THE RELATIONSHIP BETWEEN GROSS DOMESTIC SAVINGS AND ECONOMIC GROWTH IN ETHIOPIA

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This is to certify that the paper prepared by Jember Yabgeta Beza, entitled: The Relationship Between Gross Domestic Savings and Economic Growth in Ethiopia and submitted in Partial Fulfillment of the Requirements for the degree of masters 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

It is the fact that saving is one of the determinants of economic growth; especially, in developing countries. Transferring some portion of current income to the future (saving) can be considered as the source of capital stock in which it has great role in creating new investments, surging employment, rising disposable income thereby boosting production in the economy. In aggregate, these will result in economic growth. So, the main objective of this study is to examine the relationship between gross domestic saving and economic growth in Ethiopia. It also investigates whether the direction of causality runs from gross domestic saving to economic growth or vice versa. To achieve this objective, first it is necessary to test whether the variables are stationary or not. Granger causality tests were conducted using time series annual data ranged from 1974 to 2015, and the empirical result suggests that the causality runs from lnRGDS to lnRGDP in the long run in Ethiopia. However, there is no short run causality running from gross domestic saving to growth rate of economy in Ethiopia. On the other hand, there is long run causality running from growth rate of economy to gross domestic saving.

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ACRONYMS

ADF == Augmented Dickey-Fuller

GDP == gross domestic product

GDS ==gross domestic saving

ICOR ==Incremental output capital ratio

IMF ==International Monetary Fund

LDCs==least developed countries

NBE ==National Bank of Ethiopia

MoFEC==Ministry of Finance and Economic Cooperation

SSA==Sub-Saharan Africa

WB ==World Bank

CHAPTER ONE

1. INTRODUCTION

1.1 Background of the study

It is undeniable that all countries in the world want enjoying a higher economic growth and attaining social improvement so that everyone could lead better standard of living and leading a comfortable life. Because of fastest and sustainable economic growth, advanced countries are leading a better way of living standard than ever before and their social welfare is highly amended. Stakeholders in each country try their best to increase the level of national income which result in improvement in the living standard of the society (reduce the poverty level). Therefore, to maintain multidimensional improvement, responsible bodies should implement various kinds of economic policies. For instance, encourage people to transfer some portion of their current income to the future (savings), encouraging investment by formulating proper investment policies and stimulate production in the country. Saving helps us to create new investments, which in turn, investments contribute a lot to economic growth in the country's aggregate wealth. Now we can understand that an economy with an increasing saving level will have an increasing investment (Solow, 1956). Therefore, savings play greater role in providing the required amount of finance to the national capacity for investment and production, which will affect the potential of the economy to grow. This implies that increasing aggregate savings contribute to higher investment and leads to higher growth in gross domestic product as stated by the neoclassical economists. Number one constraint which faces most developing countries to achieve higher investment thereby sustainable economic growth is lower level of domestic savings. Saving in developing countries is not only used as the means of accumulating wealth but also used as smoothing consumption in face of the volatile and unpredictable income and helping to ensure the living standards of poor people whose lives are difficult and uncertain (Oladipo, 2010).

According to neoclassical growth models, countries with higher total savings will have higher investments which may lead to higher growth in national output level in the short run. This implies that countries can actually attain a higher economic growth rate by accumulating capital investments this can be done by reducing current consumption, and whatever income left after expenditures on consumption of goods and services will be savings. In other words, a nation with a higher saving rate leads to less consumption today, which result in larger amount of capital investment thereby the country will enjoy a higher economic growth rate (Romer, 1996). On the other hand, in reality and some empirical studies propose that when the respective country's economy grows, the growth of the economy will contribute to a growth in the personal income and thereby increase in per capita consumption expenditure. According to neoclassical models specifically the concept of marginal propensity, saving level increases with an increasing level of income. From this theory we can easily understand that when the economy growths, the total amount of savings will also increases in the economy (Romer, 1996). Examining the relationship between gross domestic savings and gross domestic product is important to examine the causal relationship between savings and economic growth, because this may provide useful insights on the variables which should be controlled in order to get the desired level of the targeted variable(s) (Oladipo, 2010). It can also be useful for policy makers designing policies. If the causality is from savings to economic growth, then savings should increase in order to achieve a higher economic growth. If the results imply that the economic growth causes savings, then the Keynesian point of view that savings depend on income is dominating. So decision makings will emphasize the demand side of the economy in order to increase economic growth. According to the debatable view about the relationships among consumption, saving, investment and economic growth, one may not refuse to accept that once a country's aggregate saving level increases from the growing income level; it might result in an increased level of investment

opportunities and from this a typical country might generate sustainable economic growth. On the other hand, if the economy of a typical country is growing, it might lead to increasing in savings (Sollow, 1956).

Ethiopia becomes one of the fastest non-oil rich growing economies in the world (Mulugeta, 2016). To sustain this, Ethiopian government is trying its best in attracting both domestic and especially foreign investors so that the newly created investments can generate high amount of foreign currency, to create high employment opportunities i. e, it may help the society to generate income for previously unemployed ones and higher incomes for the others and government also can generate additional income in the form of fair tax (i. e, fair tax so that investors feel confident in the tax system thereby as they become successful in their investment, they want to expand more. The more investment expands the more positive effects on economic growth such as rise in GDP, savings, forex, higher employment and so on). When Ethiopia exports goods and services to the rest of the world, we actually get foreign exchange which is one of the determinants of economic growth in the country (Dorosh, Robinson and Ahmed, 2009). This forex might be used as to the import of capital goods (equipment, machineries, etc…). Since capital goods play a great role in maintaining economic growth of developing countries like Ethiopia, there must be huge amount of foreign currency so that the nation satisfy investors' requirement for saving and foreign currency. Gross domestic saving is a type of saving in which people save within the country after paying their taxes and consumption. It consists of both private and public savings.

- Private saving is the amount of income that households have left after paying their taxes and paying for their consumption. Private saving = (Y – T – C).
- Public saving is the amount of tax revenue that the government has left after paying for its spending. Public saving = (T – G) (Mankiw, 2003).

In the same way; the major sources of savings in Ethiopia include: domestic saving (includes household savings and public savings) and external saving.

If Ethiopia has sufficient domestic savings that satisfy investor's requirement for currency, then we might not require the external savings in which it probably exposes domestic economy to irreversible risks from the rest of the world's macroeconomic crisis. However, the existing situation is opposite. Meaning that Ethiopia like other developing countries characterized by lower savings because of lower incomes. Experiences from the economic crisis in the world reveal that low saving rates have generated a severe current account deficit in a country (Obstfeld, 2009). For example, since Ethiopia is one of developing countries that face problems of current account deficit in each fiscal year which are attributed to the imbalance between export and import prices. This so because the fact that developing countries export raw materials and primary goods (i.e., agricultural goods such as, coffee and hides) which are cheap in the international market in contrast to imports that are more expensive which result in current account deficit. Even though, developing countries like Ethiopia have adequate domestic saving rates; they are obliged to have foreign currency since they import capital goods (Fekadu, 2014). In fact, Ethiopia's internal saving is so small that it might not meet investors' requirement for investment purpose, in this case the country is forced to borrow money from abroad and/or domestic savers to fill the shortage of internal savings. So, in this case the country's economic growth will not be independent of foreign aid and borrowings. This implies that what happened to the rest of the world's economy will affect the growth of domestic economy. The risks that most of the time countries suffer are exposure from currency and macroeconomic instabilities in the rest of the world. If we have greater or balanced savings with investors' requirement for doing business in the country, we will have more investments; which will increase employment level, more revenues for government in the form of tax and more savings. This also will result in higher output.

Furthermore, higher output will generate higher income. This higher income will increase consumption and saving then society will be better off.

However, countries like Ethiopia by any means of economic measurement are less developed. This implies that since less developed countries are characterized by lower level of income, the lesser consumption, lower savings, and poor living standard. The probability that these countries exposed to foreign economic shocks are high since their economy depends on foreign borrowings and foreign aid. It is obvious that under normal condition, those countries with high income levels will have higher consumption, higher saving rate. The existing investment added to with new higher investment to form higher capital accumulation. If there is higher capital stock there will be higher per capita income this will result in improvement in living standard. Therefore, investigating the relationship between saving and economic growth help to inspect which variable causes the other variable in which it will provide convenient information to policy makers on the variables which should be controlled in order to obtain the desired level of the targeted variable

A survey undertaken by the World Bank (1993) on the role of savings in economic development shows that, countries with higher saving rates have grown at faster rates than those with low saving rates. As a result of this finding, the World Bank suggested developing countries to adopt policies which encourage savings are relevant because this higher savings will contribute to higher economic growth. However, recent empirical findings have been mixed outcomes and, due to this, the debate on savings and growth remain unresolved. Scholars such as Gavin, et al (1997), Sinha and Sinha (1998), Saltz (1999), and Agrawal (2001), found that economic growth rate come first then savings can grows whereas; empirical findings by Cullison (1993), Alguacil, Cuadros and Orts (2004), and Lorie (2007), found the opposite of what the above scholars found (Oladipo, 2010).

1.2 Statement of the problem

To get fast and successful results in the economic reform, for viable economic growth and for attaining macroeconomic stability (lower inflation and lower unemployment rates) in the economy, it is essential to have an appropriate, sound, rational economic, social, and investment policies and strategies. As mentioned earlier; Ethiopia (currently enjoys the fastest growing economy) however, is one of the least developed countries in the world by any means of economic measurement. To improve these problems, the formulation and application of sound economic and capital formation policies and strategies are compulsory ingredients. Stakeholders should encourage people to transfer some resources to the future (saving), give primacy to selected sectors i.e., give priority to selected sectors which have high link with agriculture since majority of the people are agrarian in Ethiopia (i. e, formulate appropriate policies which will result in improved living standard in the rural). However, it is observed that Ethiopian economy and the growth of the economy has been constrained by a number of problems such as low per capita income, low level domestic saving, low tax base and inefficient tax collection system (Fekadu, 2014), time lags that occur between the onset of an economic problem and the full impact of the policy intended to correct the problem, the imbalance between government revenue and its expenditure, low amount of capital formation, high urban unemployment rate, even though it is improving weak performance of the private sector and fluctuations in the price and output of agricultural and industrial sectors (Tawiri, 2010). To improve the wellbeing of the society; there should be application of sound economic policies (best growth models) so that the country becomes competent in the international market which also may lead to attracting more foreign direct investment. By taking into account the problems mentioned above, policy makers should be careful before implementing specific growth models. For advanced countries, there are many empirical studies which examine the relationship between gross domestic saving and economic growth.

On the contrary, for developing countries there are some literatures on the subject matter which are empirically studied. However, these literatures are characterized by many problems such as; cross county regression which might not show the respective country's specific and existing situations. Implying that, these literatures pool different countries together; having different political, social, economic characteristics and size (Oladipo, 2010). As noted in Carrol and Weil (1993), literatures on the relationship between gross domestic saving and economic growth have different drawbacks like, inability to show country specific behaviors such as, effectiveness of government in deriving resources to improve the economy, the level of corruption and violence, and the attitude of the government and the society toward achievement of individual enterprise that affect the saving and growth of the economy. As stated earlier, knowing the direction of the causality helps a country to design appropriate policies which result in aggregate improvement in social welfare. In the study, the applicability of growth models will be analyzed and the relationship between gross domestic saving and economic growth will be empirically examined.

1.3 Objectives of the Study

The objective of the paper can be seen in terms of general and specific objectives so that it can be easily and clearly understood what the aim of this paper is.

The general objective of the study will be to analyze the relationship between gross domestic savings and economic growth rates.

Specific objectives includes

- Examine the trends in economic variables (output and gross domestic savings).
- Assess whether the saving causes economic growth or vice versa in Ethiopia.

1.4 Data sources

Time series annual data on Gross Domestic Product and gross domestic savings were collected from the National Bank of Ethiopia (NBE) as major data source, and publications of different institutions such as Ministry of Finance and Economic Development (MoFEC), World Bank, and Central statistics Authority (CSA) are also used as data sources for the problem under examination. To achieve this, the data covers the period 1974 to 2013.

1.5 Significance of the study

The significance of the study is to provide clear and coherent information about the trends and effects of savings and the growth of the economy in Ethiopia which help us to improve the living standard of the society. Furthermore, the study can be used as a source of data for further researches by other examiner. In this paper the short run as well as long run relationship between gross domestic saving and economic growth is examined. Detecting the relationship between the two variables is important to know the causal relationship between savings and economic growth, because it can provide useful information on the variables which should be controlled in order to obtain the desired level of the targeted variables. Since it provides information about the direction or which variable can cause the other; it will be useful for policy makers in designing policies. If the causality is running from gross domestic savings to economic growth, then savings should increase in order to achieve a higher economic growth. If it holds the reverse, implying that the economic growth causes gross domestic savings; then the Keynesian theory (savings depend on income is dominating) would be the best model to achieve economic growth first and then growth in gross domestic savings.

1.6 Limitation of the study

Time series data is used to examine the causality relationship between gross domestic savings and economic growth in Ethiopia. In Ethiopia, evaluating the quality of data, there is no

adequate and consistent data. There are no long year data for the variables under investigation which are sufficient to undertake the research using time series data. Furthermore, the World Bank data base has no data for the year 1980 and before this year for the variables which are examined in the study which places a limitation on the scope of the variables in the study.

1.7 Organization of the study

The structure of the paper is presented as follows: Chapter two provides theoretical issues and some empirical evidences that explain the relationship between GDS and GDP in developing countries. Basically, the focus in this chapter is on the general relationship between savings and economic growth. Chapter three is devoted to methodological framework of the study. Finally, Chapter four provides conclusions and policy recommendation based on the result of the analysis.

CHAPTER TWO

2. Literature review on economic growth models

2.1 Classical economic growth models

Classical economists such as, Adam Smith, David Ricardo, and Thomas Robert Malthus gave main emphasis to productive investment and capital accumulation as the driving factors of the growth model. Especially, Adam Smith (1776) gave attention to the concept of division of labor which leads specialization of individuals based on their specialty and the changes in production methods to achieve economic growth. They also focused on the impact of technological progress on economic growth process. Adam Smith (1776) stated about supply-side driven growth model. He puts these relationships in functional form as stated below;

$Y = f(L, K, T)$;

Where: Y is output (national income); L refers to labor; K is capital, and T land

He also indicated that growth of output or living standard of a country is a function of capital accumulation implying that countries should concern about how capital would be accumulated so that they could improve the living standard their society. According to Adam Smith, Capital accumulation is a function of investment and investment itself is a function of saving. Saving on the other hand is a function of profits. Profits are determined by the level of efficiency which itself influenced on specialization (Smith, 1776).

Adam Smith (1776) gave attention to specialization of labor which can come from two sources, first the saving and capital accumulation, and other one is the extent of the markets. Saving creates investment and thereby economic growth. If the market size is small division

of labor or specialization of labor become unfounded. The economy tries to use cost saving technology and division of labor (specialization) if there is large market size.

2.2 Neoclassical growth models:

This growth model argued that to achieve the long run economic growth, countries should worry about how an increased labor can be supplied and its improvement or capital productivity. Neoclassical economists predicted that savings and economic growth have direct relationship. This relationship can be described by the increase in savings; which can stimulate economic growth through investment (Romer, 1996). These models argued that factors of production such as labor, capital, and land or other essentials in the production of commodities can be substituted easily, which allow the economy to attain steady-state growth which means a constant proportionate rate of growth of all real variables. Neoclassical theory also cited about the long-run equilibrium of a competitive economy by paying attention to the accumulation of capital goods, growth in population, and technological progress. There are two well-known models in this category. These are;

Harrod-Domar growth model:

This growth model was developed independently by Sir Roy Harrod (1946, 1948) and Professor Evesey Domar (1946, 1947). It is based on theories which relate an economy's rate of growth to its capital stock. According to this model, important factor to achieve continuous economic growth needs to expand the level of investment in terms of fixed capital this includes; factories, machines, and human capital (people as workers). To achieve these, the country should encourage savings and generate technological progress that enable firms to produce more output with less capital (i.e., lower their capital– output ratio or $v = Y/K$) (Domar, 1946:139). It assumes that, investment is a necessary element to sustain economic growth. It advocates that savings bring the fund for purposes of expanding investments. As explained by Romer (1996), the growth rate of an economy in Harrod-Domar is dependent on

two important factors - the savings level (S) and capital-output ratio (v) of the economy. With a target growth rate, the required saving rate is known. The rate of growth of national output will continuously increase if the capital stock and labor have the same rate of growth as the growth rate of output does (as Harrod called as "warranted rate of growth"). However, this theory has some weakness such as; the condition mentioned above might not hold true. In other words, it defines a case of close economy (autarky); since it assumes that there is no government, no depreciation, and investment is just equal to savings, it fails to incorporate important factors which should be included in the model (Acemoglu, 2009). If the country is not capable of generating the required level of savings, it is a justification or an excuse for borrowing from domestic savers, other countries, and/or multinational institutions can be established even though it is unsafe for domestic economy. Since the economy is close, the investment (I) is determined by the amount of savings (S) the amount that is left after the total expenditure on consumption. Furthermore, it assumes that there are sufficient amount of savings and capital in the economy. The model also asserts that; the economy can produce any amount of savings and capital if required without any problem. Thus, saving (S) is a proportion of marginal propensity to save times national income (Y) ($S = sY$. Where; s is marginal propensity to save, Y is gross domestic product, and S is total savings. Investment is explained as the change in capital stock (ΔK). Capital stock is also expressed a proportion of national income (Y) times the capital- output ratio (v). Investment is assumed to be equal to saving; so, in equilibrium, $sY = v(\Delta Y)$. From this $\frac{s}{v} = \frac{\Delta Y}{Y}$ where; ΔY is the growth rate of GDP which can be defined as the percentage change in gross domestic product in the country. Accordingly, Harrod-Domar model can be expressed as; the growth rate of GDP ($\frac{\Delta Y}{Y}$) is determined by marginal propensity to save (s), and the national capital output ratio (v). Whereas $\frac{s}{v}$ is the rate of growth that will cause investors' expectation to be realized. From the

above expression we can conclude that those countries with higher marginal propensity to save will enjoy high rate of growth of output. (Romer, 1996). On the contrary, the capital-output ratio (v) has an inverse relationship with growth rate of output; implying that, countries with higher capital-output ratio, will have lower national income (GDP) level. According to this model, the economy can grow as far as the country increases the saving and investment levels in a certain proportion of its national income. Generally, according to Harrod-Domar model, the growth rate of the economy can be represented as follows: From the above expressions we have; $\frac{s}{v} = \frac{\Delta Y}{Y}$ recall that $\frac{\Delta Y}{Y} = g$. Now we have the equation $\frac{s}{v} = \frac{\Delta Y}{Y} = g$. Where: g is the rate of economic growth, s : is the marginal propensity to save, and (v) : is capital-output ratio (ICOR). This model has the implication that the rate of growth in GDP is determined not only by the savings, but also the national capital output ratio (ICOR). According to this model, where there is a simple economy, growth of the economy or growth of national income has direct relationship with national saving rate while it has an inverse relation with capital output ratio (v).

This model in the early postwar times was commonly used by developing countries in economic planning. However, are not successful in maintaining the required level of economic growth. With a target growth rate, the required saving rate is known. According to this growth theory, if the country is not capable of generating that level of saving, a justification or an excuse for borrowing from international agencies can be established. This is due to saving goes with the level of income (Halil, 2015). Since, in reality countries cannot get the required level of savings rather they are forced to borrow from the rest of the world to fill domestic savings and there are many problems related to debt like accumulating debt which increases the burden of the coming generation if the current generation fails to repay.

Solow-Swan growth model

In 1956, Robert Solow and T.W. Swan independently developed similar growth model. Solow-Swan growth model is based on two basic equations; these are production function and capital accumulation which explains about how the capital stock, labor, and technological progress have affects the production of output. In addition to this, they predicted that the rise in saving rate and improvements in productivity have positive correlation with per capita income level (Solow, 1956). In this model, emphasis is given to the increase in capital accumulation, higher potential of labor, and technological advancement. According to this model, the size of the economy does not matter for maintaining economic growth as the classical economist especially Adam Smith stated, rather the main factors for them which determine economic growth are capital, labor, and technology. To simplify this model, the inputs are grouped in to two categories i.e. capital K and labor L) and the output is represented by Y. This growth model is based on the Cobb-Douglas production function. That is $y = f(k)$ where; y is total output per worker and k is capital per capita (Wubu, 2011). Output per capita is equal to consumption per capita plus investment per capita as shown below:

$y = c + i$ …….……..……..…… (1)

Where, c is consumption per capita and i is investment per capita. Since saving is assumed to be equal to investment, that is $i = s$

As stated in the model, consumption is a constant proportion of income and s is marginal propensity to save. This can be represented as:

$c = (1 - s)y$ ……..……..……..…… (2)

Substitute equation (2) in to equation (1) we get: $sy = i$. This equation shows that saving per capita is equal to investment per capita.

The other important equation in the Solow-Swan model is capital accumulation equation which simply describes how capital can accumulated across time. This is situation shows as follows:

$\check{K} = sY - dK$. Where; $\check{K}$ is dK/dt or the change in capital stock across time.

This equation can be explained as; the change in the capital stock ($\check{K}$) is equal to the amount of gross investment(sY) less the amount of depreciation that occurs during the production process (dK). The capital stock per capita (v) is a constant rate, and capital is subjected to depreciation which can be represented by dK; which implies that, capital is depreciated by a constant amount in each production process. $\check{K}$ is the continuous version of $K_{t+1} - K_t$, that is the change in the capital stock in each period. On the other hand, we have sY that is a constant fraction of income of consumers they transfer as saving. As already stated in this model, the economy is closed; as a result, whatever income left after consumption expenditure would be investment and its purpose is to accumulate capital (Romer, 1996, pp.16).

To see the impact and evolution of output per person in the economy, we should better to write the capital accumulation equation in terms of capital per person. If we take natural logarithm of capital per worker ratio k, and derivate with respect to time (dt) we obtain $\frac{k}{k} = \frac{K}{K} - \frac{L}{L}$. This equation can be defined as the growth rate of the respective variables. As stated in Romer (1996), just for the purpose of viewing the effect of investment, depreciation, and population growth on capital stock, we have;

$\acute{k} = i - (n + d)k$……(4)

Where, $\acute{k}$ is change in capital and d is depreciation rate.

From the above investment saving relationship, we have: $i = sy$, then substitute sy in place of i it gives us $\acute{k} = sy - (n + d)k$…….....(5).

Since production function (y) is a function of capital per capita;

$y = f(k)$ …….. (6).

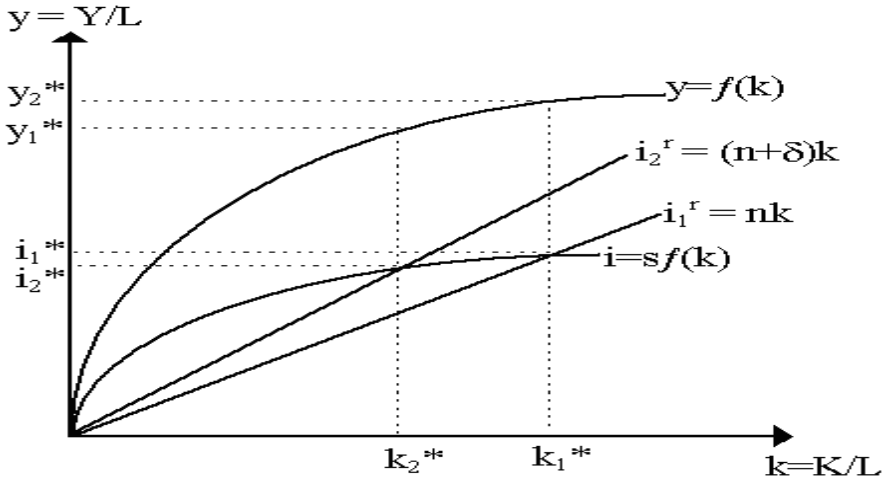
Now we can substitute equation (5) in equation (6); we have:

$\acute{k} = sf(k) - (n + d)k$…….(7).

This equation says; the change in capital per worker in each period is determined by investment per worker $sf(k)$ which increases the capital accumulation $\acute{k}$, the term nk can be defined as each period there are nL new workers around there who were not previously. If the country could not create new investments and no depreciation, then capital per worker k would decline; because the population does not keep as it is; implying that there will be higher labor force next year, partly due to depreciation of capital at the rate of d and partly due to the increase in the number of persons at the rate of n.

Since the growth rate of per capita capital at the steady state is zero in equation (7), we can write as: $sf(k) = (n + d)k$ or $sy = (n + d)k$ …… (8)

The term $n + d$ in equation (8) is effective depreciation rate for the capital-labor ratio , $k = \frac{K}{L}$. In steady state per capita capital will not change (k *); so, the level of k will always converge to the steady state level of k *. In steady state, $sy = (n + d)k$ is at break-even point as we can see this situation from the following graph:



Graph 1: Solow-Swan growth model

Source: Romer (1996)

Since the capital stock is subjected to depreciation rate in each year, if the newly created investment or saving cannot compensate the amount that capital depreciates, it is obvious that the capital stock will decrease. At steady state at point E in the above graph, shows that the saving per capita sy is equal to the required investment per capita $((n + d)k)$. If per capita capital is less than $k*$ or left side of $k*$, the saving per capita or the required investment (sy) is exceeding the capital per capita. The remaining saving surplus will add to the existing capital then there will be higher capital. Hence, per capita capital will increase until it reaches the steady state value $k*$. However, If per capita capital is greater than $k*$ or the right side of $k*$, the capital per capita is exceeding the saving per capita. Therefore, capital and GDP per capita will decline until they eventually meet the steady state at $k*$. This model is quite simple because there is only one good, government is absent, closed economy, and it does not incorporate employment fluctuation. Furthermore, important variables such as per capita capital, production per capita, and consumption per capita, are given as constant in the model at the steady state (Romer, 1996).

According to this growth model, the long run living standard is determined by three variables; these are saving rate, population growth, and productivity growth or technology progress. These factors are discussed as follows:

a) Saving

As stated in this model, the increase in saving rate will have a direct relationship with income per capita. This implies that if a nation's saving rate increase, income per capita will increase there by living standard of the society will also improves in the long run. In the above graph, point "A" is the steady state equilibrium. When saving rate rise, the curve of $sy*$ also shift upward. The equilibrium point will moves from point "A" to point "B", at the same time the per capita capital will rises, now the steady state move from $k*$ to k 1*, and output per capita also rises from y_1*to y_2*. However, this effect is short run phenomena (i.e. it does not affect the growth rate of the economy in the long run) and, the increase in income per capita which result from the increase in saving will be small. This implies that if saving rate increases the steady state k * will also surges. Income per capita will be also higher; however, the growth rate of output will not grow in the same level as the increased in saving. In other words, in level terms the output may grows as the level of savings.

b) Growth of population:

If the population increases, the amount of new investment per person that required to keep the amount of capital per worker line $k*$ will rotates up. Increase in population (n) will have an inverse relation with capital per capita and so does income per capita. Increase in population can be seen as the rise in depreciation of capital. At the steady state equilibrium point is shown as (A), if the population of the country rises, the curve of $(n + d)k*$ rotates up. The equilibrium point will move from point A to point B and the per capita Capital will declines also. The steady state equilibrium will move from k * to *k_1. And output per capita is also

decreased from y^* to y^*. To keep output per capita of the nation stable, there must be increments in investment with the same dimension of growth rate of population. In other words, there must be higher investment level in order to compensate the depreciation and more distribute the output per capital to the total population.

2.3 Endogenous Growth

The Solow growth model does shows that production function exhibits constant returns which implies that accumulating factors of production will not result in sustainable growth of per capita capital, output per capita, and consumption per capita. After many problems like oil price shock economists determined that the Solow model in reality does not hold. One of them is Paul Romer (1992) who established endogenous growth model, which is an important part of growth theory for developing countries. This growth model assumes that the country's permanent economic growth is determined by the production process, not by outside factors**.** One of the most important assumptions of endogenous growth model is the problem that neoclassical economists were not able to reply about the question for why countries have different rates of economic growth that have the same technological level. This growth model also assumes that production function exhibits increasing marginal returns on the size of production factors through the external impacts of returns on human capital investment, which will result in generating improvements in productivity. According to Lucas (1988), economic growth depends on savings and human capital investment on the one hand, and investment in research and development on the other (Romer, Mattana, 2004). Moreover, economists argued that free market system will leads to less than the optimal level of Capital accumulation in human capital and research and development. To correct such problems, government may allocate resources to improve the efficiency through human capital investment, and encouraging private investment in high-technology industries.

2.4 Empirical review

Currently, there is substantial difference in saving rates and economic performance between countries in the world. This difference is not only between poor and rich countries, but also variation increased amongst developed countries. There is a clear gap between the saving rates in low income, middle and high income countries. One can raise the question whether a country can grow more just by saving more (Opschoor, 2015). For instance, East Asia saves more than 30 percent of gross national disposable income, whereas Sub-Saharan Africa saves less than 15 percent. Over the past three decades, saving rates have doubled in East Asia and go stale in Sub-Saharan Africa, in Latin America and the Caribbean (Loayza, Schmidt-Hebbel, and Servén, 2003). In the neoclassical growth model saving rate was given emphasis. However, it was exogenously given. Due to this poor explanation of saving in neoclassical growth model, economists such as; Ramsey (1928), Cass (1965), and Koopmans (1965) led them to construct an endogenous saving rate in the new economic growth models.

A survey undertaken on the role of saving in economic development by World Bank (1993) shows that those countries with higher saving rates enjoy higher economic growth rates than those countries with low saving rates. According to this survey more saving rates result in higher economic growth. Therefore countries should formulate policies which encourage people to transfer some income to the next period (saving). However, empirical findings done currently have mixed results. Therefore, there is no common consensus among the researchers on the question of which causes the other. For instance, Caroll and Weil (1994) examined the causality relationship between economic growth rate and savings for OECD countries and their finding was economic growth Granger caused savings.

Again, Gavini et al. (1997), Sinha Sinha (1998), and Agrawal (2001) in their research found that economic growth causes growth in savings. On the other hand, Cullison (1993), Alguacil, Cuadros and Orts (2004) and Lorie (2007) found that growth in saving will lead to

higher economic growth. According to Mohan's (2006) conclusion based on cross section data from 1960 to 2001 for different economies found that, economic growth rate Granger caused savings growth rate in eight high income countries such as Sweden, Iceland, Finland, UK, Korea, Japan, Canada, and Norway- except in Singapore, 3 lower-middle income countries like Algeria, Thailand, and Colombia- except Egypt and Ecuador, 2 low income countries including Nigeria and Senegal - except Indonesia, There was bi-directional causation in all upper-middle income countries –Chile, Argentina, Brazil, and South Africa- except Malaysia (Oladipo, 2010).

It is a fact that developing countries like Ethiopia needs fast and sustainable investment growth. To do this, countries need required or/and balanced domestic saving. Ethiopia needs enormous amount of financial resources to accomplish its development plan. However, capital formation cannot be easily achieved since it is determined by the domestic saving rate. In other words, developing economies economy is characterized by low level of income and hence low level of domestic saving rate. This is the reason why Ethiopia experiences a severe resource gap (Tsegabirhan, 2010). But, domestic saving rate in Ethiopia was on the lowest for the past several decades. In the past four decades (1970/71 to 2010/11) the average domestic saving rate was only 7.9% of the GDP. According to Ayalew (2013), during the three consecutive regimes of Ethiopia over the study period reveals that the average saving rate was 13.8% of GDP during the period from 1970/71 to 1973/74, 7% from 1974/75 to 1990/91 and 7.3% from 1991/92 to 2010/11. This classification indicates that during the Imperial regime domestic saving rate was relatively high. However, in the current (that is, EPRDF)" and the Derg regime, domestic saving declined to lower per cents. Furthermore, according to World Bank report (2011), average domestic saving rate of Ethiopia was very low by any standard. For example, if we compare average domestic saving rates of Ethiopia with Sub-Saharan African countries between the periods ranging from 1980/81 to 2010/11, average

domestic saving rate in Ethiopia was only 8.6% of the GDP. On the other hand, during the same period, average domestic saving rates for Sub-Saharan Africa countries was 17.2% of GDP. This suggests that how much the domestic saving rates of Ethiopia were too much low even by Sub-Saharan Africa standards (Ayalew, 2013).

Low income economies like Ethiopia are characterized by low level of domestic saving. It represents major obstacle to achieve development in these countries; because it limits investment and economic growth. In these economies, national and foreign savings can be used as the main source for financing domestic investment. “Low or stagnant national savings usually spurs external borrowing which through the debt service burden constrains future investment”. However, due to the international debt crisis of the early 1980s; majority of developing countries could not get the access to external borrowings (Wubu, 2011). Without the alternative of domestic savings, this situation forces developing countries like Ethiopia to rely on donors' aid to finance a large part of domestic investment, a process fraught with enormous constraints. There are many causes mostly cited to describe the low level of domestic saving in countries like Ethiopia. The first cause is “low per capita income”. This implies that, it is a fact that Ethiopia is one of the least developed countries in the world. In other words; since, less developed countries are characterized by low income, low consumption and low savings. The recent empirical findings have found that the marginal propensity to save in developing countries is related to the level of income and its variation. The second cause is political and macro-financial instability and inflation which attributed to the low level of domestic saving in countries like Ethiopia. “Macro-financial instability” arises due to many factors including “lack of an appropriate legal, regulatory and prudential framework to the financial system, fiscal imbalances, financial distress and misguided monetary and financial policies”. (Zeidy, 1996, pp. 3 & 4).

An empirical study by Kebede (2014) using the ARDL bounds testing the relationship between gross domestic saving, domestic investment and economic growth found that there exists co-integration among gross domestic savings, real gross domestic product, labor force, and human capital when real gross domestic product is taken as dependent variable. According to this study, labor and investment have significant positive effect on economic growth in Ethiopia both in the short run and long run. On the contrary, gross domestic saving and human capital are statistically insignificant. Furthermore, deploying the Toda-Yamamoto, Dolado-Lutkepohl and Innovative Accounting techniques; there exists bidirectional causality between gross domestic investment and economic growth as well as between gross domestic savings and gross domestic investment. In addition this, the impulse response functions and variance decompositions show that causality running from investment to gross domestic saving and from domestic investment to gross domestic saving is stronger. On the other hand, even though there is a unidirectional causality running from economic growth to gross domestic savings; its causality is weak (Kebede, 2014:222). This project will provide updated information about the trends of macroeconomic variables in Ethiopia and it will give what previous researches got in examining gross domestic saving and economic growth. Furthermore, it will give some information on the subject matter about the direction of causality among variables.

CHAPTER THREE

3. Data analysis and Methodology of the study

3.1 An overview of the Ethiopian economy

Ethiopian economy has been registering a sustainable and promising performance with annual growth averaging 10% over the past one decade. According to United Nations country economic brief (2014), this average growth rate is about double of the average growth for Sub-Saharan Africa and triples the world average growths over this period. This led Ethiopia being regarded as one the fastest growing economies in the world. Especially, in the periods 2012 and 2013 the economy was successful in achieving macroeconomic stability. Fiscal management was also witnessed by falling and a single digit inflation; which was one of the challenges for the country before some years back. Government is expending in huge public investments with giving main emphasis to infrastructures and pro- poor sector which have vital role in transforming the economy to higher performance. Government investments have been carried out from domestic resource mobilization. In addition to this, external resource inflows are increasing over time; which have an important role in achieving the intended government goals. In 2010/11 to 201/13, domestic savings increased from 12.8% to 17.7% of the total output. Government introduced new saving mechanisms like bonds and expanding financial services (i.e. opening banking branches in almost all major cities and some rural cities) in the country also has played great role in surging domestic savings. The industry sector also saw highest growth rates especially in the years 2012/13. In this specific period, the industry sector registered 18.5% annual growth rate. This is so because; Ethiopia is currently engaged in expanding the mining sector as well as a rise in construction sub sectors (James, Kiberet, Mamuye, 2014, pp. 2).

Even though the country could attain such growths and single digit inflation; the country experiences macroeconomic instability which is one of the series issues. It is so difficult to attain stable economic growth; this is because, it is highly dependent on global and domestic shocks. The country has been suffering from terms of trade imbalances. As stated in Tilahun (2015), in comparison to other African countries Ethiopia lags behind in "export diversification" and "competitiveness" IMF (2014). In wanting to have double digit economic growth through financial openness may expose the economy to irreversible global shocks; such as, the risk of sudden stop of capital flows and further it may contribute to greater shocks and possibly it could be persistent. Moreover, an increase in public investment may crowds out private investment due to the unfavourable effects of government financing (e.g. borrowing) on the existing financial resources (savings). Consequently, the effect of public capital spending on private investment should be considered for a meaningful national policy making (Tilahun, 2015, pp. 17).

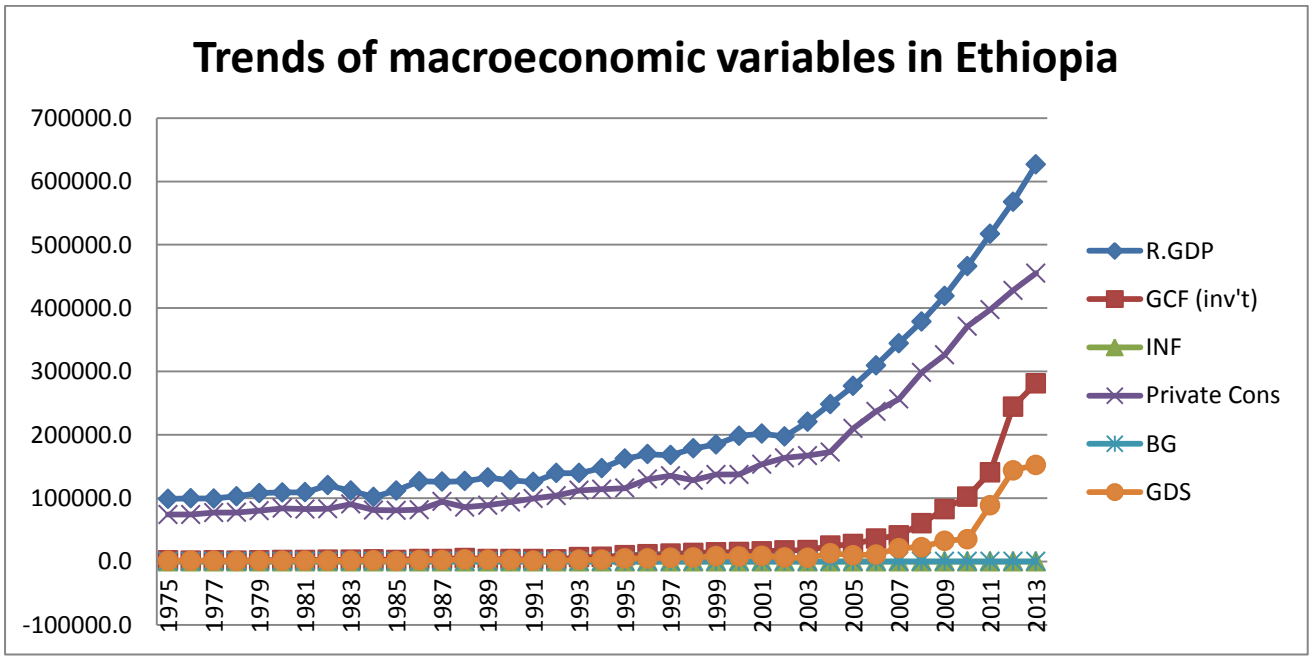


Figure1. Trends of Macroeconomic variables

Data source: National Bank of Ethiopia.

According to the report by MOFED (2014), budget deficit has increased from 2.8% of GDP in 2012 to 3.3% of GDP in 2013 and also debt-to-exports ratios has reached about 29 percent. As we can see from the above graphical representation of the trends of all macroeconomic variables in Ethiopia have been increasing except variables such as resource balance and inflation over the whole years in the sample (1975 to 2013). Both real gross domestic product and private consumption have somewhat similar trend. That means, both variables are increasing over the whole years in the sample period even if the former is greater than the later. Real gross domestic product has registered its minimum in the years 1984, 1991 and 2002; whereas, private consumption is in its downturns in 1984, 1985, 1986, 1987, 1988 1989 and 1998. On the other hand, in most of the sample years (1975 to 2003) investment and gross domestic savings have been growing at a constant growth rate. After the year 2004, both variables witnessed growths. On the contrary, both resource balance and inflation does not show any growth in sample years.

Ethiopian economy is among the fastest growing economies in the world and continued registering remarkable growth rates. According to annual report published by MoFED (2007 EFY), over the last twelve consecutive Ethiopian fiscal years (i.e.1996-2007), the economy has been registering rapid and sustainable growth. In these consecutive periods the annual average economic growth rate of output (GDP) was 10.8 %. In these years agriculture sector grew by 8.8% by on average, and the industry and the service sectors annual average growth rate was 14.4 % and 11.9% respectively. During the "GTP implementation period I" (i.e.2003-2007(EFY)), the economy has registered healthy economic growth. In these periods, national output (GDP) was grown at annual average growth rate of 10.1%. Agriculture, industry, and service sectors registered an annual average growth rate of 6.6%,

20.2%, and 10.8% respectively. According to a report by MoFED (2007EFY), gross domestic saving has been growing and has reached 21.8% of gross domestic product.

3.2. Econometric Model

3.2.1 Model Specification

As stated earlier, both short run and long run relationship between the rate of gross domestic savings in the economy and the rate of economic growth has been identified in many studies that are examined empirically (Pagano, 1996, and Gavin et al, 1997). To reduce if possible to eliminate heteroscedasticity in the disturbances of predicted model, logarithmic form is used in this paper. The model can be represented by autoregressive moving average as:

$$lnRGDP_t = lnRGDP_{t-1} + lnRGDS_{t-1} + lnPRC_{t-1} + lnGFC_{t-1} + lnINF_{t-1} + \\ +\varepsilon_{1t} \quad (3.1)$$

$$lnRGDS_t = lnRGDS_{t-1} + lnRGDP_{t-1} + lnPRC_{t-1} + lnINT_{t-1} + lnINF_{t-1} + \\ \varepsilon_{2t} \quad (3.2)$$

Where; $lnRGDP$ is the rate of growth of natural logarithm of $RGDP$ (i.e.This can be defined as the changes in the logarithm GDP in period t), $lnGDS$ is the growth rate of gross domestic savings (it is the changes in the natural logarithm of GDS in period t), $lnPRC$ is logarithm of private consumption, $lnINT$ is logarithm of interest rate, whereas, $lnINF$ is logarithm of inflation and $\varphi_{11}$and φ_{12} are intercepts for the first and the second models respectively, β_{11} and β_{21} are slopes, and $u_{1t}$and $u_{2t}$are pure white noise processes.

3.2.2 Estimation Strategy

3.2.2.1 Stationarity and Non-Stationarity

According to Harris (1995), currently econometrics has been showing that there are problems related to time series data used in the analysis of variables under investigation. This is due to

the non–stationary of time series data. A time series data is said to be stationary if its disturbance term has zero mean, constant variance and the covariance between any two-time periods depends only on the distance or lag between the two periods and not on the actual time which it is computed. To avoid the drawback of wrong implications from the non-stationary regressions, the time series data should be stationary (i.e. the data should not have unit root). Regressing a non-stationary dependent variable on another non-stationary independent variable might lead to spurious, however, one might seem the results attractive in fact, and the results are misleading (Lutkepohl, 1993).

3.2.2.2 The Unit Root Test

There are many tests usually deployed to investigate whether time series data are stationary or not. These include; Dickey-Fuller (DF), the Augmented Dickey-Fuller (ADF) test, and Phillips-Peron test. The study deployed the Augmented Dickey Fuller (ADF) test to determine the existence of a unit root (non-stationarity) of both variables. Before testing stationarity of both variables, they are transformed to their log form. This is because log transformation is best to show their growth rate over time. This test is preferred due to its characters such as uniformity and precision. According to the test of stationarity of the variables deploying Augmented Dickey Fuller test reveals that both gross domestic savings and gross domestic product are non-stationary at levels. Meaning that; they both have unit root at their levels. Therefore, both variables must be changed to first difference so that the variables will not have unit root. Variables which have unit root must be changed to first difference if not the regression becomes spurious. The Augmented Dickey Fuller (ADF) test shows that both $lnRGDP$ and $lnRGDS$ have unit roots in their level. So, both variables are changed to their first difference. In the presence of unit roots, the variables need to be differenced in order for the series to be stationary. Without differencing the time series data, a causality test would lead to misspecification (Lutkepohl, 1993).

If the ADF equation does not contain both intercept and trend the equation can be written as:

$$\Delta Y_t = \beta Y_{t-1} + \sum_{t=1}^{P} \varphi_i \Delta Y_{t-i+1} + \varepsilon_t \quad \text{(3.1)}$$

The ADF equation with the intercept can be expressed as follows:

$$\Delta Y_t = \alpha_0 + \beta Y_{t-1} + \sum_{t=1}^{P} \varphi_i \Delta Y_{t-i+1} + \varepsilon_t \quad \text{(3.2)}$$

If the model includes both the intercept and a trend, the equation can be shown as;

$$\Delta Y_t = \alpha_0 + \beta_1 t + \beta \sum_{t=1}^{P} Y_{t-1} + \sum_{t=1}^{P} \varphi_i \Delta Y_{t-i+1} + \varepsilon_t \quad \text{(3.3)}$$

Where, Y_t is lnRGDP or lnRGDS to be tested for stationarity, $\in_t$ is disturbance term and Δ is the first difference operator.

Null hypothesis of unit root test is μ =0 against the alternative hypothesis that μ<0. Where; $\mu = \beta - 1$. Accepting null hypothesis means the time series data is stationary or it does not contains a unit root whereas not rejecting the null hypothesis means the time series is non-stationary (Enders, 1995). Some time series data needs to be differenced several times before they becoming stationary. The number of times series needs to be differenced before being stationary is the order of integration. So if a time series is said to be integrated of order d, I (d), it means that it has to be differenced d times before the time series become stationary. If the series are stationary, running a regression avoids spurious regressions or false results.

3.2.2.3 Co-integration Test

Engle and Granger (1987) defined Co-integration as a condition where two or more variables are associated to form equilibrium relationships over the period of time. Furthermore, even if the time series data have unit root (non-stationary) variables, their linear combination can be stationary and they will move closely together over time to make their differences stationery. If two variables have no co-integration; it reveals that the nonexistence of long-run

relationship between the two variables. According to Engle and Granger (1987), regressing this type of model might lead to the problem of false correlations. If two variables say lnRGDP, and, lnRGDS are I (d) and the disturbance term ε_t is I (0), then the two series are called integrated of order I (1, 1). To test for co-integration, one can deploy either the Engle and Granger (1987) or Johansen (1988) Maximum Likelihood method. In the first method, lnRGDP is taken as the dependent variable; in testing for co-integration; one should first regress the dependent variable on the independent variable on their levels. After this predict their residual. Next to this, test the residuals deploying Augmented Dickey Fuller (ADF) test. If it is the case that residuals are integrated of order I (0), then lnRGDP and lnRGDS are co-integrated. This is so because, the residual are stationary (has no unit root). If the residual has unit root (non-stationary), then GDP and GDS are not co-integrated.

As Harris (1995) stated, Engel and Granger method is valid if there is only one co-integrating vectors. Furthermore, it assumes that independent variable is weakly exogenously determined whereas; the dependent variable is endogenous (can be determined within the model). In fact, there are occasions in which there exist endogenity behavior between variables under investigation and, we might not infer based on the assumption; because from such type of inferences the results may mislead to wrong decision.

According to Harris (1995), the Engel-Granger (EG) method is criticized because of: first, a test for co-integration is likely to have lower power against alternative tests. Second, in small sample estimates of long-run relationships are potentially biased. Third, we cannot draw inferences using standard t-statistics about the significance of the parameters of the long-run model. Because, since the procedure involves tow-steps, errors committed in the first step are carried over to the next step (Enders, 1995). Shortcomings in the Engel-Granger method can be avoided by deploying the Johansen's (1988) Maximum Likelihood estimators.

The Johansen Maximum Likelihood estimators enable estimating and testing for the presence of multiple co-integration relationships, in a single step procedure. If there is co-integration between two variables, it suggests the existence of causality between these variables at least in one direction.

3.2.2.4 Granger Causality Test

According to Adebiyi, (2000), if the variables in the model are not co-integrated; then the causal relationship between economic growth and gross domestic savings can be examined by deploying a Granger causality technique based on Vector Autoregressive (VAR) model. The VAR model in the study can be represented in equations (3.4) and (3.5). A VAR model serves as a flexible approximation to the reduced form of any wide variety of simultaneous structural models. Besides, it allows causality to emerge from the joint coefficients (F-statistic) of the lagged values of the explanatory variables even where the variables are not co-integrated. The VAR model is stated as follows: Higher saving, in turn, would lead to more rapid growth in productivity and living standards (Mankiw, 2003 pp.: 31).

$$\Delta lnGDP_t = \varphi_{11} + \beta_{11}\sum_{t=1}^{P} lnGDP_{t-i} + \beta_{12}\sum_{t-i}^{P} lnGDS_{t-i} + \beta_{13}\sum_{i=1}^{P} lnPRC_{t-i}$$

$$+ \beta_{14}\sum_{i-1}^{P} lnGFC + \beta_{15}\sum_{t-i}^{P} lnINF_{t-i} + \varepsilon_{1t}$$

$$\Delta lnGDS_t = \varphi_{21} + \beta_{21}\sum_{t=1}^{P} lnGDS_{t-i} + \beta_{22}\sum_{t=1}^{P} lnGDP_{t-i} + \beta_{23}\sum_{i=1}^{P} lnPRC_{t-1}$$

$$+ \beta_{24}\sum_{i=1}^{P} lnINT_{t-i} + \beta_{25}\sum_{t-i}^{P} lnINF_{t-i} + \varepsilon_{2t}$$

Where; $lnGDP$ is the rate of growth of natural logarithm of GDP (i.e.This can be defined as the changes in the logarithm GDP in period t), $lnGDS$ is the growth rate of gross domestic savings (it is the changes in the natural logarithm of GDS in period t), $lnINF$ is logarithm of inflation, whereas; and $\varphi_{11}$and φ_{12} are intercepts for the first and the second models respectively, β_{11} and β_{21} are slopes, and ε_{1t} and ε_{2t} are pure white noise processes. In the above equations (3.4) and (3.5) the lagged values of gross domestic product and domestic savings respectively are included in the explanatory variables to avoid the ups and down effects between gross domestic product and growth rate of domestic savings. As stated in Mankiw (2003, pp:704), standard economic theory predicted that during recessions savings will decrease or the growth rate of savings GDS be less than the growth rate of GDP; because consumers take out their savings during the hard times to maintain a uniform consumption pattern over time. On the other hand, savings will increase or the growth rate of gross domestic saving will exceed the growth rate of gross domestic product during economic boom. This is because, during the period of recovery and boom it is expected that people will save more in expectation that there may depression in the economy. Due to the nature of business cycle that occurs in the economy, we can expect that gross domestic savings and gross domestic product will have a direct relationship.

4.3 Vector Error Correction Approach (EVCM): A Test for Causality

As Granger (1988) stated, once we checked that there is co-integration among the variables, then we must conduct Granger-causality test in vector error correction model (VECM) to avoid problem of misspecification. If not the analyses may be conducted as a standard vector autoregressive (VAR) model. Vector error correction model (VECM) is a special case of VAR that imposes co-integration on variables in the model. The models for this paper is:

$$\Delta lnGDP_t = \partial_{0Y} + \beta_{11}\sum_{t=1}^{P} lnGDP_{t-i} + \beta_{12}\sum_{t-i}^{P} lnGDS_{t-i} + \beta_{13}\sum_{i=1}^{P} lnPRC_{t-i} +$$

$$\beta_{15}\sum_{i-1}^{P} lnGFC + \beta_{16}\sum_{t-i}^{P} lnINF_{t-i} + \mu_{1t}ERC_{t-1} + \varphi_{11} + \varepsilon_{1t}$$

$$\Delta lnGDS_t = \partial_{1Y} + \gamma_{1lnGDS}\sum_{t=1}^{P} lnGDS_{t-i} + \delta_2\sum_{t=1}^{P} lnGDP_{t-i} + \beta_{23}\sum_{i=1}^{P} lnPRC_{t-i}$$

$$+ \beta_{24}\sum_{t=1}^{P} lnINT_{t-i} + \beta_{26}\sum_{t-1}^{P} lnINF_{t-i} + \mu_{2t}ERC_{t-1} + \varphi_{21} + \varepsilon_{2t}$$

Vector error correction model (VECM) is deployed to determine the causal relationship between gross domestic savings and growth rate GDP in Ethiopia both in the short run and in the long run. The long run causality is checked by using the error correction term (speed of adjustment toward the long run equilibrium). If the error term has negative sign and the p value is less than 5%; it suggests that there is a long rung causality. If these two conditions are not satisfied, then we can conclude that there will not be long run causality. The short run causality can be examined by the t-values of the coefficients of the lagged terms of independent variables. This procedure permits temporary causality to emerge from (1) the lagged coefficients of the explanatory differenced variable and (2) the coefficient of the error correction term. In addition the VECM allows causality to emerge even if the coefficients of lagged differences of the explanatory variables are not significant. It must be pointed out that the standard Granger causality test omits the additional channel of influence, i. e. the significance of the coefficient of error correction term.

4.3.1 Serial Correlation/Autocorrelation Test

In the model, it is assumed that continuous values of the stochastic terms ε are progressively independent. Furthermore, it is ε assumed that its values in any of the periods are independent from the values in any of the preceding periods. This implies that the covariance between ε_i and ε_j is equal to zero. Implying that, if the stochastic terms are not satisfied this

assumption then the value of ε in any period is interrelated with its own previous values. This is known as autocorrelation of the stochastic term ε. In this case regression may mislead to wrong decisions. If this is the case, the parameter estimates are still statistically unbiased however, the variances of the parameter estimates are likely to be larger or the variance of the error term may be extremely undervalued. Furthermore, the estimates based on these parameter forecasts will be insignificant. This is so because, the variance is too large. For the null hypothesis of no "serial correlation" at lag order "k" is tested against the alternative hypothesis of there is serial correlation is the VAR model. If the result is insignificant, the null hypothesis is accepted; if the result is significant, the null hypothesis is rejected implying the presence of serial correlation.

3.3.2. Normality Test

The model assumes that the random variable u has a normal distribution. Symbolically:

ε~N $(0,\sigma_\varepsilon^2)$ this can be read as: ε is normally distributed around mean zero and constant variance σ_ε^2. Implying that small values of ε's have a higher probability to be observed than large values. This supposition is essential for conducting statistical tests of connotation of the parameter estimates and for making confidence intervals. If this assumption is violated, estimates of parameters may be unbiased however; the statistical reliability of the parameter estimates might not be evaluated. This is because, the tests should be based on the supposition of normal distribution of the ε's. The null hypothesis in this case is the ε's have normal distribution against the alternative that the ε's are not normally distributed.

3.3.3 Stability Test

Stability test is conducted to evaluate the stability of the coefficients in the model. To do this, there are tests like CUSUM tests and CUSUM of Squares test. The null hypothesis in this case is, the test results satisfy the stability condition. On the other hand, the alternative

hypothesis is the test results do not satisfy the stability condition. The guide line to check whether there is stability or not, we can see the blue line. If we find blue line between the two red lines, then the model satisfies the stability condition. On the other hand, if the blue line does cross the red lines, then there is problem of parameter instability in the model. The CUSUM test helps to show the coefficients or the parameters of the regression are changing systematically. On the other hand, the CUSUM square test helps to show the coefficients of the regression are changing suddenly.

CHAPTER FOUR

4.1 Discussion of Results

4.1.1. Result of Unit Root Tests

Before any meaningful regression is performed with the time series variables, it is essential to test the existence of unit roots in the variables and to establish their order of integration. The variables used in the analysis need to be stationary and or should be co-integrated in order to infer meaningful relationship from the regression. In order to find the causal relationship between gross domestic savings and economic growth, the first thing to determine is the order of integration of the variables to determine whether they are stationary or non-stationary, that is, whether they follow a stochastic trend or follow a random walk. The ADF test indicates that both lnRGDP and 1nRGDS have unit roots or non-stationary in their level. If this is the case, the variables need to be differenced in order for the series to be stationary. If one regress without differencing the data, testing a causal relationship would lead to misspecification. But when both lnRGDS and lnRGDP are differenced, the series becomes the growth rates of savings. Both variables are transformed to their natural log form because, regressing without transforming to log form and examining the direction of causality between gross domestic savings and economic growth will not show the growth rate of gross domestic saving and rate of economic growth. But, if we transform both variables in to their natural logarithm, it will show their growth rates. Currently, studies that deploy Granger causality test to examine the correlation between gross domestic savings and economic growth should use the rate of growth of savings, instead of savings; this is due to the existence of unit root (non-stationary). As shown in the appendices part, lnRGDP is not stationary at lag zero. But when it is in its lag (2) and with trend; it becomes stationary at 1%, 5%, and 10%. This means, the absolute value of critical value is greater than t statistics. The results of critical values are 4.260, 3.548, and 3.209 at 1%, 5%, and 10% respectively. On the other hand,

lnRGDS is not stationary in its lags (0), (1), (2), (3), (4), (5), (6), and (7). It becomes stationary when it is in its lags (8). That means, as shown in the appendices part, lnRGDS has unit root in its first seven lags. At lag (8) the t-statistics value is 1.694; whereas the critical values at 1%, 5%, and 10% are 2.508, 1.717, and 1.321 respectively. This means lnRGDS is not stationary at 10%; because t-statistics is greater than critical value. However, it does not have unit root at 1%, and 5% critical values. On the contrary, the remaining variables become stationary when they changed to their firs difference. After checking its stationarity, we can go for the other tests; because as stated earlier, without checking whether a variable has unit root or not, it probably will lead to spurious regression. The stationarity condition is shown in the annex part of this paper.

4.1.2 Co-integration

4.1.2.1 Engle-Granger Method

As Engle and Granger (1987) stated, once we have checked the stationarity condition for regression, we can go for a co-integration test to test causality between variables. If there is existence of a co-integrating relation between the variables; it is signal that there is a long run association between the lnRGDS and lnRGDP in Ethiopia. By deploying Engel and Granger two-step residual based test, we can test co-integration is performed. Granger (1981) first introduced the concept of co-integration. But latter it was further extended by Engle and Granger (1987). This is based on the concept that, all of the series must be integrated of order one I(1). Next if a linear combination of this collection is integrated of order zero or I(0), the collection is known as co-integrated. As Charles (1982) provided statistical evidence that many US macroeconomic time series like GNP, wages, employment have stochastic trends or called unit root process. In this case, the conventional econometric approaches do not apply to these time series. As stated by Charles (1982), although economic time series exhibit unit root process behavior, the suitable linear combination between trending variables could

remove the common trend component. The resulting linear combination of the time series variables will thus be stationary, which means the relevant time series variables are co-integrated.

First let us see natural logarithm of gross domestic product as left hand variable.

$$lnRGDP_t = 0.58 + 0.36\sum_{t=1}^{P} lnGDP_{t-1} + 0.013\sum_{t=i}^{P} lnGDS_{t-1} + 0.91\sum_{t=i}^{P} lnPRC_{t-1}$$

$$+ 0.067\sum_{i-1}^{P} lnGFC_{t-1} - 0.071\sum_{t=i}^{P} lnINF_{t-1} + \varepsilon_{1t}$$

If we make $lnRGDS_t$ as dependent variable and other variables as independent; we will have the equation like:

$$lnRGDS_t = -1.09 + 0.48\sum_{t=1}^{P} lnGDS_{t-1} + 23.73\sum_{t=1}^{P} lnGDP_{t-1} - 15.37\sum_{t=1}^{P} lnPRC_{t-1}$$

$$+ 10.56\sum_{t=1}^{P} lnINT_{t-1} - 5.81\sum_{t=1}^{P} lnINF_{t-1} + \varepsilon_{1t}$$

Where; $lnGDP$ is the rate of growth of natural logarithm of GDP (i.e.This can be defined as the changes in the logarithm GDP in period t), $lnGDS$ is the growth rate of gross domestic savings (it is the changes in the natural logarithm of GDS in period t), $lnINF$ is logarithm of inflation, whereas; $\varphi_{11}$and φ_{12} are intercepts for the first and the second models respectively, β_{11} and β_{21} are slopes, and ε_{1t} and ε_{2t} are pure white noise processes.

Coefficients of the above models can be explained as follows: in the first model the constant is about 0.58 and it is also significant in explaining real gross domestic product. This implies that if there is no change in the economy as a whole, then the economy will grow at 0.58 units. The estimated coefficient for gross domestic saving is 0.013. This implies that, a one

unit increase in gross domestic saving will contribute to the increment of gross domestic product in Ethiopia. If there is one unit increment in the private consumption, then gross domestic product will grow at 0.9 units. Gross domestic product will increase by 0.67 units if the government final consumption increases by one unit. On the other hand, if inflation increases by one unit, real gross domestic product will decrease by 0.007 units. For further information, refer the annex.

The constant in the second model is -10..9. This can be expressed as: if there is no change in the economy, gross domestic saving will decreases by 10.9. If there is a one unit surge in real gross domestic product, gross domestic saving will increase by 30.5 units. Whereas, gross domestic saving will decrease by 17 units if private consumption increased by one unit. Interest rate has a positive effect on domestic saving. This means, if interest rate increased by one unit; gross domestic saving increases by 7.78 units. On the contrary, inflation and government consumption have an inverse relation with gross domestic saving. This is because, when a one unit increment in these variables, there is corresponding decline in gross domestic product. For more detail, refer the annex.

4.1.2.2. Johansen Co-integration Test

This method was developed by Johansen (1988). Johansen co-integration is better approach to the Engle-Granger method. In this approach, there are two types of tests, either with trace or with Eigen value, and the inferences might be little. The null hypothesis for the trace test is that the number of co-integration vector is $r=r^{*} <k$, versus the alternative that r=k. in other words, one can calculate the trace statistics and the maximum eigenvalue statistics. The null hypothesis of no co-integration vector is tested against the alternative hypothesis of one co-integrating vector. Trace test is used to examine whether there exists co-integration between variables or not. In our case, the results reveal that there is co-integration relationship between gross domestic savings and gross domestic product in Ethiopia.

$$\Delta lnGDP_t = \varphi_{11} + \beta_{11}\sum_{t=1}^{P} lnGDP_{t-i} + \beta_{12}\sum_{t-i}^{P} lnGDS_{t-i} + \beta_{13}\sum_{i=1}^{P} lnPRC_{t-i}$$

$$+ \sum_{i-1}^{P} lnGFC + \beta_{16}\sum_{t-i}^{P} lnINF_{t-i} + \varepsilon_{1t}$$

$$\Delta lnGDS_t = \varphi_{21} + \beta_{21}\sum_{t=1}^{P} lnGDS_{t-i} + \beta_{22}\sum_{t=1}^{P} lnGDP_{t-i} + \beta_{23}\sum_{i=1}^{P} lnPRC_{t-i}$$

$$+ \beta_{24}\sum_{i=1}^{P} lnINT_{t-i} + \beta_{25}\sum_{t-i}^{P} lnINF_{t-i} + \varepsilon_{2t}$$

Where; $lnGDP$ is the rate of growth of natural logarithm of GDP (i.e.This can be defined as the changes in the logarithm GDP in period t), $lnGDS$ is the growth rate of gross domestic savings (it is the changes in the natural logarithm of GDS in period t), $lnINT$ is logarithm of interest rate, $lnINF$ is logarithm of inflation, $lnPRC$ is logarithm of private consumption, whereas, and $\varphi_{11}$and φ_{12} are intercepts for the first and the second models respectively, β_{11} , β_{12}, β_{13}, β_{14}, β_{15}, β_{16} and β_{21} , β_{22}, β_{23}, β_{24}, β_{25}, β_{26} are slopes, and ε_{1t} and ε_{2t} are pure white noise processes in the first and the second models respectively.

The null hypotheses for the model are 0, 1, and 2; meaning that there is no co-integration between variables for in the case of zero. For the null hypothesis 1; it implies that there is one co-integration between the two variables. And for the case of 2; it imply that, there are two co-integrating between variables. First we can check whether there is co-integration among variables or not from the first null hypothesis that is zero. As we can see from this table, the trace statistics is about 83.45; whereas the 5% critical value is 68.52. This implies that when trace statistics is more than 5% critical value; we can reject the null hypothesis. This means that there is no co-integration between lnRGDS and lnRGDP. Therefore, we can accept the alternative hypothesis; which is there is co-integration between the two variables. Now we

can move to the other null hypothesis which is 1. As we can see from the same table, trace statistics (49.29) is less than the 5% critical value (47.21). This means, we can reject the null hypothesis; that is there is no co-integration in the Johansen test. On the other hand, trace statistics is 29.10 and the 5% critical value is 29.68 in the second maximum rank. This implies that lnRGDS and lnRGDP are co-integrated or they have long run association ship. In other words, they are moving together in the long run. This is displayed in the following table:

Maximum rank	Eigen value	Trace statistics	5% critical value
0	.	83.45	68.52
1	0.60	49.29	47.21
2	0.42	29.10	29.68
Maximum rank	Eigen value	Max statistics	5% critical value
0	.	34.16	33.46
1	0.60	20.19	27.07
2	0.42	17.70	20.97

Table 4: co-integration test among variables

The results of the test Johansen co-integration show that the null hypothesis of no co-integration is rejected at 5% significance level. However, accepting the alternative hypothesis reveals the existence of co-integration relationship between savings and level of output suggests that there is long run relationship between the two series and the residuals obtained from the co-integrating vectors are stationary at their levels, i.e. I (1). According to both

maximal eigenvalue and trace statistic tests, our results indicate the existence of one co-integrating vector.

We can conclude from the above test that the rate of economic growth and growth rate of gross domestic savings are co-integrated for Ethiopia in the long-run equilibrium; have relationship between the two time series and the existence of causality in at least one direction. Generally, one needs to see the sign of a variable in the co-integration model, to examine whether the response is stable with an economic relation or whether the co-integration is just picking out some indeterminate long run association. Consequently, we find from the analysis that there is a direct long run association ship between gross domestic saving and .rate of economic growth.

Now, we need to proceed with causality tests to see if there is any causal relationship between the growth of GDP and GDS. In the analysis of co-integration, if two variables are co-integrated, the finding of no-causality in either direction is ruled out. However, although co integration indicates presence or absence of Granger-causality, it does not indicate the direction of causality between variables.

Based on both the max statistics and trace statistic tests, our result shows the existence of co-integrating vector. Thus, the Johansen co-integration test reveals that there is a long-run relationship between gross domestic savings and the growth of gross domestic product. Therefore, the long-run relationship between growth GDP and GDS is found to be direct in each co-integrating vector equation. This result shows that causality exist at least one direction.

As in Obstfeld (2008) explained, the economic theory also assumes that the relationship between per capita income and the rate of growth the economy is inversely related (Crafts and Toniolo, 1996). That means attaining high growth rates of economy will be low if there is

increment in the level of average per capita income. The explanation for this is, those countries with low per capita income will have a weak capital formation, and consequently, investment will attain growing returns in contrary to those countries with high per capita incomes. From this one can conclude that less developed countries are able to converge in income with advanced countries if developing countries flourish in increasing domestic and foreign investment. This theory has been successful in reality in developed countries, however, has not attained the same result in developing countries.

4.2.1 Vector Error Correction: A Test of Causal relation

As standard economic growth theories suggests; direct causal relationship between gross domestic savings and economic growth may work well in developed countries. In other words, in advanced countries gross domestic savings may constitute an important means of satisfying investors' requirement to finance and thereby result in growth in economy; without the requirement of foreign investment. On the hand, less developed countries like Ethiopia may not be causality between gross domestic savings and economic growth. This is so because, countries like Ethiopia are characterized by low level of domestic savings; so, to finance their huge investments they use mostly foreign inflows.

Equations	Coefficients	Stad. error	z	P>|z|
Constant	-0.01	2.32	-0.00	0.99
Lngds_1	-0.47	0.12	-3.83	0.000
Lnrgdp_1	81.78	27.05	3.02	0.003
Lnprc_1	-26.19	26.86	-0.97	0.33
Lnint_1	-7.12	6.95	-1.03	0.30

Lninf_1	-4.21	1.58	-2.66	0.01
VECT_1	-0.31	0.10	-2.96	0.003

Table 5: VECM when Lngds is taken as dependent variable

From this table we can see that one lag of variables such as Lngds, Lnrgdp and Lninf are significant in explaining the dependent variable (Lngds). This is because; the probability values for these variables are less than 5% critical values. On the other hand, Lnprc and Lnint are insignificant in explaining the dependent variable (Lngds); because, the probability values for these variables are more than 5% critical values.

Equations	Coefficients	Std. error	z	P>|z|
Constant	0.05	0.01	4.17	0.00
Lnrgdp_1	0.55	0.14	3.69	0.00
Lngds_1	0.001	0.001	1.71	0.08
Lnprc_1	-0.30	0.15	-1.95	0.05
Lngfc_1	0.04	0.06	0.73	0.46
Lninf_1	0.01	0.01	0.71	0.47
VECT_1	-0.54	0.14	-3.64	0.00

Table 6: VECM when Lnrgdp is dependent variable

Here the only variable that is significant is one lag of Lnrgdp in explaining the dependent variable (Lnrgdp); because its p value is less than 5% critical value. On the contrary, the

remaining variables are not significant in explaining the dependent variable; because, their p values are more than 5% critical values as shown in the above table.

As stated earlier, outcome of this study reveals that there is no causality running from gross domestic saving to economic growth in Ethiopia; this is due to the country experiences high resource gap and it depends heavily on foreign aid and borrowings to meet its investment requirements. In other words, the country is characterized by low level of domestic savings because of low level of income and the economy depends on external resources to accomplish huge investments which have significant impact on economic growth. As discussed earlier, this paper confirmed the existence of a positive and unidirectional causal associationship between economic growth and gross domestic savings in the long run. In Ethiopia, the growth in gross domestic product (rate of economic growth) causes growth in gross domestic savings. In the contrary, growth in gross domestic savings is not result in the growth of gross domestic product in Ethiopia. This empirical study is consistent with the Keynesian hypothesis.

4.2.2 Results of Autocorrelation

To assess the problem of autocorrelation in the model one can deploy either Breush-Godfrey /Lagrange Multiplier (LM) or alternative Durbins test. These tests are used to perform VECM Residual Serial Correlation Test. One way of the occurrence of autocorrelation is due to omitted explanatory variables from the model. The other may be misspecification of the mathematical form of the model used in the regression process. In addition to this, interpolation in the observation or misspecification of the true random term may be the other cause for the problem of autocorrelation. As shown in the table in the annex part, at lag order, the results are not significant so the null hypothesis of no serial correlation in the model is accepted. That means the random variable ε is not correlated with its preceding values; consequently, there is no serial correlation in the model.

Breush- Godfrey LM test for serial autocorrelation (autocorelation) result is presented in the following table:

Breush- Godfrey LM test for serial autocorrelation			
Lag (p)	Chi square	Degree of Freedom	Prob. > Chi square
1	0.05	1	0.82

H0: No serial correlation.

Table 1: Breusch-Godfrey LM test for autocorrelation

As we can see from this table, the probability value is high. This means, we can accept the null hypothesis which says; there is no serial correlation in the model.

Durbin's alternative test for autocorrelation			
Lag	Chi square	Degree of freedom	Prob. > Chi square
1	0.04	1	0.83

H0: no serial correlation.

Table 2: Durbin's alternative test for autocorrelation.

In the same way, the Durbin's alternative test suggests that there is no autocorrelation. Therefore we can accept the null hypothesis.

4.2.3 Results of Normality Test

The results of the normality tests reveal that the chi-squared results of Skewness and Kurtosis are statistically insignificant, so is the result of Jarque-Bera statistic. The Jarque Bera result is shown in the following table.

Equation	Skewness	Chi-square	Degree of freedom	Prob.> Chi-square
D_lnrgdp	-0.53	1.74	1	0.18
D_lngds	-.08	0.04	1	0.82
D_lnprc	0.12	0.09	1	0.72
D_lnint	0.10	0.07	1	0.78
D_lninf	0.57	2.03	1	0.15

Table 4: Skewness to test normality

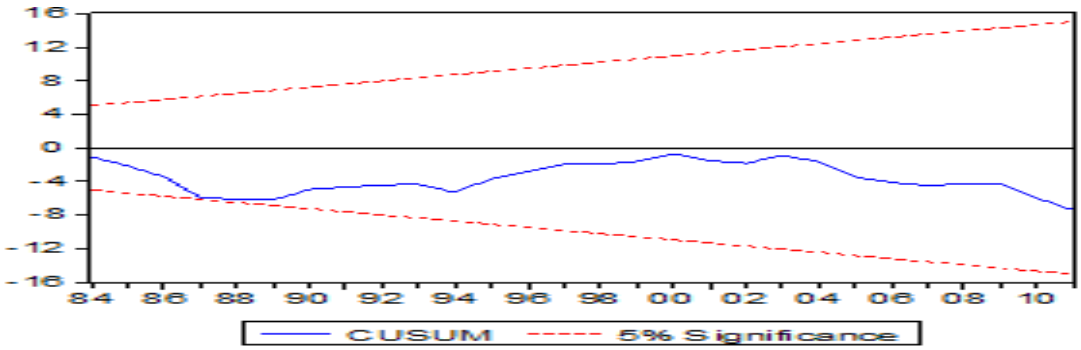
Here we cannot reject the null hypothesis. It says that the residuals are normally distributed. This is because as we can see from this table, the probability values for all the five equations are significant. This implies that, all the probability values for the above equations are more than 5% critical value.

Equation	Kurtosis	Chi-square	Degree of freedom	Prob.> Chi-square
D_lnrgdp	2.31	0.72	1	0.39
D_lngds	1.22	4.87	1	0.02
D_lnprc	1.60	3.00	1	0.08

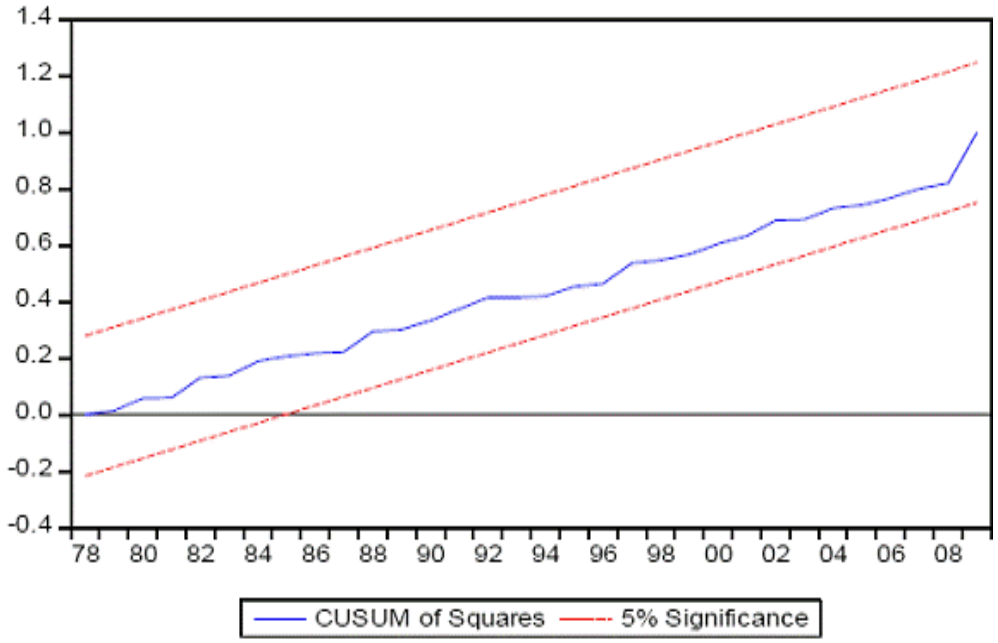
D_lnint	2.43	0.49	1	0.48
D_lninf	2.95	0.003	1	0.95

4.2.4 Results of Stability Test

As discussed earlier, CUSUM tests and CUSUM of squares tests indicate whether the model satisfies the stability condition or not. Accordingly, both tests shows that the parameter estimates of the model are stable over the sample period. As Brown, Durbin, and Evans (1975), stated that the CUSUM test is established on the cumulative sum of the recursive residuals. It plots the cumulative sum tests with 5% critical lines. If the cumulative sum goes outside the area between the two critical lines, then the CUSUM test finds parameter instability in the model.



On the other hand, The CUSUM of squares test gives a plot at the pair of 5% critical lines. If this test shows there is movement outside the 5% critical lines, then it reveals parameter instability. In this paper, both CUSUM and CUSUM square tests lie inside the two red lines.



This implies that, the coefficients in the model change neither systematically nor suddenly; rather they are stable over time.

CHAPTER FIVE

5. Conclusion and recommendation

5.1. Conclusion

Saving is one of determinants economic growth, saving might not directly affect economic growth but through creating investment, production, employment, and thereby economic growth. Those countries with higher rate of domestic savings may not depend highly on foreign direct investment or external savings which create chance of risk from unstable currency. Thus the primary propose of this paper is the relationship between domestic saving and economic growth, and give emphasis on examining the causality relationship between the domestic saving and economic growth in Ethiopia. Granger causality test were examined using time series annual data ranging from 1975 to 2013. The main objective is to investigate whether the direction of causality running from gross domestic savings to economic growth, or vice versa. In other words, the tests suggest that a unidirectional causality between rate of economic growth and rate of gross domestic savings in the long run. This causality goes from rate growth of gross domestic product to gross domestic savings. The outcomes found in this paper concerning the relationship between gross domestic savings and rate of economic growth in Ethiopia are consistent with economic growth theories. Almost all growth models are designed in context of advanced economies.

Findings in this paper: Based on the result of Granger causality test the study favors the hypothesis which says that the causality go from rate of economic growth to growth rate of gross domestic saving in Ethiopia. On the contrary, growth of gross domestic savings does not Granger cause growth rate of GDP. In this paper the empirical test result shows that there is a direct impact of economic growth on gross domestic savings. In other words, the growth in income of the country has an important role in increasing domestic savings in Ethiopia.

5.2 Recommendation

Since the study's result suggests that economic growth causes growth in gross domestic savings in Ethiopia in the long run; policy makers and responsible bodies should formulate and apply proper policies that would enhance economic growth. This is because; the growth in gross domestic product would result in growth in gross domestic savings. Furthermore, Ethiopian government should play an important role in mobilizing and allocating resources to enhance economic growth of the country; since growth in the economy will result in growth in gross domestic savings.

Annexes

```
. dfuller lnrgdp, trend lags(1)

Augmented Dickey-Fuller test for unit root        Number of obs   =        37

                                 ---------- Interpolated Dickey-Fuller ----------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic         Value             Value            Value
------------------------------------------------------------------------------
 Z(t)             0.073           -4.270            -3.552           -3.211
------------------------------------------------------------------------------

MacKinnon approximate p-value for Z(t) = 0.9949


. dfuller lngds, trend lags(1)

Augmented Dickey-Fuller test for unit root        Number of obs   =        37

                                 ---------- Interpolated Dickey-Fuller ----------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic         Value             Value            Value
------------------------------------------------------------------------------
 Z(t)            -3.536           -4.270            -3.552           -3.211
------------------------------------------------------------------------------

MacKinnon approximate p-value for Z(t) = 0.0357


. dfuller lnprc, trend lags(1)

Augmented Dickey-Fuller test for unit root        Number of obs   =        37

                                 ---------- Interpolated Dickey-Fuller ----------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic         Value             Value            Value
------------------------------------------------------------------------------
 Z(t)            -0.034           -4.270            -3.552           -3.211
------------------------------------------------------------------------------

MacKinnon approximate p-value for Z(t) = 0.9939


. dfuller lnint, trend lags(1)

Augmented Dickey-Fuller test for unit root        Number of obs   =        37

                                 ---------- Interpolated Dickey-Fuller ----------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic         Value             Value            Value
------------------------------------------------------------------------------
 Z(t)            -2.260           -4.270            -3.552           -3.211
------------------------------------------------------------------------------

MacKinnon approximate p-value for Z(t) = 0.4563
```

Co-integrating rank of VECM

```
. vecrank lnrgdp   lngds lnprc lngfc lninf, trend(constant) max

                    Johansen tests for cointegration
Trend: constant                                          Number of obs =      37
Sample:  1977 - 2013                                           Lags =       2
```

maximum rank	parms	LL	eigenvalue	trace statistic	5% critical value
0	30	-11.111877	.	83.4580	68.52
1	39	5.9695128	0.60280	49.2953	47.21
2	46	16.066361	0.42061	29.1016*	29.68
3	51	24.917532	0.38025	11.3992	15.41
4	54	30.523419	0.26142	0.1874	3.76
5	55	30.617142	0.00505		

maximum rank	parms	LL	eigenvalue	max statistic	5% critical value
0	30	-11.111877	.	34.1628	33.46
1	39	5.9695128	0.60280	20.1937	27.07
2	46	16.066361	0.42061	17.7023	20.97
3	51	24.917532	0.38025	11.2118	14.07
4	54	30.523419	0.26142	0.1874	3.76
5	55	30.617142	0.00505		

VECM when lnRGDP as dependent variable:

```
. vec lnrgdp lngds lnprc  lngfc lninf, trend(constant)

Vector error-correction model

Sample:  1977 - 2013                            No. of obs      =        37
                                                AIC             =  1.785432
Log likelihood =  5.969513                      HQIC            =  2.384054
Det(Sigma_ml)  =  4.98e-07                      SBIC            =  3.483426
```

Equation	Parms	RMSE	R-sq	chi2	P>chi2
D_lnrgdp	7	.04642	0.6999	69.96115	0.0000
D_lngds	7	8.57222	0.6633	59.0902	0.0000
D_lnprc	7	.044515	0.7442	87.27964	0.0000
D_lngfc	7	.134629	0.3808	18.45244	0.0101
D_lninf	7	.851724	0.4048	20.40661	0.0048

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D_lnrgdp						
_ce1						
L1.	-.5410202	.1485836	-3.64	0.000	-.8322387	-.2498016
lnrgdp						
LD.	.5519966	.1496087	3.69	0.000	.2587689	.8452242
lngds						
LD.	.0012155	.0007117	1.71	0.088	-.0001795	.0026104
lnprc						
LD.	-.3050659	.1561479	-1.95	0.051	-.6111102	.0009784
lngfc						
LD.	.0446453	.0611735	0.73	0.466	-.0752525	.1645431
lninf						
LD.	.0065809	.0092288	0.71	0.476	-.0115072	.0246689
_cons	.0517006	.012409	4.17	0.000	.0273795	.0760217

VECM when lnGDS as a left hand side variable:

```
. vec lngds lnrgdp lnprc  lnint lninf, trend(constant)

Vector error-correction model

Sample:  1977 - 2013                            No. of obs      =        37
                                                AIC             =  3.075448
Log likelihood = -17.89578                      HQIC            =   3.67407
Det(Sigma_ml)  =  1.81e-06                      SBIC            =  4.773442

Equation           Parms      RMSE     R-sq      chi2     P>chi2
------------------------------------------------------------------
D_lngds                7     8.50186   0.6688   60.57094   0.0000
D_lnrgdp               7     .046431   0.6997   69.91319   0.0000
D_lnprc                7     .044142   0.7485   89.26822   0.0000
D_lnint                7     .208392   0.2533   10.17738   0.1787
D_lninf                7     .852097   0.4043   20.36258   0.0048
------------------------------------------------------------------
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D_lngds						
_cel						
L1.	-.3124829	.1056716	-2.96	0.003	-.5195954	-.1053703
lngds						
LD.	-.4790133	.1251261	-3.83	0.000	-.724256	-.2337707
lnrgdp						
LD.	81.78714	27.05348	3.02	0.003	28.76329	134.811
lnprc						
LD.	-26.19062	26.86905	-0.97	0.330	-78.853	26.47175
lnint						
LD.	-7.128518	6.95004	-1.03	0.305	-20.75035	6.49331
lninf						
LD.	-4.211725	1.584477	-2.66	0.008	-7.317243	-1.106207
_cons	-.0079385	2.319659	-0.00	0.997	-4.554387	4.53851

Test for serial Correlation

```
. tsset obs, yearly
        time variable:  obs, 1975 to 2013
                delta:  1 year

. estat durbinalt

Durbin's alternative test for autocorrelation
```

lags(p)	chi2	df	Prob > chi2
1	0.023	1	0.8789

H0: no serial correlation

```
. estat bgodfrey

Breusch-Godfrey LM test for autocorrelation
```

lags(p)	chi2	df	Prob > chi2
1	0.029	1	0.8643

H0: no serial correlation

Test for stability of the coefficients

```
. vecnorm, jbera

   Jarque-Bera test
```

Equation	chi2	df	Prob > chi2
D_lnrgdp	3.293	2	0.19274
D_lngds	1.048	2	0.59206
D_lnprc	0.595	2	0.74285
D_lninv	17.860	2	0.00013
D_lngfc	0.185	2	0.91177
D_lnint	14.369	2	0.00076
D_lninf	0.886	2	0.64206
ALL	38.236	14	0.00048

.

Alternative method to check stability of the parameters

```
. vecstable
```

Eigenvalue stability condition

Eigenvalue	Modulus
.657597	.657597
-.08964554 + .59514i	.601854
-.08964554 - .59514i	.601854
-.5231081 + .08688892i	.530275
-.5231081 - .08688892i	.530275
.16964	.16964

Regression result when lnGDS is taken as dependent variable:

```
. reg lngds lnrgdp lnprc lnint lninf
```

Source	SS	df	MS		
Model	785.796259	4	196.449065	Number of obs	= 39
Residual	2385.99962	34	70.1764594	F(4, 34)	= 2.80
				Prob > F	= 0.0412
Total	3171.79588	38	83.4683126	R-squared	= 0.2477
				Adj R-squared	= 0.1592
				Root MSE	= 8.3771

lngds	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnrgdp	23.73988	25.35336	0.94	0.356	-27.78435	75.26411
lnprc	-15.37376	24.89549	-0.62	0.541	-65.96749	35.21996
lnint	10.5684	4.496517	2.35	0.025	1.430379	19.70642
lninf	.5888817	1.839008	0.32	0.751	-3.148433	4.326196
_cons	-120.7035	38.33637	-3.15	0.003	-198.6124	-42.79463

Regression result when lnGDP as left hand variable:

```
. reg lnrgdp lngds lnprc lngfc lninf
```

Source	SS	df	MS		
Model	11.1300253	4	2.78250633	Number of obs	= 39
Residual	.101867453	34	.002996102	F(4, 34)	= 928.71
				Prob > F	= 0.0000
Total	11.2318928	38	.295576126	R-squared	= 0.9909
				Adj R-squared	= 0.9899
				Root MSE	= .05474

lnrgdp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lngds	.001082	.0010741	1.01	0.321	-.0011009	.0032649
lnprc	.9237868	.0360361	25.64	0.000	.8505527	.9970209
lngfc	.0642027	.037094	1.73	0.093	-.0111813	.1395867
lninf	-.0077073	.0114401	-0.67	0.505	-.0309564	.0155418
_cons	.5628679	.2019792	2.79	0.009	.1523968	.973339