on erosion of amounts expressed in national currency, erosion of the value of tax obligations and effects on the measurement of the tax base. In this regard, Ethiopia didn't adjusted the tax system for inflation for a long time so that the value of the amount collected is eroded by inflation in the long run. The other reason could be inflation erodes the value of the tax payment obligations because of collection lags, which represent the difference between the times that a tax obligation arises and the time that the tax is paid. A higher rate of inflation will decrease the effective rate of tax, the decrease being greater the longer the collection lag.

The effect of real GDP on real tax revenue is negative; as a result 1 percent point increase in real GDP will decrease real tax rate by 0.8 percentage point in the long run. This negative and significant relationship between real GDP and real tax revenue is may be due to large tax evasion among economic agents in Ethiopia. The share of tax revenue in the country is still very low implying that though there is increase in tax revenue recently, it is too low as we compare with the rate of GDP growth. The other reason may be age-old system of tax which has been implementing in the country, ineffectiveness of the economic and tax reform programs done by the government, the presences of corruption and the decline in tax morale of the population due to different reasons. Beside these, generally, a nation with a greater share of the manufacturing sector could generate higher tax revenue as compared to the agricultural sector. Ethiopia is faced by the reality of a large share of agriculture in total output and employment, large informal sectors and occupations, many small establishments and informal economies that are outside the formal tax structure which might result in a lower level of tax revenue.

The Short run Relationship

Once the existence of long-run relationship checked and the appropriate parameters are determined, the next step is estimating the coefficients of the short term dynamics. In order to capture the short-run dynamics of the model, error correction mechanism will be applied. The coefficient of the error correction term indicates how quickly variables converge to equilibrium. Table 4.9 shows the results of the D (LCPI) equation in the error-correction model from which the short-run impact of real gross domestic product, real private final consumption and real tax

revenue on inflation can be analyzed. The coefficients of the one-period lagged differences in the table can be interpreted as the short-run parameters representing the short-run causality. The result shows that real private final consumption has positive and significant impacts on inflation rate. The short-run impact of real private final consumption show that a 10 percentage-point increase in RPFC increases inflation by 4.3 percentage points in the short run.

The result of the short-run inflation equation found that real GDP has a price depressing effect, but it is not significant. The result shows that a due to 1 percent point increase in real GDP will decrease inflation rate by 0.24 percentage point in the short run. On the other hand, real tax revenue has positive and insignificance impact on inflation in the short run. The reason is street forward; as the tax rate or revenue increase, firms rise the price of commodity as a result the overall price (inflation) will rise.

Table 4.6: Short-Run Coefficients when dependent variable is D (LCPI)

Error Correction Model	Dependent Variable: D(LCPI)	
	Coefficient	t-value
ECM	-0.045261	[-0.44668]
D(LRGDP(-1))	-0.248408	[-0.60459]
D(LRPFC(-1))	0.431337	[2.07891]
D(LRTAX(-1))	0.191365	[0.66522]
C	0.084297	[1.23548]

R^2 = 0.47, F-statistic = 3.284

The coefficient of the error correction term for the output equation below in table 4.10 possesses significant but positive sign. This may due to less explanatory variables included in the equation for real GDP. The result of short run coefficients indicates that the impact of inflation on real GDP is negative and significant. This shows that increase in inflation in the short run hampers economic growth in Ethiopia. The result indicates that 1 percent point increase in inflation rate decreases real GDP by 0.24 percent point. There is also a short run causality from real private final consumption and real tax revenue to real GDP and their impact is positive and insignificant. The result about the short run impact of real PFC and real tax revenue on real GDP is consistent with existing economic theories, especially Keynesian economic theories.

Table 4.7: Short-Run Coefficients when dependent variable is D (LRGDP)

Error Correction Model	Dependent Variable: D(LRGDP)	
	Coefficient	t-value
ECM	0.240431	[2.78765]
D(LCPI (-1))	-0.242802	[-2.01270]
D(LRPFC(-1))	0.203266	[1.51473]
D(LRTAX(-1))	0.286772	[1.54129]
C	0.117161	[2.65495]

$R^2 = 0.38$, F-statistic = 2.2475

As it can be observed from table 4.11 below the coefficient of the error correction term for the RPFC equation possesses the negative sign. This guarantees that although the actual real PFC may temporarily deviate from its long-run equilibrium value, it would gradually converge to its equilibrium. The error correction term of -0.023091 shows that about 2.3 percent of the deviation of the actual real PFC from its equilibrium value is eliminated every year; hence, full adjustment would require a period of more than forty three years. This low speed of adjustment may be attributed to structural rigidities.

The coefficients below the co-integration coefficients are short run coefficients. The result of short run coefficients indicate that there is short run causality from independent variables to dependent variable, both inflation and real tax revenue for which their coefficients are negative but not significant. The impact of real tax revenue on private final consumption is negative and this result is consistent with standard economic theories. For instance, the rise in the tax rate will reduce real private final consumption due to income effect of the tax rate. Thus, real private final consumption will decline. This finding is consistent with studies by Steindel (2001). However, the short run impact of real GDP on real PFC is positive and insignificant this result is consistent with existing theories about the relation between the variables. However, the insignificance of the coefficient term may be due to less explanatory variable inclusion in the model. The other result might be due to improvement in people saving habit which affect consumption.

Table 4.8: Short-Run Coefficients when dependent variable is D (LRPFC)

Error Correction Model	Dependent Variable: D(LRPFC)	
	Coefficient	t-value
ECM	-0.023091	[-5.21643]
D(LCPI (-1))	-0.221577	[-1.32138]
D(LRGDP (-1))	0.398283	[0.73338]
D(LRTAX(-1))	-0.035518	[-0.13649]

R^2 = 0.78, F-statistics = 13.09924

The coefficient of the ECM model for the real tax revenue equation possesses negative sign. The coefficient is -0.5667, suggesting relatively fast adjustment process in real tax revenue. Nearly 57 percent of the disequilibria from the shock of the previous period return to the long-run equilibrium in the current year.

Table 4.9: Short-Run Coefficients when dependent variable is D (LRTAX)

Error Correction Model	Dependent Variable: D(LRTAX)	
	Coefficient	t-value
ECM	-0.566731	[-3.99448]
D(LCPI (-1))	-0.362278	[-2.43558]
D(LRGDP (-1))	-0.732617	[-2.23589]
D(LRPFC (-1))	-0.003795	[-0.02294]
C	0.198454	[3.64726]

R^2 = 0.41, F-statistics = 2.6489

The short-run impacts of inflation, real GDP and real PFC on real tax revenue are found to be negative and statistically significant except RPFC, which means that a 10-percentage-point increase in inflation rate and RGDP decreases real tax revenue by 3.6 and 7.3 percentage points, respectively, in the short run. However, the impact of real private final consumption on real tax revenue is negative but insignificant in the short run. This may be because there could be substantial tax avoidance among the economic agents. The negative effect of real GDP on real tax revenue probably due to tax evasion and sectors those contribute much for real GDP may be exempted from tax so that though real GDP is increasing tax revenue may not increase.

4.2.3 Post-Estimation Diagnostics

Different post-estimation diagnostic tests were performed to guarantee that the residuals from the models are Gaussian in which the assumptions are not violated and the estimation results and inferences are trustworthy. The diagnostic test results could also be used as indicators of the validity of employing impulse-response functions and variance decomposition analyses. For the detail result of the post-estimation diagnostics see appendix 2, 3 and 4.

Residual Vector Normality Test

Multivariate version of the Jarque-Bera tests is used to test the normality of the residuals. It compares the 3^{rd} and 4^{th} moments (skewness and kurtosis) to those from a normal distribution. The test has null hypothesis stating that the error term in the model has skewness and kurtosis corresponding to a normal distribution. The result (in table 4.13) shows that the residual vector of the model is found to be not jointly normal. However, since normality is an asymptotic or large sample property, it may be expected that the residual normality could asymptotically be improved if the sample size could be increased. Unfortunately, the sample size could not be increased because of data deficiency for some variables. This may suggest that there could be small sample size problem in the data that probably reduced the power of this test.

Residual Vector Serial Correlation LM Test

Table 4.13 below show the p-values of statistical significance at 5% level for test of residual vector serial correlation. The small p-values imply that the chi-squared statistics at all lags are not large enough to help reject the null of no autocorrelation at any of the usual critical values. In this case, the serial correlation Lagrange Multiplier (LM) test fails to reject the null hypothesis of no serial correlation. This result indicates that the residuals of the estimated error correction model do not suffer from any type autocorrelation.

Residual Vector Heteroscedasticity Test

Finally, the VEC residuals heteroscedasticity test is performed. The result in table 4.13 suggests that there is no enough evidence to help reject the null of no heteroscedasticity at 5% level of significance. Therefore, the residuals of the model are found to be homoscedastic. This, together

with the results of the other pre and post estimation diagnostic tests, suggests the validity and robustness of the estimated results.

Table 4.10: Diagnostic checks for VECM

Test	Statistics		p-value
	Lag	Chi-square	
Residual Vector Serial Correlation LM	1	17.45274	0.3569
	2	17.47906	0.3553
	3	17.94296	0.3272
Residual Vector Normality (Jarque-Bera) 8df	Joint		0.0000
Residual Vector Heteroscedasticity	Joint	204.6872	0.1001

4.2.4 Impulse Response Function

Impulse response functions could tell us how the endogenous variable at any point in time may respond to a one standard deviation innovation (impulse) generated from any of the variables earlier times and how that effect may be multiplied (lasts for long or is transitory). Here, though the impulse response results based on Cholesky's impulse response analyses are sensitive to the ordering of the variables and the lag length, this study employed Cholesky's impulse response function analysis. (See appendix 5 for detail result of impulse response function)

The response of real tax revenue to one standard deviation positive shock of inflation rate, real GDP and real private final consumption in the future ten years is positive. However, in the short run real tax revenue respond negatively to shock in inflation rate, real private final consumption and real GDP in the long run in Ethiopia. The results indicate that the real tax revenue contribute significantly to shocks to itself.

Impulse Response Functions is also computed for inflation rate and real GDP. The results indicate that the short run fluctuations in real GDP is attributable significantly to shocks to itself while the long run fluctuation in inflation rate is also due to shock to itself. The result from appendix 5 indicates that positive shocks to real private final consumption will have significant and positive impact on inflation rate in the long run. While real GDP responds positively to

shocks in real tax revenue but it has significant negative impact in the long run shocks on real tax revenue. The result also indicates that positive shock to real private final consumption has significant impact on real GDP which is consistent with Keynesian economic theory.

Looking for the impulse response function of real private final consumption is significant and positive for shocks in RPFC itself. One standard deviation shock in real tax revenue significantly and negatively responded by real private final consumption in the short run as well as in the long run. On the other hand, a one standard deviation shock in real GDP is responded negatively by real private final consumption for some period and began to respond positively after third year. The function also shows significant and positive response of real private final consumption to a one standard deviation shocks in inflation rate.

4.2.5 Variance Decomposition Function

The variance decomposition provided further evidence of relationships among the variables under investigation. Therefore, the variance decomposition makes possible to determine the relative importance of each variable in creating fluctuations in other variables. Appendices (6-9) present full decomposition of the variation in LCPI, LRGDP LRPFC and LRTAX.

The result reveals that all the variation in LCPI is explained by the lagged value of the variable itself in the first period. But in the second period, LPFC also explains about 6.7% of the variation and this variation in real private final consumption continue its explanation until period 15 then begin to decline. On the other hand, the variation in real GDP take relatively significant shares after 2nd period in explaining the variation in real LCPI and slightly increasing throughout the period. The results further showed that a huge variation in LCPI in the data is explained by the lagged values of the variable itself (67%) in the long run. In summary, over forty years, about 16%, 8% and 9% of the forecast error variance of LCPI is explained by disturbances in LRGDP, LRPFC and LRTAX respectively.

Appendix 7 show that real tax revenue is responsible for explaining 31% of the variation of LRGDP after five time periods, this percentage reaches 50% after seventeen time periods and goes up to 52.5% after forty time periods. On the other hands, the variation in LRGDP in the data is explained by the lagged values of the variable itself become declining and its variation

became 22% after forty time period. The role of LCPI and LRPFC in LRGDP variability increases through time in the long run and is about 9.8% and 22.2% respectively.

Variance Decompositions is also computed for real private final consumption and real tax revenue (See Appendix 8 and 9). The forecast error variance of LPFC significantly explained by the LRGDP both in the short run and long run while real tax revenue and inflation just explain 5.7% and 8.1% respectively. On the other hands, the forecast error variance of LRTAX is explained by variation in RGDP in the short run and its role starts to decline after four time period. Contrary to this, the role of LCPI in real tax revenue variability increase dramatically after 4 period time and its variation became 44% after forty time period.

CHAPTER FIVE

5. CONCLUSIONS AND POLICY RECOMMENDATIONS

5.1 Conclusions

The study examined whether there is nexuses between tax revenue, inflation, private final consumption and economic growth in Ethiopia using data from 1970-2015. Co-integration and Vector Error Correction approaches have been applied for the identification of nexuses between the variables both in the short run and in the long run. The study applied the shocks or impulse accounting to study such as the response of the variables on each other and percent contributions of volatility of a variable on other variables. Based on the findings of the study from econometric results, the following conclusions are derived.

The impact of inflation rate on real tax revenue is negative and significant in the long run. This is might be because of the effect of the inflation on erosion of amounts expressed in national currency, erosion of the value of tax obligations and effects on the measurement of the tax base. In this regard, Ethiopia didn't adjust the tax system for inflation for a long time so that the value of the amount collected is eroded by inflation in the long run. The other reason could be inflation erodes the value of the tax payment obligations because of collection lags, which represent the difference between the times that a tax obligation arises and the time that the tax is paid.

The effect of real GDP on real tax revenue is negative and significant in the long run. This negative and significant relationship between real GDP and real tax revenue is may be due to large tax evasion among economic agents in Ethiopia. The share of tax revenue in the country is still very low implying that though there is increase in tax revenue recently, it is too low as we compare with the rate of GDP growth. The other reason may be ineffectiveness of the economic and tax reform programs taken by the government, the presences of corruption and the decline in tax morale of the population due to different reasons. Beside these, generally, a nation with a greater share of the manufacturing sector could generate higher tax revenue as compared to the agricultural sector. Ethiopia is faced by the reality of a large share of agriculture in total output and employment, large informal sectors and occupations, many small establishments and informal economies that are outside the formal tax structure which might result in a lower level of tax revenue.

Real private final consumption has positive and significant impacts on inflation rate while the result of the short-run inflation equation found that real GDP has a price depressing effect, but it is not significant. On the other hand, real tax revenue has positive and insignificance impact on inflation in the short run.

The result of short run coefficients indicates that the impact of inflation on real GDP is negative and significant. This shows that increase in inflation in the short run hampers economic growth in Ethiopia. There is also a short run causality from real private final consumption and real tax revenue to real GDP and their impact is positive and insignificant. The result about the short run impact of real PFC and real tax revenue on real GDP is consistent with existing economic theories, especially Keynesian economic theories.

The impact of real tax revenue on private final consumption is negative and this result is consistent with standard economic theories. For instance, the rise in the tax rate will reduce real private final consumption due to income effect of the tax rate. However, the short run impact of real GDP on real PFC is positive and insignificant implying it is consistent with existing economic theories. The short-run impacts of inflation, real GDP and real PFC on real tax revenue are found to be negative and statistically significant except RPFC.

Furthermore, dynamic response of the variables to each other is analyzed using impulse response function and variance decomposition function. The impulse response function analysis of the variables shows that some of the variation in each variable is caused by other variables. The response of real tax revenue to one standard deviation positive shock of inflation rate, real GDP and real private final consumption in the future ten years is positive. However, in the short run real tax revenue respond negatively to shock in inflation rate, real private final consumption and real GDP in the long run in Ethiopia. The results indicate that the real tax revenue contribute significantly to shocks to itself.

Impulse response function of real private final consumption is significant and positive for shocks in RPFC itself. The short run fluctuations in real GDP is attributable significantly to shocks to itself while the long run fluctuation in inflation rate is also due to shock to itself. Real GDP responds positively to shocks in real tax revenue but it has significant negative impact in the long run shocks on real tax revenue.

Variance decomposition function for inflation rate is mainly explained by the lagged value of the variable itself and the remaining variations explained by real PFC, real GDP and real tax revenue. The variation in LRGDP in the data is explained by the lagged values of the variable itself become declining and its variation became 22% after forty time period. The role of LCPI and LRPFC in LRGDP variability increases through time in the long run and is about 9.8% and 22.2% respectively. The forecast error variance of LPFC significantly explained by the LRGDP both in the short run and long run.

After examining the nexuses between tax revenue, inflation, private final consumption and economic growth in Ethiopia the following policy implications are forwarded.

5.2 Policy Recommendations

There is negative relationship between inflation rate and real gross domestic product in the short run. This means that there will be inevitably inflationary problem during economic growth in the country. Government should target appropriate threshold level of inflation rate so that optimal level of economic growth would be attained.

The positive impact of real tax revenue on economic growth in the short run shows that government should intervene to increase the benefit from tax to promote sustainable economic growth in the country. The result also suggests that the tax system is not revenue productive, and in such situations increasing revenue through efficient way should be the main objective of tax policy. The fact that tax-to-GDP ratio remained too low exhibits the need of pragmatic approach of policy makers to raise the tax revenue through tax reforms that focus on increasing the tax base.

Lastly, this study examined whether there are nexuses between tax revenue, inflation, private final consumption and economic growth in Ethiopia during the period 1970-2015. This is done only at aggregate level and, thus, the impacts of disaggregated approach using ARDL Co-Integration are open to research.

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Appendices

Appendix 1: Phillips-Perron Stationarity Test Result

Variable	Tests statistics under different case			Order of Integration
	Intercept	Trend and Intercept	No Trend No Intercept	
LCPI	-0.605669	-2.986663	1.896826	I(1)
D(LCPI)	-7.953137	-7.859927	-7.009952	
LRGDP	3.121320	0.112800	5.212582	I(1)
D(LRGDP)	-6.102024	-7.093387	-4.290795	
LRPFC	-1.058682	-3.332894	1.659600	I(1)
D(LRPFC)	-8.706163	-8.629447	-8.214824	
LRTAX	1.770326	-0.041061	5.291661	I(1)
D(LRTAX)	-5.230009	-5.587588	-3.812369	

Note: D shows the variable is differenced once. MacKinnon (1996) one-sided critical values for rejection of a unit root are used here.

Appendix 2: The post estimation joint diagnostic test results for residual normality

VEC Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: residuals are multivariate normal
Date: 05/16/16 Time: 03:43
Sample: 1970 2015
Included observations: 43

Component	Skewness	Chi-sq	df	Prob.
1	3.419917	83.82011	1	0.0000
2	2.938176	61.86898	1	0.0000
3	-0.535958	2.058629	1	0.1513
4	-0.362138	0.939867	1	0.3323
Joint		148.6876	4	0.0000

Component	Kurtosis	Chi-sq	df	Prob.
1	18.86962	451.2217	1	0.0000
2	16.61425	332.0813	1	0.0000
3	3.467631	0.391799	1	0.5314
4	2.998978	1.87E-06	1	0.9989

Joint	783.6949	4	0.0000

Component	Jarque-Bera	df	Prob.
1	535.0418	2	0.0000
2	393.9503	2	0.0000
3	2.450427	2	0.2937
4	0.939868	2	0.6250
Joint	932.3824	8	0.0000

Appendix 3: The post estimation joint diagnostic test results for Residual Vector Serial Correlation LM Test

VEC Residual Serial Correlation LM Tests

Null Hypothesis: no serial correlation at lag order h

Date: 05/16/16 Time: 04:24

Sample: 1970 2015

Included observations: 43

Lags	LM-Stat	Prob
1	17.45274	0.3569
2	17.47906	0.3553
3	17.94296	0.3272

Probs from chi-square with 16 df.

Appendix 4: The post estimation joint diagnostic test results for Residual Vector Heteroscedasticity Test

VEC Residual Heteroscedasticity Tests: No Cross Terms (only levels and squares)
Date: 05/16/16 Time: 04:25
Sample: 1970 2015
Included observations: 43

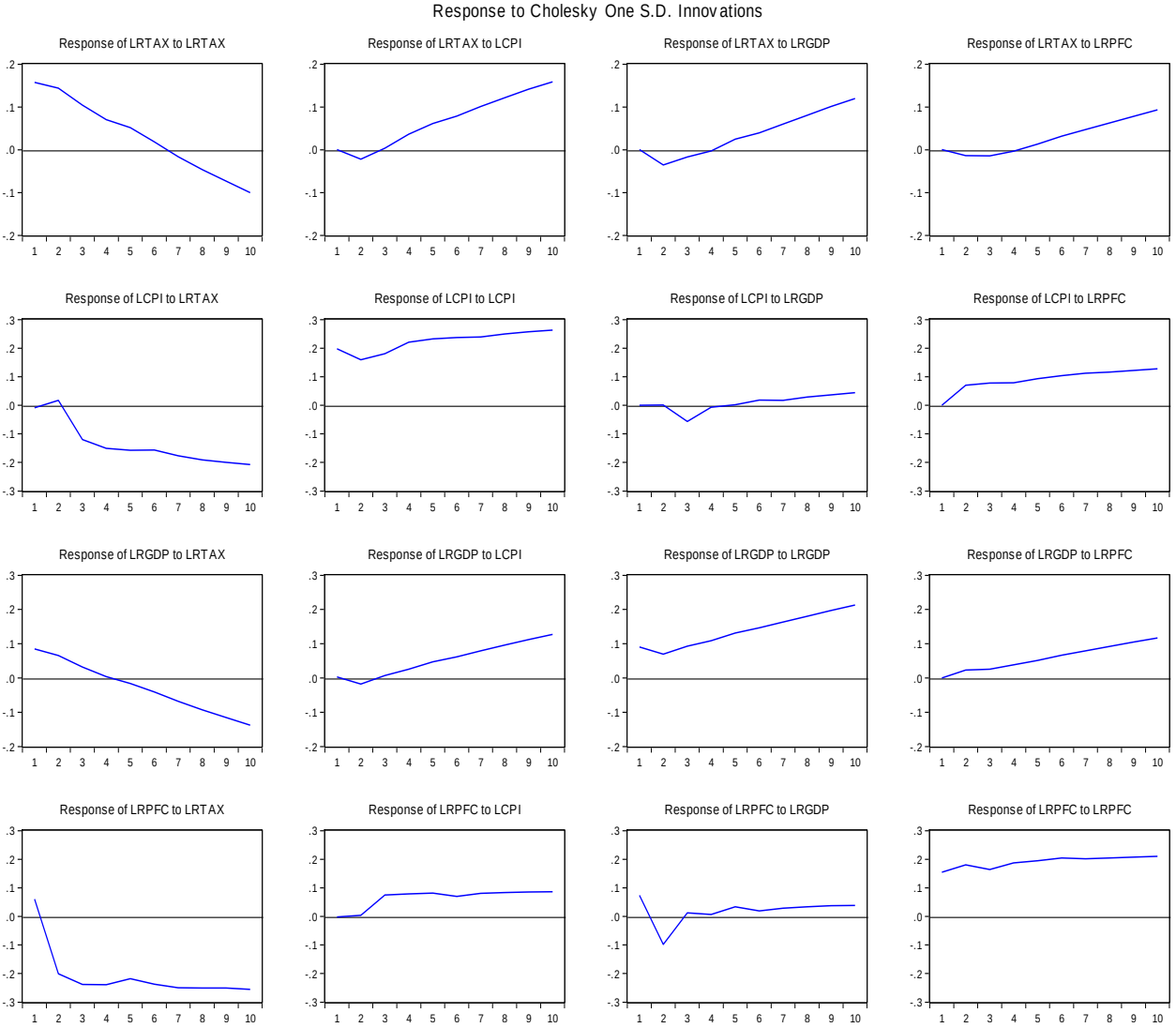
Joint test:

Chi-sq	df	Prob.
204.6872	180	0.1001

Individual components:

Dependent	R-squared	F(18,24)	Prob.	Chi-sq(18)	Prob.
res1*res1	0.384438	0.832708	0.6506	16.53082	0.5556
res2*res2	0.385463	0.836320	0.6471	16.57489	0.5525
res3*res3	0.738085	3.757376	0.0015	31.73765	0.0236
res4*res4	0.333372	0.666782	0.8093	14.33499	0.7070
res2*res1	0.296905	0.563043	0.8926	12.76690	0.8052
res3*res1	0.459385	1.132991	0.3815	19.75353	0.3469
res3*res2	0.383012	0.827704	0.6556	16.46953	0.5598
res4*res1	0.512974	1.404372	0.2158	22.05789	0.2294
res4*res2	0.375257	0.800876	0.6820	16.13604	0.5831
res4*res3	0.332197	0.663264	0.8125	14.28448	0.7104

Appendix 5: Impulse Response function



Appendix 6: Variance Decomposing functions (LCPI)

Period	S.E.	LCPI	LRGDP	LRPFC	LRTAX
1	0.194139	100.0000	0.000000	0.000000	0.000000
2	0.256480	89.98474	1.823922	6.749480	1.441855
3	0.321044	79.22133	9.744955	9.377901	1.655815
4	0.376220	76.50804	10.44798	9.789279	3.254704
5	0.420780	75.33935	10.57235	10.49558	3.592726
6	0.450823	74.91726	10.23250	11.57402	3.276217
7	0.474136	73.88854	10.93847	12.20995	2.963034
8	0.493100	73.34704	11.52427	12.27818	2.850516
9	0.510003	72.83850	11.96735	12.11132	3.082830
10	0.525976	72.25235	12.27237	11.82886	3.646414
11	0.541796	71.54137	12.62196	11.47870	4.357966
12	0.557605	70.90818	12.95556	11.09598	5.040275
13	0.573361	70.39480	13.24248	10.72836	5.634363
14	0.588979	69.99137	13.49273	10.39910	6.116804
15	0.604387	69.67061	13.72960	10.11343	6.486351
16	0.619531	69.42051	13.95195	9.867129	6.760413
17	0.634359	69.22210	14.15314	9.656057	6.968700
18	0.648841	69.05397	14.33512	9.474441	7.136463
19	0.662972	68.90174	14.50233	9.315305	7.280618
20	0.676765	68.75904	14.65688	9.172302	7.411774
21	0.690241	68.62320	14.79913	9.041124	7.536544
22	0.703427	68.49256	14.93029	8.919077	7.658067
23	0.716349	68.36678	15.05192	8.804444	7.776854
24	0.729033	68.24648	15.16518	8.696218	7.892119
25	0.741498	68.13245	15.27082	8.593920	8.002807
26	0.753759	68.02507	15.36956	8.497335	8.108036
27	0.765829	67.92437	15.46211	8.406287	8.207234
28	0.777717	67.83017	15.54906	8.320557	8.300213
29	0.789430	67.74206	15.63091	8.239879	8.387144
30	0.800975	67.65953	15.70809	8.163937	8.468441
31	0.812357	67.58200	15.78098	8.092383	8.544634
32	0.823583	67.50893	15.84994	8.024856	8.616274
33	0.834658	67.43985	15.91527	7.961005	8.683878
34	0.845588	67.37435	15.97724	7.900510	8.747894
35	0.856377	67.31211	16.03612	7.843082	8.808692
36	0.867032	67.25285	16.09211	7.788468	8.866566
37	0.877556	67.19636	16.14544	7.736451	8.921752
38	0.887956	67.14245	16.19628	7.686839	8.974438
39	0.898235	67.09095	16.24480	7.639467	9.024783
40	0.908398	67.04172	16.29117	7.594188	9.072927

Appendix 7: Variance Decomposing functions (LRGDP)

Period	S.E.	LCPI	LRGDP	LRPFC	LRTAX
1	0.125564	0.526412	99.47359	0.000000	0.000000
2	0.160308	0.468974	96.84005	2.632828	0.058145
3	0.193708	1.502687	89.54505	3.617907	5.334353
4	0.236492	4.424519	75.46183	5.069058	15.04459
5	0.292481	7.760550	61.35272	6.787998	24.09873
6	0.352141	9.587716	50.36604	8.830806	31.21544
7	0.413023	10.57740	42.07693	10.39856	36.94710
8	0.472613	11.02186	36.37904	11.53499	41.06411
9	0.528577	11.14273	32.62627	12.39865	43.83235
10	0.579673	11.06654	30.15768	13.08050	45.69528
11	0.625897	10.91552	28.48152	13.59593	47.00702
12	0.667899	10.75318	27.33920	13.97286	47.93477
13	0.706369	10.60419	26.55063	14.25367	48.59152
14	0.741995	10.47623	25.98661	14.46804	49.06913
15	0.775404	10.37218	25.55737	14.63412	49.43633
16	0.807128	10.29131	25.21184	14.76446	49.73240
17	0.837553	10.22970	24.91969	14.87029	49.98033
18	0.866937	10.18256	24.66246	14.95958	50.19540
19	0.895448	10.14570	24.42956	15.03722	50.38751
20	0.923191	10.11588	24.21624	15.10609	50.56179
21	0.950226	10.09060	24.02063	15.16814	50.72062
22	0.976589	10.06816	23.84174	15.22466	50.86545
23	1.002306	10.04754	23.67867	15.27636	50.99743
24	1.027402	10.02826	23.53048	15.32368	51.11757
25	1.051903	10.01013	23.39605	15.36700	51.22683
26	1.075839	9.993086	23.27403	15.40665	51.32624
27	1.099242	9.977138	23.16301	15.44298	51.41688
28	1.122145	9.962297	23.06160	15.47631	51.49980
29	1.144579	9.948549	22.96855	15.50695	51.57595
30	1.166575	9.935845	22.88275	15.53522	51.64619
31	1.188160	9.924110	22.80327	15.56137	51.71125
32	1.209358	9.913257	22.72934	15.58566	51.77174
33	1.230192	9.903191	22.66034	15.60830	51.82818
34	1.250679	9.893822	22.59575	15.62945	51.88097
35	1.270838	9.885071	22.53516	15.64928	51.93049
36	1.290683	9.876865	22.47821	15.66790	51.97702
37	1.310229	9.869148	22.42460	15.68544	52.02082
38	1.329488	9.861870	22.37404	15.70197	52.06212
39	1.348473	9.854993	22.32630	15.71758	52.10112
40	1.367194	9.848482	22.28117	15.73235	52.13800

Appendix 8: Variance Decomposing functions (LRPFC)

Period	S.E.	LCPI	LRGDP	LRPFC	LRTAX
1	0.184103	0.001079	30.73493	69.26399	0.000000
2	0.330890	0.066379	44.34546	50.74964	4.838518
3	0.416217	1.010295	36.57987	44.77509	17.63475
4	0.488214	1.101242	32.41699	45.11183	21.36993
5	0.537966	0.911038	29.15667	48.13487	21.79741
6	0.582588	1.144538	28.61277	49.68804	20.55465
7	0.616075	1.578416	28.81414	50.23587	19.37157
8	0.642228	2.212915	29.07183	50.62502	18.09024
9	0.664713	2.965763	29.32054	50.80268	16.91102
10	0.686093	3.750149	29.72372	50.65112	15.87502
11	0.706122	4.401258	30.24636	50.35557	14.99681
12	0.724960	4.905629	30.75929	50.09604	14.23904
13	0.743177	5.292491	31.24495	49.90584	13.55672
14	0.761122	5.591599	31.71098	49.77076	12.92667
15	0.778850	5.822316	32.15193	49.68080	12.34495
16	0.796325	6.006737	32.54688	49.63521	11.81117
17	0.813573	6.164534	32.89473	49.62034	11.32040
18	0.830586	6.308293	33.20389	49.61998	10.86784
19	0.847326	6.444308	33.48261	49.62344	10.44965
20	0.863755	6.575530	33.73545	49.62657	10.06246
21	0.879865	6.703098	33.96697	49.62700	9.702924
22	0.895665	6.826716	34.18163	49.62345	9.368208
23	0.911169	6.945381	34.38262	49.61606	9.055943
24	0.926390	7.058139	34.57169	49.60612	8.764060
25	0.941348	7.164453	34.74995	49.59494	8.490655
26	0.956063	7.264181	34.91828	49.58351	8.234020
27	0.970550	7.357489	35.07737	49.57248	7.992652
28	0.984823	7.444777	35.22773	49.56227	7.765225
29	0.998894	7.526585	35.36982	49.55304	7.550558
30	1.012773	7.603490	35.50415	49.54476	7.347599
31	1.026467	7.676036	35.63127	49.53729	7.155407
32	1.039983	7.744698	35.75168	49.53047	6.973145
33	1.053327	7.809872	35.86591	49.52416	6.800058
34	1.066504	7.871882	35.97443	49.51822	6.635469
35	1.079522	7.930986	36.07769	49.51256	6.478766
36	1.092384	7.987394	36.17608	49.50713	6.329394
37	1.105096	8.041280	36.26997	49.50190	6.186851
38	1.117663	8.092798	36.35966	49.49686	6.050681
39	1.130091	8.142086	36.44544	49.49200	5.920466
40	1.142382	8.189273	36.52757	49.48733	5.795825

Appendix 9: Variance Decomposing functions (LRTAX)

Period	S.E.	LCPI	LRGDP	LRPFC	LRTAX
1	0.154822	0.406097	45.61560	0.032106	53.94620
2	0.204720	0.232392	35.55424	0.402242	63.81113
3	0.226252	2.415831	34.20780	0.783858	62.59251
4	0.245769	12.68851	32.43297	0.693267	54.18525
5	0.276949	25.60815	30.38036	1.083522	42.92797
6	0.315019	35.11991	26.07566	2.917841	35.88659
7	0.361167	40.50012	21.52328	5.084674	32.89193
8	0.410453	42.79835	17.98629	7.054508	32.16086
9	0.458055	43.45452	15.69231	8.710930	32.14224
10	0.500857	43.41621	14.21784	10.06907	32.29689
11	0.538622	43.20980	13.26237	11.09625	32.43158
12	0.571923	43.03417	12.65783	11.85750	32.45050
13	0.601604	42.93894	12.28450	12.42929	32.34727
14	0.628502	42.91965	12.04319	12.86901	32.16815
15	0.653431	42.96247	11.86991	13.20956	31.95806
16	0.677039	43.04704	11.73261	13.47793	31.74242
17	0.699762	43.15262	11.61367	13.69707	31.53663
18	0.721857	43.26254	11.50280	13.88327	31.35139
19	0.743468	43.36635	11.39539	14.04631	31.19194
20	0.764661	43.45850	11.29138	14.19223	31.05788
21	0.785448	43.53698	11.19221	14.32509	30.94572
22	0.805815	43.60229	11.09918	14.44734	30.85120
23	0.825747	43.65647	11.01311	14.56021	30.77021
24	0.845236	43.70207	10.93439	14.66440	30.69914
25	0.864286	43.74144	10.86291	14.76048	30.63518
26	0.882909	43.77643	10.79816	14.84899	30.57641
27	0.901125	43.80840	10.73939	14.93052	30.52169
28	0.918959	43.83819	10.68580	15.00565	30.47036
29	0.936437	43.86628	10.63665	15.07500	30.42207
30	0.953585	43.89289	10.59127	15.13918	30.37666
31	0.970424	43.91811	10.54911	15.19876	30.33402
32	0.986974	43.94194	10.50976	15.25424	30.29406
33	1.003253	43.96441	10.47288	15.30608	30.25663
34	1.019274	43.98555	10.43822	15.35465	30.22158
35	1.035049	44.00539	10.40558	15.40029	30.18874
36	1.050590	44.02403	10.37480	15.44327	30.15791
37	1.065906	44.04154	10.34573	15.48381	30.12891
38	1.081006	44.05803	10.31826	15.52213	30.10157
39	1.095899	44.07359	10.29227	15.55840	30.07574
40	1.110591	44.08831	10.26765	15.59277	30.05127

Declaration

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

Declared by:

Name: Firehiywot Handamo Godiso

Signature: …….

Date: ……..

Confirmed by (advisor)

Name: Fantu Guta (PhD)

Signature: ……

Date: ……

Place and date of submission: ……