Ethiopian Civil Service University

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THE IMPACT OF HUMAN CAPITAL DEVELOPMENT ON ECONOMIC GROWTH IN ETHIOPIA: *EVIDENCE FROM ARDL APPROACH TO CO-INTEGRATION.*

Msc. Thesis

By:

Kidanemariam Gidey Gebrehiwot

June, 2013
Addis Ababa

THE IMPACT OF HUMAN CAPITAL DEVELOPMENT ON ECONOMIC GROWTH IN ETHIOPIA: *EVIDENCE FROM ARDL APPROACH TO CO-INTEGRATION* .

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MASTERS OF SCIENCE IN DEVELOPMENT ECONOMICS

BY

Kidanemariam Gidey Gebrehiwot

June, 2013

Addis Ababa

DECLARATION

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BIOGRAPHY

Kidanemariam Gidey Gebrehiwot was born in “Tanbuklo” village near Adigrat city, in Tigray National Regional State, in the Northern part of Ethiopia on October, 1980. He attended his elementary and junior education in Abyot-Chora Elementary and junior School at Shashemene city in Oromiya National Regional State. He attended his high school education in two schools namely, Shashemene high school and Shire-Endasilasie high school. After completion of his high school education, he joined Mekelle University and got his B.A. Degree in Economics in 2006. After that he was employed in Bureau of Finance and Economic Development (BoFED) of the Tigray National Regional State and served for about five years as a macroeconomic policy analyst. Then, he joined the Ethiopian Civil Service University in October, 2011 to follow his postgraduate studies for the M.Sc. in Development Economics.

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TABLE OF CONTENTS

TABLE OF CONTENTS(Continued)

TABLE OF CONTENTS (Continued)

LIST OF TABLES

PAGE

LIST OF FIGURES

LIST OF TABLES IN THE APPENDIX

LIST OF ACRONYMS

AIC……………………	Akaike Information Criterion
AR (1)…………………	Autoregressive Order One
ARDL…………………	Autoregressive Distributed Lag
ADF………………..…	Augmented Dicky Fuller
CGE…………………...	Computable General Equilibrium
CSLS…………………..	Centre for the Study of Living Standards
CUSUM……………….	Cumulative Sum of Recursive Residuals
CUSUMSQ……………	Cumulative Sum of Squares of Recursive Residuals
DF………………...…...	Dicky Fuller
DW…………………….	Durbin Watson
ECT…………………...	Error Correction Term
EEA/EEPRI…………..	Ethiopian Economic Association/Ethiopian Economic Policy Research Institute
EEA/EEPRI…………..	Ethiopian Economic association
FDRE……………….…	Federal Democratic Republic of Ethiopia
GDP………………...…	Gross Domestic Product
HSDP……………….…	Health Sector Development Plans
ILO……………………	International Labor Organization
MOE…………………..	Ministry of Education
MOH…………………..	Ministry of Health
MOFED……………….	Ministry of Finance and Economic Development
NBE………………...…	National Bank of Ethiopia
NGO………………...…	Non-Governmental Organizations
ODA…………………...	Official Development Assistance

LIST OF ACRONYMS (Continued)

OECD………………… Organization for Economic Co-operation and Development

OLS…………………… Ordinary Least Square

UNCTAD…………..… United Nations Conference on Trade and Development

UNESCO……………... United Nations Educational, Scientific and Cultural Organization

USD…………………… United States Dollar

UNDP…………………. United Nations Development Programme

VECM………………... Vector Error Correction Model

WB……………………. World Bank

WDE………………….. World Data on Education

ABSTRACT

The main objective of the study was to investigate the long run and short run impact of human capital on economic growth in Ethiopia (using real GDP per capita, as a proxy for economic growth) over the period 1974/75-2010/2011. The ARDL Approach to Co-integration and Error Correction Model are applied in order to investigate the long-run and short run impact of Human capital on Economic growth. The finding of the Bounds test shows that there is a stable long run relationship between real GDP per capita, education human capital, health human capital, labor force, gross capital formation, government expenditure and official development assistance. The estimated long run model revels that human capital in the form of health (proxied by the ratio of public expenditure on health to real GDP) is the main contributor to real GDP per capita rise followed by education human capital (proxied by secondary school enrolment). Such findings are consistent with the endogenous growth theories which argue that an improvement in human capital (skilled and healthy workers) improves productivity. In the short run, the coefficient of error correction term is -0.7366 suggesting about 73.66 percent annual adjustment towards long run equilibrium. This is another proof for the existence of a stable long run relationship among the variables. The estimated coefficients of the short-run model indicate that education is the main contributor to real GDP per capita change followed by gross capital formation (one period lagged value) and government expenditure (one period lagged value). But, unlike its long run significant impact, health has no significant short run impact on the economy. Even its one period lag has a significant negative impact on the economy.

The above results have an important policy implication. The findings of this paper imply that economic performance can be improved significantly when the ratio of public expenditure on health services to GDP increases and when secondary school enrolment improves. Such improvements have a large impact on human productivity which leads to improved national output per capita. Hence policy makers and / or the government should strive to create institutional capacity that increase school enrolment and improved basic health service by strengthening the infrastructure of educational and health institutions that produce quality manpower. In addition to its effort, the government should continue its leadership role in creating enabling environment that encourage better investment in human capital (education and health) by the private sector.

Key words: ***Ethiopia, Economic Growth, Human capital, Education, Health, ARDL method of Co-integration, ECM model.***

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

With its large reserves of human and natural resources, Ethiopia should have been a prosperous economy with low poverty level, improved infrastructure services, better education and health status. However, it is one of the poorest countries in the world manifested by low per capita income and low human development index. According to Word Bank (2011) data, the real per capita income level of the country was 141.86 USD in 1981.This figure has decreased with some fluctuations for the next 11 years and reached to 115.8 USD in 1991. After the overthrow of the military regime, real per capita income level showed a continuous improvement for the next 5 years and reached to 125.58 USD in 1996/97. But, in the next 6 years generally declined (with some ups and downs) to 124.30 USD in 2003 .Starting from 2004, it has increased continuously and reached to 231 USD in 2011. On the other hand, in 2000, human development index of the country was 0.274. This figure has slightly increased to 0.363 in 2011 (UNDP, 2011).

Modern theory of economic growth argues that human capital, especially education and health has the principal role on achieving economic growth and development (Gyimah-Brempong and Wilson, 2005). In line with this, Ethiopia has made some movements to create skilled and competent citizens through designing different education and health policies and implementing them.

Before 1925, in Ethiopia, education was limited to religious institutions. After that, recognizing the importance of education, the imperial regime has tried to design a plan that expands secular education in the country (Oumer, 2007). During the military regime, educational program was formulated with the slogan of education for production, education for scientific realization, and education for political consciousness (Woubet, 2006). But, limited provision, inequitable distribution, inefficiency, irrelevance and poor quality were fundamental problems of education prior to 1991(MOE, 2008). In 1974/75 the ratio of expenditure on education to total GDP was 1.58 percent and declined for the next seven years.

After 1981/82, it has showed a slight increment and reached to 1.92 in 1989/90 (EEA/EEPRI, 2010 and MoE ,2011).

In addition to the education sector, at the beginning of the military regime, a new health policy which emphasizes on disease prevention and control and rural health services was designed. Further, the government formulated a ten-year health perspective plan as part of the ten-year economic development plan launched in 1984. The goal of this plan was providing basic health services to the majority of the population (Mongabay, 2010).To achieve this goal, health stations, health centers, rural hospitals, regional hospitals, and central referral hospitals were supposed to provide proper health care to the society. However, by the late 1980s, these facilities were available to only a small fraction of the country's population (Ibid).

After the overthrow of the military regime, in 1994 education Sector Strategy was designed by the current government (WDE, 2010). The main focuses of the strategy was: changing curriculum; expanding primary, secondary and tertiary level education; improving the quality of education ; making education more relevant to the demands of the community; restructuring the organization and administration of the education system (Ibid). According to EEA/EEPRI, (2010) and MoE (2011) data, the ratio of educational expenditure to total GDP was around 1.64% in 1991/92 .This has generally increased for the next twenty years and reached to 4.57 % in 2010/11.

As one part of its socioeconomic measures, FDRE government has also developed national health policy and comprehensive Health Sector Development Plans (HSDPs) in 1996/97. Democratization and decentralization of the health care system; developing preventive and curative components of health care; creating accessible health care service for all parts of the population; and encouraging private and NGO participation in the health sector were the main goals of the policy). During the past fifteen years, the government has made an inspiring skeleton for improving the health of the people (MOH, 2010). Expenditure on health as a percentage of GDP was 3.89% in 1995 and after ten years it reached to 4.89% with some slight fluctuations in the middle (UNESCO ,2010) .But, the desired outcome is not achieved yet, though some major efforts are done (MOH , 2010).

As we have seen above, though the degree of emphasis and success may vary from one regime to another, an effort has been made to increase the productivity of the citizens and the total income of the country.

1.2 Statement of the Problem.

Human capital refers to the "knowledge, skills, competence and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being" (OECD, 2001:17). Recent growth literature has given more emphasis to the consequence of human capital in economic growth and development .Generally; economic growth and development theorists argued that human capital has a substantial effect on economic growth and development (Kefela and Ren, 2007). For instance, According to Harbison (1971) wealth of a nation is critically determined by its level of human capital. For him , differences in the level of socio-economic development across nations is determined not so much by natural resources and the stock of physical capital but by the quality and quantity of human resources. Similarly, Lucas (1988); Romer (1990); Mankiw, Romer, and Weil (1992 and Bergheim (2005) argued that human capital is crucial so as to increase the productivity of labor and physical capital. In addition, ILO report (2003) as cited by Patron (2006: 3) states that, "the knowledge and skills endowment of a country's labor force, rather than its physical capital, determines its economic and social progress, and its ability to compete in the world economy". In other words, human capital is the main source of knowledge and a guide for the implementation of this knowledge in the production process.

Even though there is an argument on the importance of human capital for economic growth of any country, it is still controversial that what factors should be considered as human capital and how to measure it. In most of the studies education or health related indicators are employed as a proxy for human capital (Qadri and Waheed, 2011).

Like other countries, Ethiopia has devoted much resource and efforts to the education and health sectors anticipating productivity improvement of the citizens and thereby economic growth. These resources are cost to the society not only because they are economic resources but also because they have alternative uses. Therefore, investigating the relationship between human capital (resources devoted to this sector) and economic growth may be a big concern to policy makers and even to the society.

Some researchers have tried to investigate the relationship between human capital development and economic growth in Ethiopia. For instance, using school enrollment as a proxy for human capital, Seid (2000) found an insignificant impact of human capital on output level. Similarly Wubet (2006) has got the same result that proves the non existence of any relationship between the two macroeconomic variables. But, their approach of measuring human capital ignores the health aspect of human capital development, while both education and health are important component of human capital.

On the other hand, using public spending on education and health sector as a proxy for investment in human capital development, Teshome (2006) found a positive impact of human capital development on economic growth in Ethiopia. This finding is reinforced by Tofik (2012) who found a positive and significant relationship between capital spending on human capital and economic growth. But both of them didn't show the separate impact of the health and education sector on economic growth. In addition Tofik failed to incorporate the recurrent human capital expenditure account of the government. Since both education and health are important elements of human capital, using both indicators is relatively better measure of human capital than using education or health indicators alone. Therefore, the author of this paper has used both the education and health indicators so as to empirically analyze the effects of human capital development on economic growth by taking secondary school enrolment rate as a proxy for human capital in the education area and the ratio of public expenditure on health to GDP as a proxy for human capital in the health area.

All of the above researchers who tried to identify the relationship between human capital and economic growth in Ethiopia have used the same technique of analysis (Johnson's Co-integration technique). Even though the Johnson's Co-integration technique is one of the widely used methods of time series analysis, its outcome could not be reliable for small sample size (Pesaran and Shin, 1997; Narayan, 2005; Udoh and Ogbuag, 2012). Relatively, the Autoregressive distributed lag method of co-integration has more advantage over the Johnsons method (Pesaran and Shin, 1997; Pesaran and Shin, 1999; Pesaran, Shin, and Smith, 2001; Harris and Sollis, 2003; Narayan, 2005; Chaudhry & Chaudhry, 2006; Ang ,2007 and Rahimi and Shahabadi , 2011). Hence this paper has used this approach to provide valid empirical evidence on the effects of human capital development on economic growth.

1.3 Research Objectives

The main objective of the study is to analyze the impact of human capital development on economic growth in Ethiopia over the period 1974/75-2010/11. The study will try to address the following specific objectives:

- To empirically evaluate the impact of human capital development on economic growth in Ethiopia, both in the short-run and in the long-run.
- To analyzes the causal relationship between human capital development and economic growth in Ethiopia.
- To derive policy implications from the empirical analysis.

1.4 Research Questions

- Does human capital development have a significant long-run and short-run impact on economic growth in Ethiopia?
- Is there a causal relationship between human capital development and economic growth in Ethiopia?

1.5 Significance of the Study

This study is expected to generate the following benefits:

- It will improve the practical knowledge and skill of the researcher of this study by making familiar with factual evidence on the macroeconomic problems.
- It will produce general information on the relationship between human capital development and economic growth.
- It will serve as a spring board for further studies on human capital development and economic growth.
- It will generate evidences for policy implications that aim to analyze the interaction of human capital development and economic growth.

1.6 Scope and Limitation of the Study

The study has used 37 years annual data covering from the period 1974/75 to 2010/11.The study excludes comparative analysis with other countries. In order to empirically analyze the long run and short run relationship between human capital development and economic growth (real GDP per capita), only secondary school enrolment is used as a proxy for the education human capital. On the other hand, the ratio of total government expenditure on health to GDP is used as a proxy for health human capital indicator. In this research, though learning on the job (experience) could have an impact on human capital development, only formal education is used as a proxy for human capital formation in the education area. On the other hand, the research didn't include the impact of private expenditures on health. But, since most of the basic health service is provided by the government, government expenditure on health can explain the health human capital created in Ethiopia. Further, though only two variables (labor force and official development assistance) are taken from international organizations (UNCTAD and WB), such mixed sources of data may have little impact on the quality of the results.

1.7 Organization of the Study

The paper has six chapters .The first chapter deals with the introduction part of the paper. Chapter two reviews the theoretical and empirical literature regarding human capital and economic growth. The third chapter presents the overview of economic growth, education and health sectors in Ethiopia. Chapter four addresses the model specification and methodology aspect of the paper. The fifth chapter concentrates on the results and discussion part of the paper. And finally, the conclusion and recommendation part is presented in the sixth chapter.

CHAPTER TWO

LITERATURE REVIEW

2.1 Theoretical Literature Review

Before the modern human capital theories come to literature, a given economy is mostly believed to depend only on physical capital (land, machinery and equipment) and raw Labor. Investment in capital equipment was largely assumed the dominant factor of output. For instance, the classical theorists give much focuses on the exploitation of labor by capital (Marimuthu, Arokiasamy and Ismail, 2009).However, after 1950s some modern economists come and formally treat education and health as the key factors in improving human capital and thereby increasing economic progress (Kern, 2009).

2.1.1 Human capital and neoclassical growth theories

Schultz (1961) and Becker (1962) are among the first human capital theorists. According to them, education augments individual's skill and thus his or her human capital. A higher skill level in the workforce increases the production capacity. On the other hand, Schultz (1975) as cited by Xiao (2001) suggests that education enables individual workers to adjust themselves in accordance with changing economic conditions by understanding any shocks, analyzing information, and reallocating resources. On the other hand, Spence (1973) perceived education as a market signal for the potential productivity of workers. It also serves as a screening tool to select potential workers that can be trained for specific jobs more quickly and at a lower cost than their counterparts. But their argument was not practically incorporated in to economic growth theories until the standard neoclassical growth model was revised by Mankiw, Romer, and Weil in the year 1992. These scholars have used a Cobb-Douglas production function to reexamine the Solow growth model.

Generally, neoclassical growth theory argues that long-term economic growth is determined solely by the accumulation of factor inputs such as physical capital and labor. Studies reveal a significant contribution from technical progress, which is defined as an exogenous factor. Solow (1957) and Cass (1965) are among those who first demonstrated this. They propose the convergence theory of growth which treats technology as the sole long run determinant of growth.

Generally, they said that, in the long run, sustained positive growth rate of output per capita is only apparent if there is continues advances in technological knowledge in the form of new goods, new markets, or new processes. If there is no technological progress, then the effects of diminishing returns would eventually cause economic growth to cease. When we continue to provide people with more and more of the same capital goods without inventing new uses for the capital, then the extra capital goods become redundant and therefore the marginal product of capital will become negligible. This idea is captured formally by assuming the marginal product of capital to be strictly decreasing in the stock of capital (Aghion and Howitt, 1998). In other words, assuming diminishing returns to scale, they said that as capital per worker increases, growth of the economy slows down until it reaches the steady state and the lower the initial level of income per capita the higher is the predicted growth rate (Weil, 2009). But the model cannot explain the existence of continuous economic progress like the case of East Asian developing economies (Zarra-Nazhad & Hosainpour, 2011).

2.1.2. Human capital and endogenous growth theories

In order to address the limitations of the neoclassical theory and answer the long-run determinants of economic growth, in the mid 1980s, endogenous growth models were developed. Lucas (1988) and Romer (1990), who are the famous proponents of this theory, include deliberately created technological changes as an explanatory variable in their growth model. For endogenous growth theorists, it is not only technology which determines the growth of a given nation, but there are other factors (such as human capital) that are not captured by the neoclassical growth model.

Lucas (1988) considers human capital as a separate input in the production function formed predominantly by workers through education or on-the-job training. In the Lucas (1988) model, the rate at which human capital is being accumulated was seen as the critical determinant of productivity growth.

On the other hand Romer (1990) treats human capital as a factor affecting innovation that have a positive impact on the long-run rate of productivity growth, instead of treating human capital as a direct input to the production of goods. That means, for Romer endogenous growth is caused by accumulating technology /knowledge while for Lucas it is the non-decreasing marginal returns of human capital that creates endogenous growth.

Generally, they conclude that just having a large population is not sufficient to generate growth, rather stock of human capital and research and development are sources of economic growth. According to these models, the law of diminishing returns to scale may not be true since the returns on physical and human capital goods do not necessarily diminish through time. If the owner of the capital employs a skilled and healthy worker, the productivity of the capital and the technology will improve. Another justification to the possibility of increasing returns to scale is the spillover of knowledge across producers and external benefits from improvements in human capital (Wilson and Briscoe, 2004).

Similarly, in order to re-examines the Solow growth model and to explain the cross country per capita income variation, Mankiw, Romer, and Weil (1992) has formulated an augmented Solow model, in which human capital enters as a factor of production with those of physical capital and raw labor. They conclude that differences in human capital, saving and population growth determines cross-country differences in income per capita. That means accumulation of physical capital and population growth has greater impacts on income per capita when human capital is taken into account in the model. According to the above researchers, excluding it from the model may result in biased results.

2.1.3. Investment in education and rate of returns to education

The time and money spent in formal schooling, on-the job-training and off-the-job training are the main investments in education. These investments involve direct tuition expenditures, foregone earnings during schooling, and reduced wages during training that are incurred in order to gain a return on this investment in the future. Becker (1993) in his book entitled "*Human Capital: A Theoretical and Empirical Analysis with special reference to education"* argues that there are different kinds of investments in human capital that include schooling, expenditures on medical care, on job training and others. In other words, investment in human capital refers to activities that influence future real income through the embedding of resources in people. So, to him investment on education and training is the most important issue to create human capital. Giving more emphasis to education, he justified that education and training raise the productivity of workers by providing useful knowledge and skills.

Generally, the costs of education and the employment opportunities after education are the two key determinants of the private returns to education (Rephann, 2002, cited in Fleischhauer, 2007). As with investments in physical capital, a human capital investment is only undertaken if the expected return from the investment (which is equal to the net internal rate of return) is greater than the market rate of interest. That means, schooling is an investment that is undertaken expecting future income for individuals who receive it.The return to education comes through the channel of increased earnings for the worker and higher productivity for the firm as well as increased employment probabilities (Ibid).

According to Mincer (1981, 1989, 1996) wages /return of a worker are determined by the size of his/her human capital stock. As a result wage disparity among workers is mainly due to the variation in the sizes of human capital stocks not due to the raw labor. The returns to education are not solely private. There may be spillovers from education to other individuals, in which case the social benefits would be higher than the sum of private returns to educated individuals. McMahon (1998, 2010) has classified the returns to education as monetary and non-monetary as well as private and social. Wages are the direct private and monetary returns from education. The effects of education on GDP growth and on the earnings of others (by making them more productive) are also other forms of monetary social benefits /returns. Beyond the monetary benefits, education may have non monetary benefits to individuals as well as to the society as a whole. (Ibid, 2010). Health effects, more efficient household management, lifelong adaptation and continued learning at home (use of new technologies as Internet, radio and television, educational reading etc.), non monetary job satisfaction, are some of the non-monetary private returns. The gains from living in an educated society (better citizenship, democracy stability, poverty reduction and lower crime rates) and community services from education (dissemination of knowledge through articles, books, media and also informally) are some of the examples of on-monetary social benefits. In addition, it may facilitate the development of democratic institutions, human rights, political stability, lower state welfare costs, lower public incarceration costs, contributions to social capital, to the generation of new ideas, etc (Ibid).Therefore taking only the private returns may underestimate the full return of society.

2.1.4 Health and human capital

Education is only one aspect of human capital development. Health status may also affect the human capital level of individuals and thereby the growth of a given country. Health capital can affect economic growth through the channels of productive efficiency, life expectancy, learning capacity, creativity, etc (Howitt, 2005). Healthier workers will become strong, energetic, creative, attentive so forth that makes them more effective in the production process with any given combination of skills, physical capital and technological knowledge. That means, better health enhances the effective and sustained use of the knowledge and skills that individuals acquire through education.

As with investment in education and training, the quantity and quality of the human-capital stock can be increased through investment in the prevention and treatment of illness (Gardner and Gardner, 2001). Due to this some scholars includes stock of health on their model and argued that health determines the total working hour that an individual wants to spent to generate income (Basov, 2002).

Barro (2013) argues that better health can reduce the depreciation of education capital, and thus increases the favorable effect of education on growth. He has developed a model that includes the effect of health on productivity and concludes that:

> *"For a given quantities of labor hour, physical capital, workers schooling and experience, an improvement in health raises a workers' productivity. In addition to this direct effect, an improvement in health lowers rate of mortality and disease and thereby decreases the effective rate of depreciation on human capital"*(Baroo,2013:351).

2.1.5 Rationale for public intervention in education and health

Education policy can affect educational outcome through educational quantity or through the impact on educational quality. Educational quantity is usually expressed in enrolment levels or average years of schooling or literacy rate. Educational quality has been traditionally measured by input measures such as teacher-student ratios, and total public expenditures on education. A more recent strategy, however, is to evaluate educational quality in terms of output indicators measuring the performance of students and graduates through test scores in areas like maths, reading and science are often used. (Patron, 2006).

The most important motivation for public intervention in education and health are the presence of market failures, and equity considerations (Ibid).The idea of education and education externalities or market failures occurs when the benefits of individually acquired education and health may not be restricted to the individual, but might spill over to others as well, accruing at higher levels of aggregation (e.g. the public). For instance, among education externalities are crime reduction and better health outcomes better household management and improvements in GDP or productivity (Moretti, 2006 and Hanushek and Wobmann, 2007).These spillovers, if not internalized by public intervention, may drive a block between the social and private rate of return to education. This implies that social returns to education may exceed private returns if we take into account these non-pecuniary spillovers.

2.1.6 Measuring human capital

There are many arguments on how to measure human capital. Le, Gibson, and Oxley (2003) identifies three major approaches to measure human capital: the Outcome-based approach, the income-based approach, and the cost-based approach.

Some researchers use only educational indicators (outcome-based approach), such as school enrollment rate, educational attainment or the rate of literacy, to measure a country's human capital. For instance, Mankiw, Romer and Weil (1992), Barro and Lee (2000), and DePleijt (2011) have used average level of schooling (or educational attainment) as a proxy for human capital. But using these measures as a proxy for human capital have some limitations First, it undermines the quality of schooling which may be affected by educational infrastructures, access to educational services. Second, it assumes productivity among workers varies with levels of education and it is proportional to their years of schooling (Mulligan and Sala-I-Martin, 2000). That means, a worker with ten years of schooling is assumed to have ten times as much human capital as a worker with one year of schooling (Jones and Fender, 2011). However, individual's effectiveness can be recognized after participating in production activities (Dae-Bong, 2009). Similarly, Levine and Renelt (1992) have measured human capital based on school enrollment rates. The assumption behind using such measure is that enrolment rates measure the current investment in human capital that will be reflected in the stock of human capital sometime in the future. However, there is a long time lag between investment in education and additions to the human capital stock; hence, current enrolment rates may not indicate the schooling level of the current labor force but of the future labor force (Le, Gibson, and Oxley, 2003). In addition, the education level of current students may not be fully added to the future productive human capital stock because graduates may not join to the labor force. But with its limitations, enrolment rates can be acceptable proxies for human capital in some countries (Judson, 2002; as cited by Jones and Fender (2010).

Income-based approach is another alternative which values human capital stock using the earnings of the individual obtained from a labor market. Mulligan & Sala-i-Martin (2000) argued that the aggregate stock of human capital is the sum of individual incomes. The income-based approach has been the most popular approach in recent applications. It is recently employed to measure human capital in China, the United States, the United Kingdom, Australia, New Zealand, Sweden and Norway (Christian, 2011). But wages differences which vary for many reasons may not truly reflect differences in productivity. In addition, data on earnings are not widely available, especially in developing countries where the wage rate is often not observable (Le, Gibson, and Oxley, 2003).

Cost-based (conventional) approach is one alternative measure of the stock of human capital. It is an indirect measure of human capital which relies on summing costs invested for human capital creation (Dae-Bong, 2009). Kendrick (1976), Eisner (1988), Oluwatobi & Ogunrinola (2011) and Umaru (2011) are among the influential examples of systematically measuring the stock of human capital using the cost of educating and training people. A number of OECD countries have implemented this cost-based approach to the measurement of education services. Schreyer (2008) and Diewert (2008) has argued that the cost-based approach is the second best alternative way of valuing output while the best option would be to use final demand prices to value output. However it is not far from some limitations. For instance Appleton and Teal (1998) and Dae-Bong (2009) criticized that it is a measure that identifies inputs rather than outputs of human capital. That means it is difficult to precisely classify boundary between investment and consumption in the perspective of costs for the human capital. In addition, there is a long time lag between investment in education and additions to the human capital stock; hence, current investment may not indicate the current level of human capital. The investments on education may not also be effectively used to create productive human capital stock because investment may partially be wasted through corruption, grade repetition and dropouts.

The stock of health capital can be measured in terms of outcome indicators or input indicators. Though it is difficult to apply it, the best way of outcome indicators is measuring through self-reported health status of the population (CSLS, 2001). Average life expectancy at birth of the population, infant mortality rate, morbidity rate, the risk of financial insecurity from illness etc are also some of the second alternative measures health outcome indicator (CSLS, 2001 and Howitt, 2005). The use of life expectancy as a proxy variable of health, however, does not consider all the dimensions of health. Out of the many dimensions of health (mortality, morbidity, disability and discomfort), life expectancy takes into account only mortality (Evans, Barer, M. and T. Marmor, 1994). Moreover, life expectancy reveals only the lifetime of the stock of human capital implying nothing will be changed with time in the labor force or population. Hence, since the outcome indicators can be affected by the inputs devoted in the health area. Therefore, we can measure it through the input indicators such as total resources devoted by government and/or individuals to the health system, resources devoted to the advancement of medical knowledge, and resources devoted to infrastructure affecting public health etc (CSLS, 2001).

2.2 Empirical Literature Review

Despite their conclusions are controversial, different scholars have tried to analyze the relationship between human capital and economic growth. Mankiw, Romer, and Weil (1992), on their cross-country regression analysis, have showed that human capital as one of the reasons for income variation across countries. That means they found a positive and significant correlation between human capital and per capita income growth. Barro (1991) also found the same result on 98 countries during the period from 1960 to 1985. In their OLS based human capital augmented Cob-Douglass Production function analysis, enrollment rates to primary and secondary school are taken as a proxy of the human capital.

Again, Barro (1996; 2013) have measured human capital using average years of schooling in primary and secondary school .He found positive and significant relationship between per capita income growth and human capital from 1960 to 1990. Based on his simple panel regression analysis, Barro reported that the process of catching up was firmly linked to human capital formation: only those poor countries with high levels of human capital formation relative to their real GDP tended to catch up with the richer countries. Benhabib and Spiegel (2002) also find an indirect positive and significant correlation between the two macroeconomic variables. According to their finding, countries with a larger human capital stock show faster technological catch-up. Similarly, Bassanini and Scarpetta (2001) investigate the relationship between human capital accumulation and economic growth for OECD countries between 1971 and 1998. They said that one extra year of schooling increases the long-run average per capita output level by about 6%.

Barro and Sala-i-Martin (1995; 2004) also tried to prove the effect of primary, secondary, and tertiary school attainment (by sex) on economic growth. They got an insignificant effect of primary education of males and females on economic growth. But they found significant relationship for males' secondary and tertiary education. They also analyzed the role of educational attainment on the convergence theory. Their result proves that countries with relatively low initial GDP grow faster when they have higher levels of human capital in the form of educational attainment .Baldwin and Borrelli (2008) also wrote an article that show relationship between higher education and economic growth in US and conclude that expenditure on higher education has a positive relation with per capita income growth.

Health capital is an asset that enables us to fully develop our capacity. The life of human being is incomplete if there is health problem (physical and /or mental). Theoretically, a healthy person can not only work more effectively and efficiently but also devote more time to productive activities. However, there is little empirical literature on the effects of health capital on growth as compared to the other macroeconomic studies .Some scholars like, Barro (1966; 2013) has formulated a model that includes physical capital inputs, level of education, health capital, and the quantity of hours worked. The model assumes that "people are born with initial endowments of health which depreciate with age and grow with investment in health". Based on his analysis, he concluded that an increase in health indicators raises the incentives to invest in education and a raise in health capital lowers the rate of depreciation of health. Taking life expectancy as an indicator of health, Bloom Canning, and Sevilla (2004) also found a strong positive and statistically significant effect on output. They suggest that each extra year of life expectancy raises the productivity of workers and leads to an increase of 4% in output.

Gyimah- Brempong and Wilson (2005) and Odior (2011) also argued that education captures just one aspect of human capital. It could not account the differences in school quality and health aspect of human capital. For instance, based on microeconomic evidences, Strauss and Thomas (1998) argue that health explains the variations in wages at least as much as education. Gyimah-Brempong and Wilson (2005) find that health capital indicators positively influence aggregate output. They find that about 22 to 30 percent of the growth rate is attributed to health capital, and improvements in health conditions equivalent to one more year of life expectancy are associated with higher GDP growth of up to 4 percentage points per year. Barro and Sala-i-Martin (1995; 2004), have also included life expectancy and infant mortality in their growth regressions as a proxy of tangible human capital and concluded that life expectancy has a strong positive relation with growth.

Using other indicators of human capital, some researchers have analyzed the relationship between the two macroeconomic variables. For instance, using the dynamic panel estimator method, Gyimah- Brempong and Wilson (2005) showed a positive and robust link between investment in health & education and economic growth in Africa and the rest of the world for the period 1960-2000. Odior (2011), also made a research in Nigeria to provide an empirical evidence on whether government expenditure on health can lead to economic growth or not. He used an integrated sequential dynamic computable general equilibrium (CGE) model and found a significant relationship between economic growth and government expenditure on health sector. In addition, taking government recurrent and capital expenditures on education and health, Oluwatobi & Ogunrinola (2011) and Umaru (2011) have made an econometric analysis in Nigeria , over the period 1970-2008 and 1977- 2007 respectively, to analyze the relationship between government spending on education and health and economic growth. They followed the Johnson cointegration technique and got a positive relationship between government recurrent expenditure on human capital development and real output, while capital expenditure is negatively related to the level of real output. Kefela and Rena (2007) who made their study on North East African States also showed that 40 percent to 60 percent of growth rates in per capita GDP were resulted from investment in human capital.

When we come to the Ethiopian case, Woubet (2006) has made co-integration analysis to investigate the impact of human capital on total level of output using the Barro and lee method of human capital measurement over the period 1971-2005. He got an insignificant relationship between the two macroeconomic variables. But this finding ignores health which is one component of human capital development. For instance, the returns to health in rural Ethiopian agriculture are more than double of the returns to inputs like fertilizer (Kefela and Rena, 2007).On the other hand, using public spending on education and health sector as a proxy for investment in human capital development, Teshome (2006) found a positive impact of human capital development on economic growth in Ethiopia over the period 1960/61-2003/04. This finding is reinforced by Tofik (2012) who found a positive and significant relationship between capital spending on human capital and economic growth from year 1975 to year 2010. But both of them didn't show the separate impact of the health and education sector's spending on economic growth. In addition Tofik fails to incorporate the recurrent expenditure account of the government.

CHAPTER THREE

OVERVIEW OF ECONOMIC GROWTH, EDUCATION AND HEALTH SECTORS IN ETHIOPIA.

3.1 Public Spending on Education and/or Health in Ethiopia.

It is appropriate to analyze the trends of Education and Health expenditures in real terms than nominal terms. But to convert the nominal public expenditures in to real terms, there is no reliable price index which can serve as deflator. Thus, the share of public expenditure on education and health to GDP is used as one indicator to see the trends in the improvement of the education and health sector.

As shown in Figure 1, the share of total expenditure on education to GDP slightly increase from average of 1.33 percent in years 1974/75-1979/80 to average of 1.78 in years 1980/81-1985/86 . During 1986/87-1990/91, the share has also increased to an average value of 1.9 percent. However, during the entire military period, there were forward and backward movements in the yearly values of the educational indicator. After 1990/91, total expenditure on education as a percentage of GDP has increased continuously (except for the year 1999/00) and almost tripled within twelve years (from 1991/92 to 2002/2003). As it is depicted in Figure 1, between the year 1991/92 and 1997/98, the average share of total expenditure on education to GDP was 2.26 percent .Then, it has increased from an average of 3.71 percent in years 1998/99-2004/05 to an average of 4.44 percent in year 2005/06-2010/11.

On the other hand, the average value of expenditure on health as a percentage of GDP was 0.5 percent between 1974/75-1979/80. In the next six years, it has increased and recorded an average value of 0.63 percent. Between 1986/87-1990/91, health expenditure as a percentage of GDP has showed almost a constant trend recording an average value of 0.65 percent.

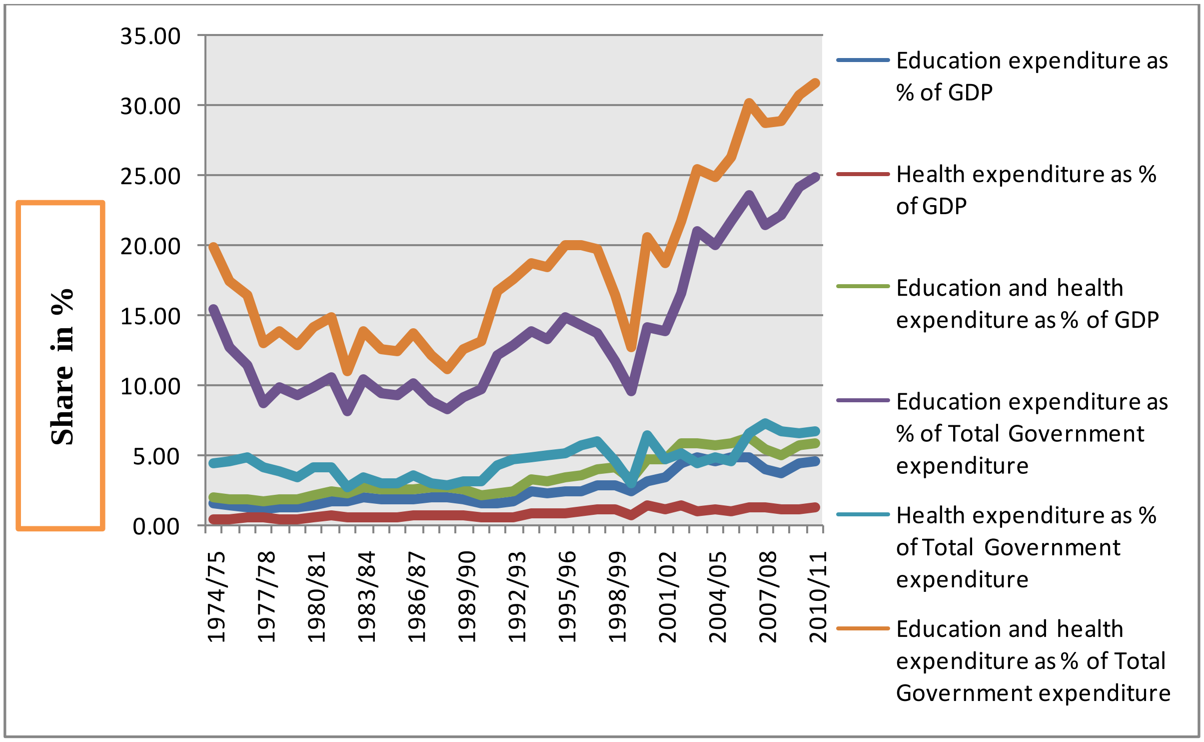

Figure 1 Trends in the share of public spending on education and/or health to GDP and total government expenditure in Ethiopia (1974/75-2010/11).

Source: Own calculation based on MoFED and EEA data.

After the overthrow of the military regime, the share of health expenditure to GDP has increase with some oscillations. Between the year 1991/92 and 1997/98, its average share was 0.9 percent. After that, it has recorded an average of 1.17 percent in years 1998/99-2004/05 and average of 1.23 percent in year 2005/06-2010/11. Since total expenditure on education is much more than that of health expenditure, the sum of expenditure on education and health as a percentage of GDP has showed the same trend as the share of expenditure on education to GDP. From the above graph, we can also see that during the period 1974/75 to 1977/78, Education expenditure as a share of total government expenditure has sharply declined from 15.4 percent to 8.78 percent. Then it starts to oscillate around an average value of 9.5 percent up to the year 1990/91.After that, it has generally showed a continuous increment up to 2010/2011 (except for the year 1999/00). On the other hand, the average value of expenditure on health as a percentage of total government expenditure was 4.24 percent between 1974/75-1979/80. In the next six years, it has decreased and recorded an average value of 3.45 percent. Between 1986/87-1990/91, health expenditure as a percentage of total government expenditure has further declined to an average value of 3.20 percent. After the overthrow of the military regime, the share of health expenditure to total government expenditure has increased with some oscillations. Between the year 1991/92 and 1997/98, its average share was 5.17 percent. After that, it has decreased to an average value of 4.77 percent in years 1998/99-2004/05 and then increased to an average of 6.4 percent in year 2005/06-2010/11.

3.2. Life Expectancy and Death Rate

As it is shown in Figure 2, during the period 1974/75 to 1984/85, life expectancy was almost constant showing a little bit fluctuations around an average value of 44.2 years. Then after, this figure has continuously increase and reached to 59.3 years in 2010/11. Between 1974/75 and 1990/91 , Ethiopia's life expectancy at birth has increased by almost 3 years while it has increased by 11.4 years from the year 1991/92 to 2010/ 2011. Similarly, From 1974/75 to 1984/85, crude death rate was almost constant around an average value of 20. In the next 26 years this value has continuously declined and reached to 9.39 in 2010/11. Between 1974/75 and 1990/91, number of deaths per 1,000 midyear population has decreased by 2 while it has declined by 8 from the year 1991/92 to 2010/ 2011.

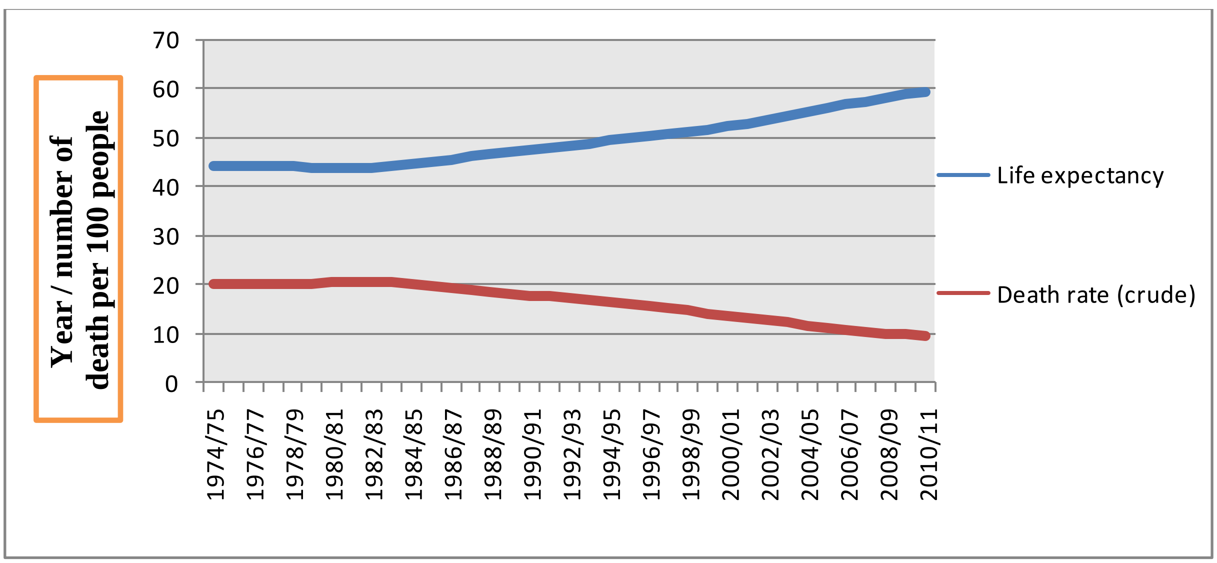

Figure 2 Trends of life expectancy and death rate (1974/75-2010/11)

Source: Own calculation based on Index Mundi[1] data.

[1] http://www.indexmundi.com/facts/ethiopia/life-expectancy-at-birth (or /death-rate)

3.3.Enrolment Rate and Educational Attainment

During the first nine years of the military regime (1974/75-1982/83) gross enrolment in the primary school has generally increased continuously from 18.89 percent in 1974/75 to 42.55 percent in 1982/83. But it has declined for the next three years. This could be mainly due to the severe droughts encountered during 1983/84 and 1984/85. After that the primary school enrollment rate has recovered in the year 1986/87 and 1987/88, but the recovery was short-lived as the country plunged into political turmoil that eventually terminated in the overthrow of the military regime in 1990/91. After the overthrow of the military regime, the primary school enrollment rates were deteriorated for two consecutive years more than the rates they were in 1988/89–1990/91.After 1993/94; it has showed a continuous improvement for the next eighteen years and reached 105 percent in 2010/11.

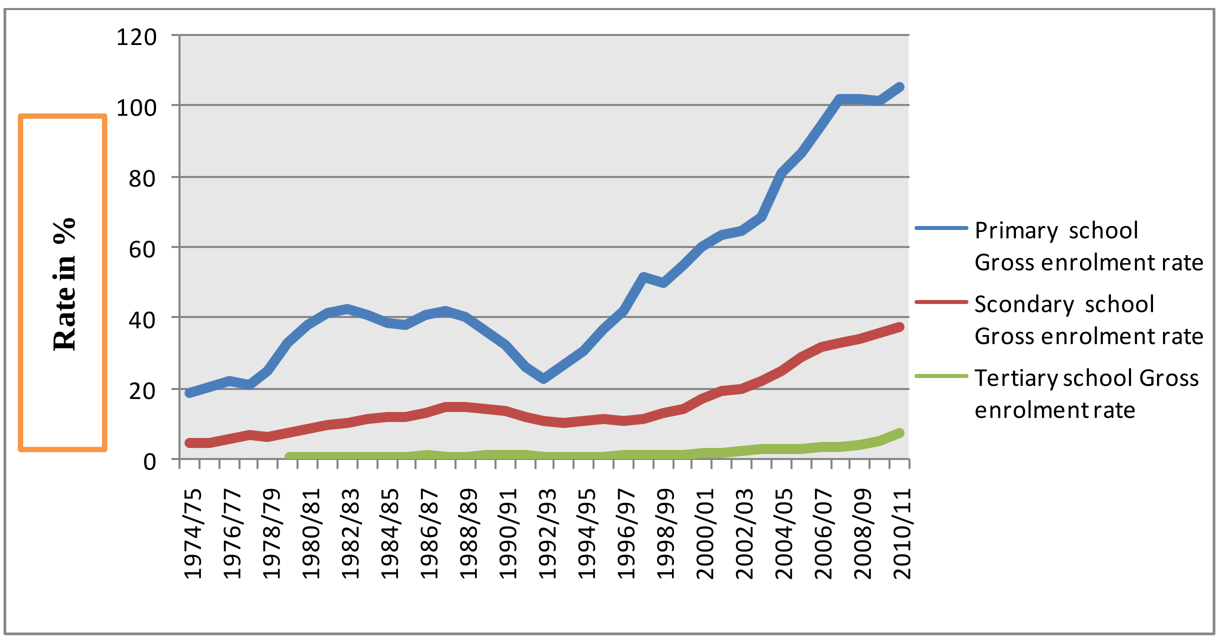

Figure 3 Trends of gross enrolment rate in Ethiopia (1975-2011).

Source: World Bank (2012) database[2].

Note that: There is no data from the year 1974/75-1983/84 for secondary school gross enrolment rate and from the year 1974/75-1979/80 for the tertiary school gross enrolment rate.

[2] http://data.worldbank.org/data-catalog/ed-stats

During 1984/85-1988/89, secondary school gross enrollment rate increased from 4.88 percent to 15.06 percent. However it has generally decreased during the transitional government periods (1991/92-1994/95). As Figure 3 clearly demonstrates, after 1994/95 it has increased continuously for the next sixteen years and reached to 37.6 percent in 2010/11. Gross enrollment rate in the tertiary level is very poor in Ethiopia as compared to the primary and secondary level .It was below one percent until the year 1998/99. Starting from 1999/00, it has showed above one percent rate and reached 7.6 percent in 2010/11.

Table 1. Percentage of economically active population (age 15-64) by educational attainment

Year	Primary level (in %)	Secondary level (in %)	Tertiary level (in %)
1975	4.27	1.92	0.13
1980	5.73	3.10	0.21
1985	7.18	4.64	0.32
1990	9.11	6.78	0.47
1995	11.03	8.96	0.66
2000	12.79	9.89	0.99
2005	13.28	12.36	1.26
2010	13.88	14.99	1.54

Source: World Bank (2010) database[3].

According to world Bank(2010) data, only 4.27 percent, 1.92 percent ,and 0.13 percent of the economically active population was attained primary level , secondary level and tertiary level of education respectively in1975. After forty year, the percentage of persons who reached the primary level, secondary level and tertiary level of education have increased to 13.88 percent, 14.99 percent and 1.54 percent respectively. This indicates us; still the majority of Ethiopia's economically active population did not attain even the primary level education. Especially the proportion of economically active population who attained Tertiary level has remained below one percent until the year 2000. (For detail information, see Table 1 above).

[3] http://data.worldbank.org/data-catalog/ed-stats

3.4.Trends of Real GDP and Per Capita Income Growth in Ethiopia

The average rate of growth in real gross domestic product for the period 1975/76-1979/80 was 2.21 percent per annum .In contrast, the per capita GDP has decelerated by an average growth rate of -0.54 percent. The shocks induced due to the emerging new policy and the war with Somalia during the period 1974/75–77/78 could mainly explain the poor growth performance. In the next five years real GDP has decelerated at an average growth rate of 2.05 percent. Similarly, the growth rate of real GDP per capita was -10.16 percent. These negative growth rates could be due to the severe drought in 1983/84 and 1984/85 periods. In the last six year periods of the military regime (1985/86-1990/91) the growth rate of the Real GDP and Real GDP per capita has increased to 4.9 percent and 2.42 percent respectively. This increment could be due to the double digit growth rates in 1985/86 and 1986/87, mainly showing the recovery from the small base.

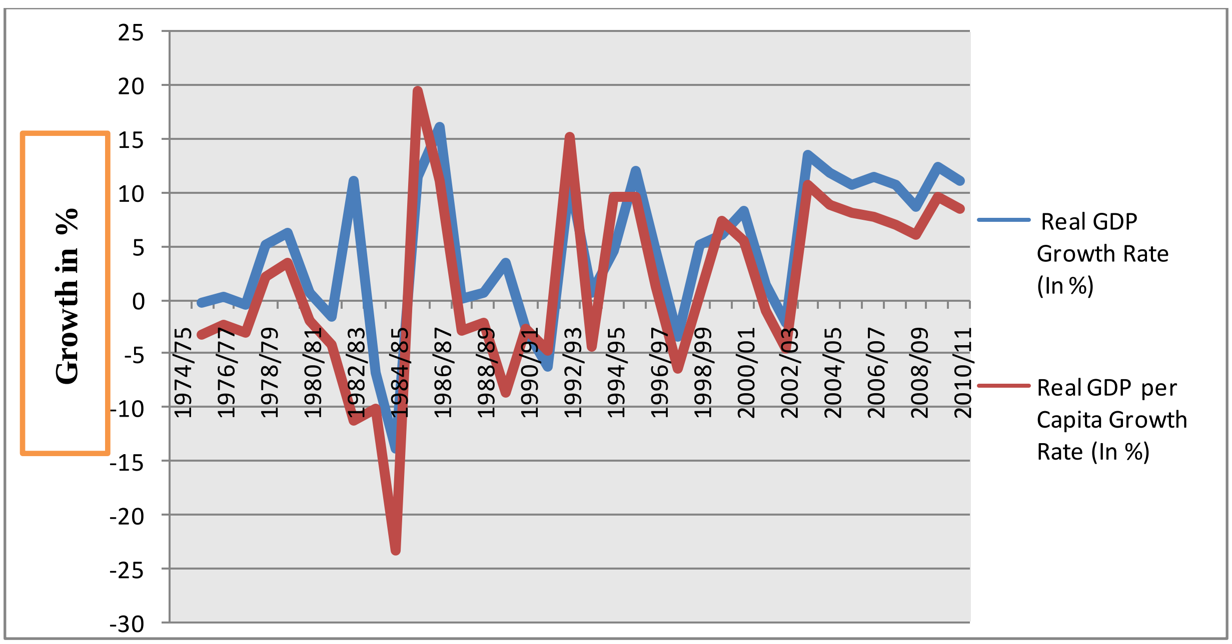

Figure 4.Trends of real GDP and GDP per capita growth in Ethiopia.

Source: Own calculation based on National Bank of Ethiopia data (2011/12).

Therefore it is interesting to note that growth trends are extremely irregular. Agricultural sector performance which in turn is related to the vagaries of nature could be one of the reasons associated with such irregularities. In addition, repeated war and instabilities in the country is the other factor that is responsible for such lopsided economic trend.

After the collapse of the military rule in 1991, the transitional government of Ethiopia took over the economy. In the period 1991/92-1995/96 the overall GDP growth rate averaged 4.49 percent per annum, while the per capita GDP growth rate was 5.1. In the next five years (1996/97-2000/01), though there was a drought in 1997/98, it has recorded an average growth rate of 4.13 percent. During this period, the per capita GDP growth was low (1.7 percent) relative to the previous five years average. During the period 2001/02 -2002/03, the average growth rate of real GDP has decreased with a negative growth rate of -2.16 percent in 2002/03 (drought period). After 2003, Ethiopia has witnessed the most rapid growth in its history. As Figure 4 indicates such double digit growth has lasted for eight years. Even excluding the highest growth rate of 13.57% in 2004 that has certain recovery pattern from the drought of 2002/03, the average annual growth rate of 2004/05-2010/11 is still as high as 11.04 percent.

CHAPTER FOUR

MODEL SPECIFICATION AND METHODOLOGY

4.1. Theoretical Framework and Model Specification

Different scholars have designed different conceptual frameworks that incorporate human capital as one of the determinant factor of economic growth. Among those scholars, Mankiw, Romer and Weil (1992) and Weil (2009) has accommodated human capital as an independent factor of production in their empirical analysis. Griffin and Knight (1990) as cited by Appleton and Teal (1998) has also used health and education as determinants of GDP per capita assuming education, good health and longevity are essentially valuable output determinants. These researchers have employed the human capital augmented Solow growth model (Cobb- Douglas production function) as their framework, specifying output/output per worker as dependent variable while labor, physical capital and human capital are dependent variables.

Bernanke and Gurkanak (2001) also applied Cobb- Douglas production function so as to analyze the relationship between human capital and economic growth. Duma (2007) who studied the sources of growth in Sri Lanka has used a human capital augmented Cobb-Douglas production function in the study, taking output growth as a dependent variable while growth in labor, growth in physical capital and growth in human capital were taken as explanatory variable. Madsen, Saxena , and Ang (2008) who studied the relationship between human capital and economic growth of India have also used the human capital augmented production function and employed the co-integration method was adopted for their estimation. The general form of the human capital augmented Cobb-Douglas production is shown below:

$$Y_{t=}K_t^{\alpha}\ H_t^{\beta}\ (AL)_t^{1-\alpha-\beta}\ u \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

By transforming the equation in to log-linear form:

$$\ln Y_t = \alpha \ln K_t + \beta \ln H_t + (1-\alpha-\beta)\ln\,(AL_t) + v \ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

Where,

Y is output level; α is Elasticity of Physical capital with respect to output

K is level of physical capital β is Elasticity of Human capital with respect to output

H is level of Human Capital v is an error term

L is the level labor force, $\alpha + \beta < 1$

A is level of Productivity/technology

The above model can be transformed in to empirically estimable form as follows:

According to Mankiw, Romer and Weil (1992) , Labor and technology are assumed to grow at the rates n and g and the number effective units of labor (AL_t) grows at the rate $n + g$.

$$L_t = L_0 e^{nt}$$

$$A_t = A_0 e^{gt}$$

Assuming constant shares of output denoted by s_k and s_h are devoted to gross investment in physical capital and human capital respectively we can write:

$$IK_t = s_k Y_t$$

$$IH_t = s_h Y_t$$

Where IK_t and IH_t are investments in physical capital and human capital respectively.

Letting $k = \frac{K}{AL}$ as the stock of physical capital per effective unit of labor, $h = \frac{H}{AL}$ as the stock of human capital per effective unit of labor, $y = \frac{Y}{AL}$ as the level of output per effective unit of labor, n is the growth rate of labor, g is the rate of technological change and d is the common (time-invariant) depreciation rate, we can derive the time path (differentiation with respect to time) of k and h as follows (Mankiw, Romer and Weil, 1992).

$$\frac{\partial k}{\partial t} = \dot{k} = s_k \; y_t \; - (n+g+d)k_t$$

$$\frac{\partial h}{\partial t} = \dot{h} = s_h \; y_t - (n+g+d)h_t$$

Under the assumption that $\alpha + \beta < 1$ (*i.e.* decreasing returns to scale), this system of equations can be solved to obtain steady-state values of k^* and h^* defined by:

$$k_t^* = \left[\frac{{s_k}^{1-\beta} \; {s_h}^{\beta}}{n+g+d}\right]^{\left(1/_{1-\alpha-\beta}\right)}$$

In natural logarithm form:

$$ln \; k_t^* = \frac{1-\beta}{1-\alpha-\beta} \ln \; s_k + \frac{\beta}{1-\alpha-\beta} \ln \; s_h - \frac{1}{1-\alpha-\beta} \; ln \; (n+g+d)$$

$$h_t^* = \left[\frac{{s_k}^{1-\alpha} \; {s_h}^{\alpha}}{n+g+d}\right]^{\left(1/_{1-\alpha-\beta}\right)}$$

In natural logarithm form:

$$\ln h_t^* = \frac{1-\alpha}{1-\alpha-\beta} \ln \; s_k + \frac{\alpha}{1-\alpha-\beta} \ln \; s_h - \frac{1}{1-\alpha-\beta} \; \ln (n+g+d)$$

Substituting these two equations into the original production function (equation 1) and taking logs yields the expression for the steady-state output (y_t^*):

$$\ln y_t^* = \ln \frac{Y_t}{L_t} = \ln A_t + g_t - \frac{\alpha+\beta}{1-\alpha-\beta} \ln (n+g+d) + \frac{\alpha}{1-\alpha-\beta} \ln s_k + \frac{\beta}{1-\alpha-\beta} \ln s_h$$

Since $\ln A_t$ is not observable, it will be captured by the error term (Mankiw, Romer and Weil, 1992). Similarly, g_t is not observable and its parameter cannot be distinguished from the constant term empirically (Bassanini and Scarpetta, 2001). Hence, the estimated basic empirical growth equation could be expressed as follows:

$$\ln y_t^* = \ln \frac{Y_t}{L_t} = C + \frac{\alpha+\beta}{1-\alpha-\beta} \ln(n+g+d) + \frac{\alpha}{1-\alpha-\beta} \ln s_k + \frac{\beta}{1-\alpha-\beta} \ln s_h \quad \text{..... (3)}$$

Therefore, based on this theoretical framework developed by Mankiw, Romer and Weil (1992), the following empirically estimable log-linear type of model (with some modification to accommodate other additional variables) is specified.

$$\mathrm{LnGDPPC}_t = f(LnLAB_t, LnGCF_t, LnEHC_t, LnHHC_t, LnGOEX_t, LnODA_t, D_1, D_2) \text{.....(4)}$$

Where:

$LnGDPPC_t$ = Natural logarithm of real GDP per capita at time *t*.

$LnLAB_t$ = Natural logarithm of labor force growth rate at time *t*.

$LnGCF_t$ = Natural logarithm of gross capital formation at time *t*.

$LnEHC_t$ = Natural logarithm of education human capital at time *t*.

$LnHHC_t$ = Natural logarithm of health human capital at time *t*.

$LnGOEX_t$ = Natural logarithm of total government expenditure at time *t*

$LnODA_t$ = Natural logarithm of official development assistance at time *t*.

D_1 and D_2 are dummy variables for policy change and recurrent drought

Generally, the empirical analyses related to human capital and economic growth mostly rely on measures of formal education as a proxy for human capital formation by ignoring the contribution of health on human capital development, while both education and health are important for human capital development (Gundlach, 1996; Karagiannis & Benos (2009)).

To avoid such limitations, many researchers have used both of the education and health measures as a proxy for human capital. For instance, Karagiannis & Benos (2009) have used enrolment rates, student/teacher ratios for the educational indicators and number of medical doctors and hospital beds for the health indicators. On the other hand, Qadri and Waheed 2011) have used education indicator (enrolment rates) and health indicator (share of total government expenditure on health to GDP). Barro (2003) has also measured human capital using education (educational attainment) and health (life expectancy). Including both the education and health indicators are relatively better measure of human capital than using education or health indicators alone. Because it expresses the notion that both education and health are an important elements of human capital.

With regard to this paper, both the education and health indicators separately are used so as to empirically analyze the effects of human capital development on economic growth. The secondary school enrolment rate level is used as a proxy for human capital in the education area. On the other hand, the share of total government expenditure on health to GDP is used as a proxy for health human capital in the health area. The availability of data in Ethiopia and other international databases related to education and health indicators of Ethiopia are also more suitable to use such techniques of measurement than the other alternative measures discussed above.

4.2. Data Sources and Measurement of Variables

The study has used 37 year annual data from 1974/75-2010/11. Most of the data is collected from Ministry of Finance and Economic Development (MOFED), Ethiopian Economic Association (EEA) and National Bank of Ethiopia (NBE). Some of the data is also collected from international organizations (such as, UNCTAD and World Bank CD–ROM). The detailed sources of data for each variable are described in table 2.

Table 2. Summary of data source by variable

Type of variable	Unit/Proxy	Source
Real GDP per capita	Real Gross Domestic product per capita	NBE
Physical Capital stock	Ratio of real Gross Capital Formation to real GDP.	MoFED
Labor force	Labor force growth rate	UNCTAD
Education Human capital	Secondary school enrollment	MoE and EEA
Health Human capital	Ratio of government expenditure on health (recurrent and capital) to GDP.	MOFED and EEA
Total government expenditure	Ratio of total government expenditure (recurrent and capital) to GDP	NBE and MoFED
Official development assistance	Ratio of Official development assistance to GDP.	World Bank

Note: All of the variables are included in the model in real terms

The descriptions and measurements of the dependent and the explanatory variables that are included in the model of this paper are explained as follows:

i. Real GDP Per Capita (GDPPCt)

Like the studies made by Mankiw , Romer and Weil (1992), Barro and Lee (1993), Benhabib and Spiegel (1994) and Barro and Sala-i-Martin (1995; 2004), Real GDP per capita that indicate the total amount of the market value of all domestically produced final goods and services divided by total population is taken as a proxy for economic growth (dependent variable).

ii. Share of Real Gross Capital Formation to GDP (GCF_t)

It is a proxy for physical capital stock in the economy and it is derived by dividing the gross fixed capital formation adjusted through GDP deflator to real GDP. Barro and Sala-I-Martin (1995; 2004) shows that the sign expected from the coefficient GCF is positive, because the accumulation of the capital is supposed to favor the growth of the real GDP by fostering further production of new goods and services.

iii. Labor

Theoretically, labor force is a major element for sustainable rate of economic expansion. It could be the engine of growth for labor intensive economies like Ethiopia. But if it couldn't be used efficiently and if it is less productive, it may be a burden for the economy because of high rate of unemployment. It is incorporated in the model in its growth rate.

iv. Human Capital Development

Human capital is a factor influencing labour productivity because it facilitates the absorption of new technology, increases the rate of innovativeness and promotes efficient management (Adamu, 2003; as cited in Sankay, Ismail, and Shaari, 2010). Consequently, for high labor productivity, investment in human capital is termed as endogenous factor that enhance accumulation of physical capital through knowledge, skills, attitudes and health status of the people who participate in the economic process. Therefore, this variable is included in the model to represent the "knowledge, skills, competence and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being. It is represented by the share of public health expenditure (recurrent and capital) to GDP and secondary school enrolment. Therefore, higher level of human capital development in the form of education and health are expected to have a positive impact on economic growth.

v. Ratio of Government Expenditure to Real GDP

This variable refers to the ratio of the sum of recurrent and capital budget of the Ethiopian government to real GDP. To avoid double counting government expenditure on human capital is deducted from total government expenditure .Similarly, since ODA is included in the model as one explanatory variable; government expenditure is taken only the expenditures from domestic sources (excluding the external assistance and loan). It is entered in to the model as a share of GDP. Since, budgetary expansion would boost the economy and would cause an increase in the real GDP growth rate, the sign expected from the coefficient of public spending is positive

vi. Ratio of Official Development Assistance to Real GDP

The view on the relationship between official development assistance aid and economic growth can be classified in to three. The first view is that aid has a positive contribution to the socio-economic status of the recipient country. The second argument rests on the idea that aid might lead to poor or negative productivity by discouraging alternative development policies and institutions (Rajan and Subramanian, 2005; Ekanayake and Chatrna ,2008). The other argument is that the marginal contribution of aid depends on the institutional environment (policy) of the recipient country. If there is good economic policy environment, it is crucial for the efficient allocation of aid to investment which has a positive impact on the economy. However, it will have little or no impact on economic growth if there is institutional destruction and capacity constraints (Hansen and Tarp, 2000). Therefore, since Ethiopia is among the main aid recipient countries in Africa; it is entered in to the model as one control variable.

vii. Dummy Variable

Changes in economic policies can influence the performance of the economy through investment on human capital and infrastructure, improvement in political and legal institutions and so on (Easterly, 1993). On the other hand, recurrent drought and bad weather condition have a negative impact on the economy, especially in developing countries that are predominantly dependent on agriculture. Therefore, policy change dummy (D1) and recurrent drought dummy (D2) are added in to the model. The dummy for changes in economic policies take zero for the period 1974/75-1991/92 and one otherwise. Similarly, the drought dummy takes zero, if there was relatively good weather condition and one if there was drought. The drought periods are determined based on the findings of (Webb, Braun, and Yisehac, 1992; Viste, Korecha, and Sorteberg , 2012).

All of the variables discussed above are given in logarithm form (except the policy change and drought dummy). The log-linear form of specification enables the researcher to interpret the coefficient of the dependent variables directly as elasticity with respect to the independent variables (Sarmad, 1988). In addition it is also useful for accommodating the hetreoskedasticity problem (Goldstein and Khan, 1976).

4.3. Methodology of the Study

4.3.1. Stationarity and non-stationarity of time series data.

The concept of "stationarity" is related to the properties of stochastic processes[4]. Time series data is assumed to be stationary if the mean, variance and covariance of the series are independent of time. In other words, there exists stationary process if it generates constant mean and variance. (Banerjee ,et.al, 2003). On the other hand, non-stationarity in a time series occurs when there is no constant mean, no constant variance, or both of these properties. In this case it is not possible to use simple OLS to estimate long-run linear relationships between variables .If we do so , it would lead to spurious regression /non-sense economic analysis where R-squared is approximating unity, t and F-statistics look significant and valid. Hence, we will be obliged to falsely concluding that there is a relationship between two unrelated non-stationary series. This kind of problem (unit root problem) can be solved by differencing the data set (Gujarati, 2004). If the variable is stationary without differencing, then it is integrated of order zero, I(0). A variable is said to be integrated of order one, or I(1), if it is stationary after differencing once, or of order two, I(2) if differenced twice. In order to determine the degree of stationarity, a unit root testing will be carried through the Augmented Dicky-Fuller (ADF) test.

4.3.2. Unit root testing

Let us now discuss how to test the existence of unit roots in a time series data. Augmented Dicky-Fuller (ADF) test is one of the widely used approaches of unit root testing. The simplest starting point for testing stationarity is an autoregressive model of order one, AR(1) and the DF test can be estimated in three different forms of AR(1) model as specified below (Gujrati, 2004).

Y_t is a random walk: $Y_t = \delta Y_{t-1} + u_t$ ....(5)

Y_t is a random walk with drift: $Y_t = \beta_1 + \delta Y_{t-1} + u_t$.......... ...(6)

Y_t is a random walk with drift and trend: $Y_t = \beta 1 + \beta_2 t + \delta Y_{t-1} + u_t$... ..(7)

[4] **Stochastic Process:** A sequence of random variables indexed by time.

where t is the time or trend variable and u_t is a white noise error term[5].

For simplicity, let us consider equation (5), a random walk autoregressive model:

A convenient technique for carrying out the unit root test is to subtract Y_{t-1} from both sides of equation (5) and to define $\Phi = \delta\text{-}1$.

Subtracting Y_{t-1} from both sides of equation (4) gives:

$$Y_t - Y_{t-1} = \delta Y_{t-1} - Y_{t-1} + u_t \quad \text{...}(8)$$

$$\Delta Y_t = (\delta\text{-}1) Y_{t-1} + u_t$$

$$\Delta Y_t = \Phi\, Y_{t-1} + u_t \text{...}(9)$$

Where $\Phi = (\delta\text{-}1)$, Δ is the first difference operator and $u_t \sim IN[0, \sigma^2]$

The fundamental idea behind the **Dickey-Fuller (DF)** unit root test for stationarity is to simply regress ΔY_t on one period lagged value of Y_t and find out if the estimated Φ is statistically equal to zero or not.

Then, the null hypothesis H_o: $\Phi = 0$ against the alternative hypothesis H_a: $\Phi < 0$ will be tested.

If $\Phi = 0$ or $(\delta = 1)$, equation (9) will become a random walk without drift model, that is, a non-stationary process. When this happens, we face what is known as the unit root problem. On the other hand, If $\Phi < 0$ or $(\delta < 1)$, then the series Y_t is stationary. (Yule, 1989) as cited by Ssekuma, 2012).

The decision to reject or not to reject the null hypothesis is based on the Dickey-Fuller (DF) critical values of the τ (tau) statistic and the test procedure for unit roots is shown as follows:

- Set the null and alternative hypothesis as:

[5] **White noise error term** is a process of random variables that are serially uncorrelated, have zero mean, and a constant variance

H_o: $\Phi = 0$

H_a: $\Phi < 0$

- Calculate the test statistic using

$$F = \frac{\hat{\Phi}}{SE(\hat{\Phi})}$$, where $SE(\hat{\Phi})$ is the standard error of $\hat{\Phi}$.

- Compare the calculated test statistic in equation with the critical value from Dickey-Fuller table to reject or to accept the null hypothesis.

In order to calculate the critical values of the τ (tau) statistic, Dicky-Fuller assumes that the error terms (u_t) are not correlated (Enders, 1996). But the error term in the Dickey-Fuller test usually has autocorrelation, which needs to be removed if the result is to be valid. In addition, the critical values of τ (tau) statistics do not follow the normal distribution function and in general, the critical value is considerably larger than its counterpart of t- distribution.

Therefore, using such critical values can lead to over-rejection of the null hypotheses when it is true (Ibid). Hence, Dickey and Fuller have developed a test known as the **Augmented Dickey-Fuller (ADF**) test to solve this kind of difficulty (Green, 2004). In the ADF test, the lags of the first difference dependent variable is added in the regression equation until the autocorrelation problem will be resolved .The regression equation is presented in the following form:

$$\Delta Y_t = \Phi\, Y_{t-1} + \beta \sum_{i=1}^{p} \Delta Y_{t-i} + u_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(10)$$

Since a random walk process may have no drift, or it may have drift or it may have both deterministic and stochastic trend, let us include an intercept β_1 as well as a time trend t in the model.

$$\Delta Y_t = \beta_1 + \beta_2 t + \Phi\, Y_{t-1} + \beta \sum_{i=1}^{p} \Delta Y_{t-i} + u_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(11)$$

where β_2 the coefficient on a time trend series**;** Φ is the coefficient of Y_{t-1} ; p is the lag order of the autoregressive process, $\Delta Y_t = Y_t - Y_{t-1}$; Y_{t-1} is lagged values of order one of $\boldsymbol{Y_t}$ **;** ΔY_{t-i} are changes in lagged values; and u_t is the white noise.

The parameter of interest in the ADF model is Φ and the null and alternative hypothesis that will be tested are as follows:

$$H_o: \ \Phi = 0$$

$$H_a: \ \Phi < 0$$

The ADF test procedure for unit roots is similar to statistical tests for hypothesis and it can be tested on three possible models as specified in equations (5), (6) and (7). But, the critical values of the tau test to test the hypothesis that $\Phi = 0$, are different for each of the three specifications. (Gujrati , 2004). Hence, due to the above advantages over DF test, the researcher has used the ADF test of stationarity. In addition, the lag-length of the ARDL model is determined by Akaike Information Criterion (AIC).

4.3.3. Cointegration analysis and vector error correction model.

If a group of time series variables are individually integrated of the same order and if at least one linear combination of these variables is stationary, then the variables are said to be co-integrated (Harris, 1999 and Enders, 2004). This means there could be a long-run equilibrium relationship between these variables. Testing for cointegration implies testing for the existence of such a long-run relationship between economic variables. This test could be done through the Engle-Granger procedure, the Johansen's co-integration procedure, Autoregressive Distributed Lag (ARDL) method of cointegration etc.

Engle-Granger Approach is one of the widely used tests of Co integration. It is a residual based test of cointegration. In order to apply the Engle-Granger procedure, first, all the variables must be integrated of the same order. Once the variables are found to have the same order of integration, the next step is estimating the cointegrating parameter through OLS and test for cointegration (Yaffee, 1999). To do this, we have to calculate residuals from the estimated equation and test its stationarity, usually by ADF test (Ssekuma, 2012). If the residuals are stationary, it implies that the variables are cointegrated. (Enders,1996).

The second stage involves forming the error correction model, where the error correction term is the residual from the cointegrating relationship, lagged once. This term tells us the speed of adjustment to the long run equilibrium (Ibid). However, using Engle-Granger method has some weaknesses. For instance, if we have more than two variables, there may be more than one cointegrating vectors. But it can find out only one co-integrating vector. Second, a cointegration test may depend on the direction of the variable put in the left side of the cointegration. That means, the method does not allow the variables in the right hand side to be potentially endogenous. (Enders,1996). In addition, since Engle-Granger's method is a two-step estimation procedure, any error introduced in the first step may carry over into the second step, making the results unreliable (Ibid).

Johansen maximum Likelihood (1988) cointegration method is one of the techinique that solves the above shortcomings of **Engle-Granger procedure** (Ibid). Basically, it can estimate more than one cointegration relationship, if the data set contains two or more time series. It relies heavily on the relationship between the rank of a matrix and its characteristic roots. (Ssekuma , 2011).

However, since Johansen cointegration techniques require that all the variables in the system to have equal order of integration, i.e the application of the Johansen technique will fail when the underlying regressors have different order of integration , especially when some of the variables are I(0) (Pesaran, Shin, and Smith, 2001). That means the trace and maximum eigenvalue tests may lead to erroneous co-integrating relations with other variables in the model when $I(0)$ variables are present in the system (Harris, 1999).

Fortunately, to overcome this problem, Pesaran and Shin (1997, 1999, 2001) have developed a new **Autoregressive Distributed Lag (ARDL) model** which have more advantages than the Johnson cointegration approach .First , the ARDL approach can be applied irrespective of whether the regressors are I(1) and I(0). Second, while the Johansen cointegration techniques require large data samples for validity, the ARDL procedure provides statistically significant result in small samples (Pesaran and Shin, 1997; Pesaran and Shin, 1999; Narayan, P., 2005; Udoh and Ogbuag , 2012). That means, it avoids the problem of biasness that arise from small sample size (Chaudhry & Chaudhry, 2006).Third, the ARDL procedure provides unbiased and valid estimates of the long run model even when some of the regressors are endogenous (Harris and Sollis, 2003, Pesaran and Shin, 1999, Ang,J.,2009). Further, in using the ARDL Approach, a dummy variable can be included in the co-integration test process, which is not permitted in Johansen's method (Rahimi and Shahabadi, 2011). Therefore, due to the above mentioned advantages, the researcher has used the ARDL method of co-integration to investigate the impact of human capital development on economic growth.

The ARDL approach involves two steps for estimating the long-run relationship (Pesaran, Shin, and Smith, 2001). The first step is to examine the existence of long-run relationship among all variables in an equation and the second step is to estimate the long-run and short-run coefficients of the model. We run the second step only if we find a co-integration relationship in the first step.

The generalized ARDL (p,q) model can be shown as follows(Green,2003):

$$Y_t = c + \Upsilon t + \alpha_0 Y_{t-1} + \cdots \alpha_p Y_{t-p} + \beta_0 X_t + \cdots \beta_q X_{t-q} + \lambda D_1 + v_t \ldots (12)$$

Where c , t , D and v_t are intercept ,time trend and dummy variable and white noise error term respectively and Y_t and X_t are stationary variables.

The above model is said "autoregressive" since it includes p lags of dependent variable Y_t .At the same time it is also a "distributed lag" model because it includes q lags of explanatory variable X_t.

After testing the existence of a long run relationship between the variables through the Bound Testing, a vector Error Correction model (VECM) will be formed.

For simplicity let us assume ARDL (1,1).Then equation (12) will become:

$$Y_t = \beta_0 X_t + \beta_1 X_{t-1} + u_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (13)$$

Subtracting Y_{t-1} from both sides of the equation gives us:

$$\Delta Y_t = \beta_0 X_t + \beta_1 X_{t-1} + (\rho - 1)\, Y_{t-1} + u_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (14)$$

By letting $(\rho - 1) = \delta$, we will get the following equation:

$$\Delta Y_t = \beta_0 X_t + \beta_1 X_{t-1} + \delta Y_{t-1} + u_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (15)$$

$$\Delta x_t = X_t - X_{t-1} \text{ , Thus } X_t = \Delta x_t + X_{t-1}$$

Substituting X_t in to equation (15), we can write as:

$$\Delta Y_t = \beta_0\, \Delta x_t + \beta_0 X_{t-1} + \beta_1 X_{t-1} + \delta Y_{t-1} + u_t$$

$$\Delta Y_t = \beta_0\, \Delta x_t + (\beta_0 + \beta_1) X_{t-1} + \delta Y_{t-1} + u_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (16)$$

Let $\boldsymbol{\Phi} = \beta_0 + \beta_1$.This gives:

$$\Delta Y_t = \beta_0\, \Delta x_t + \Phi X_{t-1} + \delta Y_{t-1} + u_t$$

$$\Delta Y_t = \beta_0\, \Delta x_t + \delta Y_{t-1} + \Phi X_{t-1} + u_t$$

$$\Delta Y_t = \beta_0\, \Delta x_t + [\delta Y_{t-1} + \Phi X_{t-1}] + u_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (17)$$

Multiplying the term $[\delta Y_{t-1} + \Phi X_{t-1}]$ by $\frac{\delta}{\delta}$ will give us:

$$\Delta Y_t = \beta_0 \Delta X_t + \delta \left[Y_{t-1} + \left(\frac{\Phi}{\delta}\right) X_{t-1} \right] + u_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (18)$$

Thus, the error correction model can be written as:

$$\Delta Y_t = \beta_0 \Delta X_t + \delta\, [Y_{t-1} - \alpha X_{t-1}] + u_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (19)$$

Where, $\alpha = -\left(\frac{\Phi}{\delta}\right) = -\left(\frac{\beta_0 + \beta_1}{\delta}\right)$ and $\delta = (\rho - 1)$

Therefore we can write the error correction model in the following form:

$$\Delta Y_t = \beta_0 \Delta X_t + (\rho - 1) \left[Y_{t-1} - \left(\frac{\beta_0 + \beta_1}{\rho - 1}\right) X_{t-1} \right] + u_t$$

$$\Delta Y_t = \beta_0 \Delta X_t + \delta\, ECT_{t-1} + u_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (20)$$

Where $\delta = \rho - 1$ is the error correction parameter that measures the speed of adjustment.

$\left[Y_{t-1} - \left(\frac{\beta_0+\beta_1}{\delta}\right) X_{t-1}\right] = ECT_{t-1}$ is error correction term lagged by one period.

Adding an intercept, time trend and dummy variables, we can rewrite our ECM model in the following general form:

$$\Delta Y_t = c + \Upsilon t + \beta_0 \Delta X_t + \delta\, ECT_{t-1} + \lambda D_1 + u_t \ldots\ldots\ldots\ldots\ldots\ldots (21)$$

Therefore, following the ARDL approach proposed by Pesaran and Shin (1997, 1999) and Pesaran, Shin, and Smith (2001), the following model is specified in order to determine/test the long-run co-integration relationships between variables.

$$\Delta \, LnGDPPC_t = \beta_0 + \lambda_1 LnGDPPC_{t-1} + \lambda_2 LnLAB_{t-1} + \lambda_3 LnGCF_{t-1}$$

$$+ \lambda_4 LnEHC_{t-1} + \lambda_5 LnHHC_{t-1} + \lambda_6 LnGOEX_{t-1} + \lambda_7 LnODA_{t-1}$$

$$+ \beta_1 \sum_{i=1}^{n} \Delta \, LnGDPPC_{t-i} + \beta_2 \sum_{i=0}^{n} \Delta \, LnLAB_{t-i} + \beta_3 \sum_{i=0}^{n} \Delta \, LnGCF_{t-i}$$

$$+ \beta_4 \sum_{i=0}^{n} \Delta \, LnEHC_{t-i} + \beta_5 \sum_{i=0}^{n} \Delta \, LnHHC_{t-i} + \beta_6 \sum_{i=0}^{n} \Delta \, LnGOEX_{t-i}$$

$$+ \beta_7 \sum_{i=0}^{n} \Delta \, LnODA_{t-i} + \beta_8 t + \beta_9 D_1 + \beta_{10} D_2 + e_t \ldots\ldots\ldots\ldots\ldots (22)$$

Where:

$LnGDPPC_t$ = Natural logarithm of real GDP per capita at time *t*.

$LnLAB_t$ = Natural logarithm of labor force growth rate at time *t*.

$LnGCF_t$ = Natural logarithm of gross capital formation at time *t*.

$LnEHC_t$ = Natural logarithm of education human capital at time *t*.
$LnHHC_t$ = Natural logarithm of health human capital at time *t*.
$LnGOEX_t$ = Natural logarithm of total government expenditure at time *t*
$LnODA_t$ = Natural logarithm of official development assistance at time *t*.
D_1 and D_2 are dummy variables for policy change and recurrent drought
λ_1, λ_2, λ_3, λ_4, λ_5, λ_6, and λ_7 are coefficients that measure long run relationships.
β_1, β_2, β_3, β_4, β_5, β_6, and β_7 are coefficients that measure short run relationships.
e_t is an error term and n denotes lag length of the auto regressive process.
t is the time trend of the model.

To test whether there is a long run equilibrium relationship between the variables; bounds test for co-integration is carried out as proposed by Pesaran and Shin (1999) and Pesaran, Shin, and Smith (2001). The hypotheses are shown below:

H_o: $\lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = \lambda_6 = \lambda_7 = 0$. That means there is no long run relationship among the variables.
H_a: $\lambda_1 \neq \lambda_2 \neq \lambda_3 \neq \lambda_4 \neq \lambda_5 \neq \lambda_6 \neq \lambda_7 \neq 0$. That means there is a long run relationship among the variables.

The non-standard F-statistics is used to test the above hypothesis. The critical values of the F-statistics for this test are available in Pesaran, Shin, and Smith (2001). On the other hand, Narayan (2005) also estimated his own critical values by arguing that the critical values provided by Pesaran, Shin, and Smith (2001) are appropriate for relatively large sample sizes. He said that using such critical values for small sample size may produce misleading results. As a result, Narayan (2005) has generated a new set of critical values for small sample sizes ranging from 30 to 80 observations based on similar technique, GAUSS code[6], which was employed by Pesaran, Shin, and Smith (2001). They provide two sets of critical values namely the upper bound values and the lower bound values. If the computed F-statistics is

[6] **GAUSS** code is a programming language designed for matrix-based operations and manipulations, suitable for high level statistical and econometric computation.

higher than the appropriate upper bound of the critical value, the null hypothesis of no co-integration will be rejected. If it is below the appropriate lower bound, the null hypothesis cannot be rejected, and if it lies within the lower and upper bounds, the result would be inconclusive. In this paper, the computed F-statistics is compared with both critical values provided by Pesaran, Shin, and Smith (2001) and Narayan (2005.

After confirming the existence of long-run relationship among the variables, the following stable long-run model is estimated:

$$LnGDPPC_t = \beta_0 + \beta_1 \sum_{i=1}^{n} LnGDPPC_{t-i} + \beta_2 \sum_{i=0}^{n} LnLAB_{t-i}$$

$$+\beta_3 \sum_{i=0}^{n} LnGCF_{t-i} + \beta_4 \sum_{i=0}^{n} LnEHC_{t-i} + \beta_5 \sum_{i=0}^{n} LnHHC_{t-i}$$

$$+\beta_6 \sum_{i=0}^{n} LnGOEX_{t-i} + \beta_7 \sum_{i=0}^{n} LnODA_{t-i} + \beta_8 t + \beta_9 D_1 + \beta_{10} D_2 + \mathbf{v}_t \ldots\ldots\ldots (23)$$

The next step is to estimate the vector error correction model that indicates the short run dynamic parameters (adjustment parameters that measure the speed of correction to long-run equilibrium after a short-run disturbance). The standard ECM is estimated as follows:

$$\Delta LnGDPPC_t = \beta_o + \beta_1 \sum_{i=1}^{a} \Delta LnGDPPC_{t-i} + \beta_2 \sum_{i=0}^{b} \Delta LnLAB_{t-i}$$

$$+\beta_3 \sum_{i=0}^{c} \Delta LnGCF_{t-i} + \beta_4 \sum_{i=0}^{d} \Delta LnEHC_{t-i} + \beta_5 \sum_{i=0}^{e} \Delta LnHHC_{t-i}$$

$$+\beta_6 \sum_{i=0}^{f} \Delta LnGOEX_{t-i} + \beta_7 \sum_{i=0}^{g} \Delta LnODA_{t-i} + \beta_8 t + \beta_9 D_1$$

$$+\beta_{10} D_2 + \delta ECT_{t-1} + u_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (24)$$

Where:

β_1 , β_2, β_3, β_4, β_5 , β_6, and β_7 = coefficients that represents the short run dynamics of the model .

ECT_{t-1} = error correction term lagged by one period.

u_t = vector of white noise error terms and $(a - g)$ denotes the optimal lag length of each variable in the auto regressive process.

D_1 and D_2 are dummy variables for policy change and recurrent drought

$\delta =$ error correction parameter that measure the speed of adjustment towards the long run equilibrium.

The error correction term term (ECT) is derived from the corresponding long run model whose coefficients are obtained by normalizing the equation. After estimating the long run and short run model, misspecification test, normality test, serial correlation test, heteroscedasticity test and cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) test for stability of the model is undertaken to check the robustness of the model. In order to estimate the models specified in equation (22), (23) and (24) above and to perform the pre estimation and post estimation diagnostic tests, *Microfit4.1* and *Eviews6* statistical packages are used.

CHAPTER FIVE

RESULTS AND DISCUSSION

5.1 Augmented Dicky-Fuller Unit Root Test

In order to determine the degree of stationarity, a unit root testing is carried out through the standard Augmented Dicky-Fuller (ADF) test. This test was undertaken to check the order of integration of the variables. The test was done for two alternative specifications. First it is tested with constant but no trend, and then it is tested with constant and trend (See Table.3).

Table 3: ADF unit root test results

Variables (At level and 1st difference)	t-stat (with intercept but no rend)	t-stat (with intercept and trend)
LnLAB	-2.3066	-1.9913
Δ LnLAB	-5.7451***	-5.8121***
LnGCF	-1.5491	-3.4126*
Δ LnGCF	-4.3045***	-4.2318**
LnEHC	-0.2712	-1.9382
Δ LnEHC	-4.0889***	-3.9826**
LnHHC	-1.1560	-4.2745***
Δ LnHHC	-5.5383***	-5.4463***
LnGOEX	-2.6037	-2.4077
Δ LnGOEX	-4.6049***	-4.6030***
LnODA	-1.3859	-2.0645
Δ LnODA	-6.3378***	-6.3233***
LnGDPPC	0.3360	-0.5261
ΔLnGDPPC	-4.5721***	-5.4292***

Source: Author's Calculations.

Note: The rejection of the null hypothesis is based on MacKinnon (1996) critical values. Akaike information criterion (AIC) is used to determine the lag length while testing the stationarity of all variables. The ***, ** and * sign indicates the rejection of the null hypothesis of non-stationary at 1%, 5% and 10% significant level respectively

The results from this test show that six of the variables are non-stationary in their levels (for both type of specifications) while the null of non-stationarity is not rejected for one variable (health human capital- with intercept and trend) at 5 % level of significance .On the other hand, in their first differences, all of the variables are stationary. These results indicate that, with intercept and trend, six of the variables are I (1) and one of them is I (0). Such results of stationarity test would not allow us to apply the Johansen approach of co-integration. This is one of the main justifications for using the ARDL approach (bounds test approach of cointegration) developed by Pesaran, Shin, and Smith (2001).

5.2 Long run ARDL Bounds Tests For Co-integration

The first task in the bounds test approach of co-integration is estimating the ARDL model specified in equation (22) using the appropriate lag-length selection criterion. In this paper Akaike Information Criterion (AIC) was taken as a guide and a maximum lag order of 2 was chosen for the conditional ARDL model. Then F-test through the Wald-test (bound test) is performed to check the joint significance of the coefficients specified in equation (22). The Wald test is conducted by imposing restrictions on the estimated long-run coefficients of real GDP per capita, labor force growth, gross capital formation, education human capital, health human capital, government expenditure and official development assistance. The computed F-statistic value is compared with the lower bound and upper bound critical values tabulated in Table CI (III) case IV of Pesaran, Shin, and Smith (2001) and Appendix-X case V of Narayan (2005).

Table 4. Pesaran et al. (2001) and Narayan (2005) lower and upper bound critical value

Description	At 1% level		At 5 % level	
	Lower bound , **I(0)**	Upper bound **I(1)**	Lower bound **I(0)**	Upper bound **I(1)**
Pesaran (2001) critical values for K=6	3.60	4.90	2.87	4.00
Narayan (2005) critical values for K=6	4.53	6.26	3.33	4.70

Source: Pesaran, Shin, and Smith (2001) and Narayan (2005) tables.

As it is depicted in Table-5 below, with an intercept and trend, the calculated F statistics 9.536 is higher than the Pesaran, Shin, and Smith (2001) and Narayan (2005) upper bound critical values at 1% level of significance. This implies that the null hypothesis of $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = 0$ (there is no long-run relationship) against its alternative $\beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq \beta_6 \neq \beta_7 \neq 0$ (there is long-run relationship) is rejected based on the Pesaran, Shin, and Smith (2001) and Narayan (2005) critical values at 1% level of significance.

Table 5. Bounds test for co-integration analysis

Description	Value
Number of observation	37
Optimal Lag length of the model	2
Calculated F-statistic	9.536

Source: Author's Calculations.

5.3 . Long-run Model Estimation.

This result indicates us the existence of a long-run relationship among real GDP per capita, labor force, gross capital formation, education human capital, health human capital, government expenditure and official development assistance. After confirming the existence of long-run co-integration relationship among the variables, the estimated long-run relationship between the variables are estimated and the estimated coefficients after normalizing on real GDP per capita (GDPPC) are reported in Table 6.

Table 6. Estimated long run coefficients using the Autoregressive Distributed Lag Approach :ARDL (1,0,2,2,2,2,1) selected based on Akaike Information Criterion

Dependent variable is LnGDPPC				
Regressor	**Coefficients**	**S.E**	**T-Ratio**	**Prob**
LnLAB	0.09724	0.11326	0.8586	0.404
LnGCF	-0.74489	0.37269	-1.9987	0.064
LnEHC	0.50965	0.14294	3.5656	0.003***
LnHHC	0.59292	0.21315	2.7817	0.014**
LnGOEX	-0.45653	0.18191	-2.5096	0.024**
LnODA	-0.17643	0.06854	-2.5740	0.021**
Policy change dummy(D1)	0.00804	0.10184	0.0790	0.938
Drought dummy (D2)	-0.16527	0.04093	-4.0377	0.001***
Constant	4.22870	1.80160	2.3472	0.033**
Trend	-0.01307	0.01871	-0.6987	0.495

R-Squared	0.98729	S.D. of Dependent Variable	0.23960
R-Bar-Squared	0.97118	Residual Sum of Squares	0.02482
S.E. of Regression	0.04068	Equation Log-likelihood	77.2398
F-stat.	61.305[0.000]	Akaike Info. Criterion	57.2398
DW-statistics	2.1965	Schwarz Bayesian Criterion	41.6863
Mean of Dep. Variable	7.0529		

Source: Author's Calculations.

Note: The ***, ** and * sign indicates the significance of the coefficients at 1%, 5% and 10% significant level respectively.

As it is shown in Table-6, the estimated coefficients of labor force, health human capital and education human capital, policy change dummy and drought dummy have the hypothesized signs while gross capital formation, government expenditure and official development assistance have unexpected signs. In addition, the estimated coefficients of education human capital, health human capital, government expenditure, official development assistance, and drought dummy are statistically significant while labor force, gross capital formation, and policy dummy are not statistically significant.

Since I have specified my growth model in a log-linear form, the coefficient of the dependent variable can be interpreted as elasticity with respect to real GDP per capita. The coefficient of health is 0.5929. This indicates that, in the long run, holding other things constant, a one percent change in health (proxied by the ratio of public health expenditure to GDP) brought 0.5929 percent change in real GDP. Next to health, education has significant long run impact on the Ethiopian economy .A one percent increase in secondary school enrolment has resulted in 0.5096 percent change in real GDP per capita. The findings of this research concerning the long run positive impact of the education and health human capital are consistent with the endogenous growth theories (mainly advocated and/or developed by Lucas (1988) , Romer (1990), Mankiw, Romer and Weil (1992)) which argue that improvement in human capital (skilled and healthy workers) leads to productivity improvement that enhances output. With respect to the researches made in Ethiopia, the finding of this research is also similar to Teshome (2006) and Tofik (2012).

On the other hand, government expenditure and official development assistance and drought have a significant negative impact to the Ethiopian economy. The significant negative impact of government expenditure on the Ethiopian economy is consistent with the findings of Tofik (2012) and Teshome (2006) entailing the dominance of the unproductive and inefficient government spending that could not add any value to the economy (like wages and salaries, rent, debt servicing and transfer payments). The finding of this research in relation to ODA is also similar to the findings of Rajan and Subramanian (2005), Ekanayake and Chatrna (2008), Mallik (2008), and Tasew (2011). Labor force growth has no any significant impact on real GDP per capita. This may be due to the combined effect of high population growth and low productivity of the labor force. Further, the unexpected sign of gross capital formation is similar to the findings of Martha (2008) and Tadesse (2011). The unexpected sign of the coefficient of GCF contradicts with economic growth theories. In my opinion, it may be data and/or valuation problem, but it is difficult to justify the exact reason behind such unexpected result using this research. Hence, further detailed research should be done to identify the reason behind such result (unexpected sign of GCF).

5.3.1 Long-run diagnostic tests

To check the verifiability of the estimated long run model, some diagnostic test is undertaken. The results reported in Table-7 indicate that there is no error autocorrelation and heteroskedasticity, and the errors are normally distributed. In addition the Ramsey functional form test confirms that the model is specified well .Hence, the relationship between the variables is verifiable or valid.

Table 7. Long-run diagnostic tests

Test Statistics	LM Version	F Version
Serial Correlation test	CHSQ(1)= 0.58187[0.446]**	F(1, 14) = 0.23668[0.634]**
Functional Form test	CHSQ(1)= 1.06340[0.302]**	F(1, 14) = 0.43869[0.519]**
Normality test	CHSQ(2)= 0.79174[0.673]**	Not applicable
Heteroscedasticity test	CHSQ(1)= 0.00974[0.921]**	F(1, 33) = 0.00919[0.924]**

Source: Author's Calculations.

Note: The sign ** indicates the significance of the coefficients at 5% level of significance. The test for serial correlation is the LM test for autocorrelation, the test for functional form is Ramsey's RESET test, the test for normality is based on a test of skewness and kurtosis of residuals, the test for heteroskedasticity is based on the regression of squared residuals on squared fitted values.

In addition to the above diagnostic tests, the stability of long run estimates has been tested by applying the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) test. Such tests are recommended by Pesaran and Shin (1999, 2001).

Since the test statistics of this stability tests can be graphed, we can identify not only their significance but also at what point of time a possible instability (structural break) occurred. If the plot of CUSUM and CUSUMSQ statistic moves between the critical bounds (at 5% significance level), then the estimated coefficients are said to be stable.

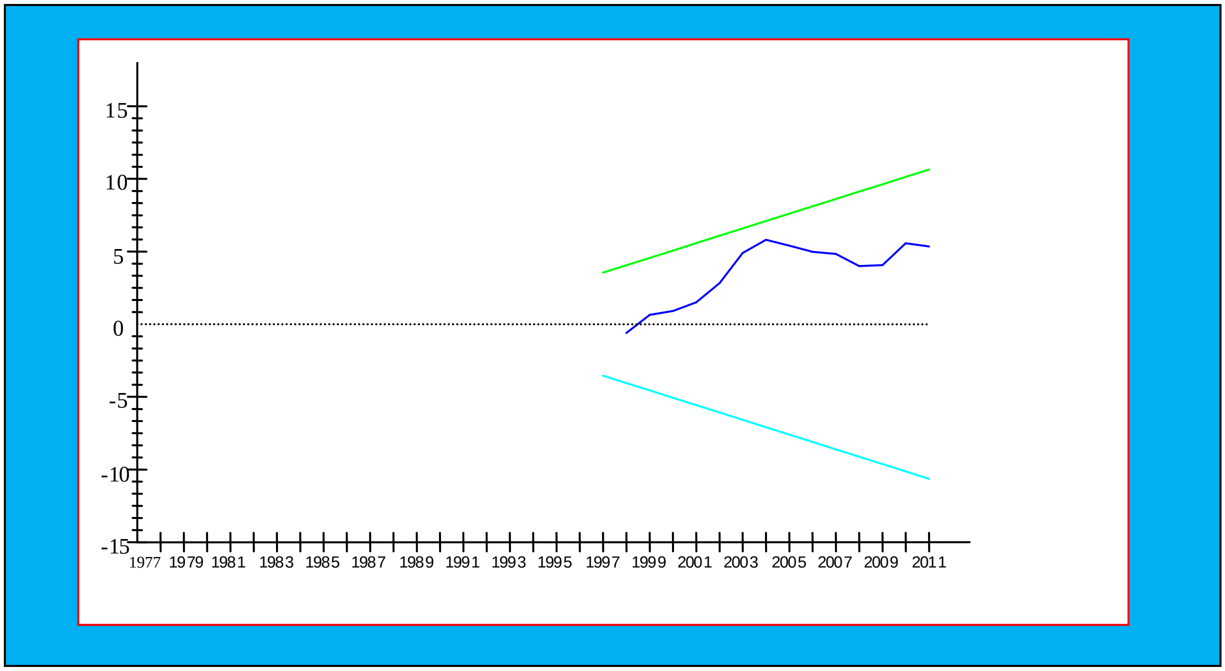

Fig 5. Plot of cumulative sum of recursive residuals

Source: Author Calculations.

Note: The straight lines represent critical bounds at 5% significance level

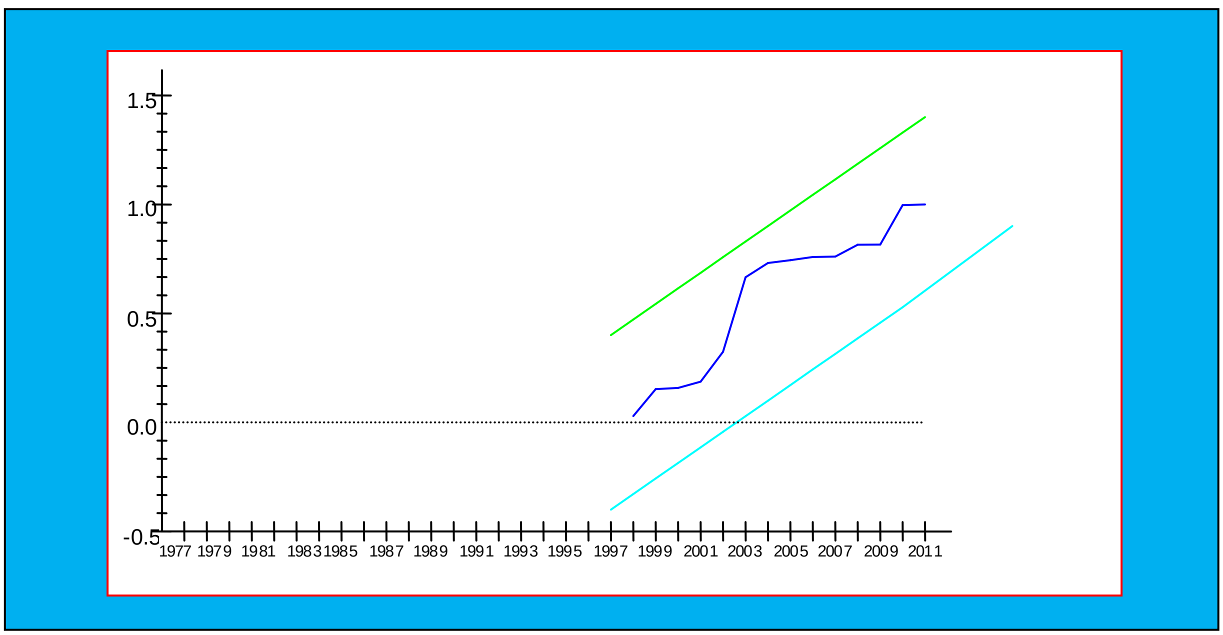

Fig 6. Plot of cumulative sum of squares of recursive residuals

Source: Author Calculations.

Note: The straight lines represent critical bounds at 5% significance level

The results of both CUSUM and CUSUMSQ test are reported in Figures 5 and 6 . As can be seen from the first figure, the plot of CUSUM test did not cross the critical limits. Similarly, the CUSUMSQ test shows that the graphs do not cross the lower and upper critical limits. So, we can conclude that long and short runs estimates are stable and there is no any structural break. Hence the results of the estimated model are reliable and efficient.

5.4 . Short run Error Correction Estimates

After the acceptance of long-run coefficients of the growth equation, the short-run ECM model is estimated. The coefficient of determination (R-squared) is high explaining that about 90.235 % of variation in the real GDP is attributed to variations in the explanatory variables in the model. In addition, the DW statistic does not suggest autocorrelation and the F-statistic is quite robust.

The equilibrium error correction coefficient, estimated -0.7366 is highly significant, has the correct sign, and imply a very high speed of adjustment to equilibrium after a shock. Approximately 73.66 percent of the disequilibrium from the previous year's shock converges back to the long-run equilibrium in the current year. Such highly significant Error correction term is another proof for the existence of a stable long run relationship among the variables (Banerjee, et al., 2003).

The estimated short-run model reveals that education is the main contributor to real GDP per capita change followed by gross capital formation (one period lagged value) and government expenditure (one period lagged value). When enrolment increases by one percent, real GDP per capita increases by 0.76867 percent while the same percentage change in its one period lagged value resulted in about 0.7150 percent rise in real GDP per capita. But, unlike its long run significant impact, health has no significant short run impact on the economy. Even its one period lagged value has a significant negative impact on the economy. This could be due to the reason that health expenditure may have big impact on the people who have no positive impact on the economy. Due to this, it may increase the dependency ratio that dilutes resources of the economy that would have been invested in creating new assets and values. The other possible reason could be high rate of unemployment. That means, even though health status of the labor force increases in the short run, until it is employed it will dilute resources that would have been allocated for new investment.

Table 8. Error correction representation for the selected Autoregressive Distributed Lag model : ARDL (1,0,2,2,2,2,1) selected based on Akaike Information Criterion

Dependent variable is ΔLnGDPPC				
Regressor	**Coefficients**	**S.E**	**T-Ratio**	**Prob**
ΔLnLAB	0.07163	0.09103	0.7869	0.441
ΔLnGCF	0.11542	0.07965	1.4492	0.163
ΔLnGCF(-1)	0.31605	0.10660	2.9648	0.008***
ΔLnEHC	0.76867	0.21877	3.5136	0.002***
ΔLnEHC(-1)	0.71501	0.22209	3.2194	0.004***
ΔLnHHC	-0.06594	0.07250	-0.9095	0.374
ΔLnHHC(-1)	-0.18325	0.08123	-2.2560	0.035**
ΔLnGOEX	-0.10862	0.13065	-0.8314	0.416
ΔLnGOEX(-1)	0.25814	0.10822	2.3854	0.027**
ΔLnODA	-0.03819	0.05875	-0.6501	0.523
Policy change Dummy(D1)	0.00593	0.07500	0.0790	0.938
Drought Dummy(D2)	-0.12174	0.02871	-4.2405	0.000***
Constant	3.11490	1.58110	1.9701	0.063*
Trend	-0.00963	0.01465	-0.6573	0.518
ECM(-1)	-0.73660	0.19218	-3.8329	0.001***
Where , *ECM* = RGDP-0.097240*LAB+ 0.74489*PCAP-0.50965*EHC-0.59292*HHC +0.45653*GOEX +0.17643*ODA -0.0080438* D1 + 0 .16527* D2 -4.2287* constant + 0.013072*Trend				

R-Squared	0.90235	S.D. of Dependent Variable	0.08646
R-Bar-Squared	0.77867	Residual Sum of Squares	0.02482
S.E. of Regression	0.04068	Equation Log-likelihood	77.2398
F-stat.	9.9013[0.000]	Akaike Info. Criterion	57.2398
DW-statistics	2.19650	Schwarz Bayesian Criterion	41.6863
Mean of Dep. Variable	0.01314		

Source: Author's Calculations.

Contrary to its insignificant long run impact, one period lag of gross capital formation has a positive contribution to economic growth at 5 percent level. Similarly, a one period lagged value of government expenditure has a positive impact on real GDP per capita. In addition, unlike its negative long run effect, official development assistance has no significant effect on the economy in the short run.

5.4.1 Short-run diagnostic tests

To check the verifiability of the estimated short run model, some diagnostic test is undertaken. The results reported in Table-9 indicate that there is no error autocorrelation and heteroskedasticity, and the errors are normally distributed. In addition the Ramsey functional form test confirms that the model is specified well .Hence, the relationship between the variables is verifiable or valid.

Table 9.Short run diagnostic test

Test Statistics	LM Version	F Version
Serial Correlation test	CHSQ(1)= 0.07801[0.780]**	F(1, 19) = 0.04244[0.839]**
Functional Form test	CHSQ(1)= 1.17343[0.279]**	F(1, 19) = 0.64780[0.431]**
Normality test	CHSQ(2)= 0.72033[0.688]**	Not applicable
Heteroscedasticity test	CHSQ(1)= 16.55290[0.281]**	F(1, 33) = 1.28188[0.299]**

Source: Author's Calculations.

Note: The sign ** indicates the significance of each diagnostic tests at 5% level of significance. The test for serial correlation is the LM test for autocorrelation, the test for functional form is Ramsey's RESET test, the test for normality is based on Jarque-bera test, and the test for heteroskedasticity is based on Breusch-Pagan-Godfrey test.

5.5 The Pair wise Granger Causality Results

A granger causality test is made to identify the direction of causality between the dependent variable, education and health. The result is reported in Table-10 below. The result revealed that, at lag length of one, there is significant causality between real GDP per capita, education human capital (proxied by secondary school enrolment) and health human capital (proxied by the ratio of public health expenditure to real GDP).

Table 10. Pair wise granger causality test

Null Hypothesis	Lag length 1		Lag length 2	
	F-stat	Prob.	F-stat	Prob.
EHC does not Granger Cause GDPPC	5.89901	0.0208**	2.22794	0.1253
GDPPC does not Granger Cause EHC	12.9837	0.0010***	1.64900	0.2092
HHC does not Granger Cause GDPPC	3.91545	0.0056***	1.97634	0.1562
GDPPC does not Granger Cause HHC	0.54944	0.4638	2.42323	0.1058

Source: Author's Calculations.

Note: The signs *** and ** indicate the significance of the coefficients at 1% and 5% level of significance respectively.

There is a Uni-directional causal relationship from health to real GDP per capita while a Bi-directional relationship is identified between real GDP per capita and education. The bidirectional relationship between real GDP per capita and education implies that education (secondary school enrolment) is not only a cause for real GDP per capita change but it is also an effect. On the other hand, when the lag length of the ARDL model increases to two, there is no any significant causality between real GDP per capita, education human capital and health human capital.

CHAPTER SIX

CONCLUSION AND POLICY IMPLICATION

6.1 Conclusion

The main objective of the study was to analyze the impact of human capital development on economic growth in Ethiopia (using real GDP per capita, as a proxy for economic growth). To determine the impact of human capital development on economic growth (real GDP per capita), the study has used the ARDL Approach to co-integration and the error correction model (ECM).

The main finding of this paper is that in the long run health human capital (proxied by the ratio of public health expenditure to GDP) and education human capital (proxied by secondary school enrolment) are the main contributors to real GDP per capita rise. In other words, the result reveals that economic performance can be improved significantly when the ratio of public expenditure on health services to GDP increases and when secondary school enrolment improves. Holding other things constant, a one percent change in health (proxied by the ratio of public health expenditure to real GDP) brought 0.5929 percent change in real GDP. Next to health, education has significant long run impact on the Ethiopian economy .A one percent increase in secondary school enrolment has resulted in 0.5096 percent change in real GDP per capita. However, government expenditure, official development assistance and recurrent drought have negative impact on the economy. The findings of this research concerning the long run positive impact of the education and health human capital are consistent with the endogenous growth theories (mainly advocated and/or developed by Lucas (1988) , Romer (1990), Mankiw, Romer and Weil (1992) which argue that improvement in human capital (skilled and healthy workers) leads to productivity improvement and thereby output growth. With respect to the researches made in Ethiopia, the finding of this research is also similar to Teshome (2006) and Tofik (2012).

In the short run, the coefficient of error correction term is -0.7366 suggesting about 73.66 percent annual adjustment towards long run equilibrium. This is another proof for the existence of a stable long run relationship among the variables. The estimated short-run model reveals that education is the main contributor to real GDP per capita change followed by gross capital formation (one period lagged value) and government expenditure (one period lagged value). When enrolment increases by one percent, real GDP per capita increases by 0.7686 percent while the same percentage change in one period lagged value of it resulted in about 0.7150 percent rise in real GDP per capita. But, unlike its long run significant impact, health has no significant short run impact on the economy. Even its one period lag has a significant and negative impact on the economy. This could be due to the reason that health expenditure may have big impact on the people who have no positive impact on the economy. As a result, dependency ratio may increase that dilute resources of the economy that would have been invested in creating new assets and values.

A causality test result indicates that there is a Uni-directional causal relationship from health to real GDP per capita while a Bi-directional relationship is identified between real GDP per capita and education. On the other hand, when the lag length of the VAR increases to two, there is no any significant causality between real GDP per capita, education human capital and health human capital.

6.2 Policy Implication

The results of this study have important policy implications. In order to improve economic growth, public expenditure needs to be better prioritized towards basic health service provision. In addition, to achieve economic growth, more resources should be devoted to educate the citizens of the country. Such measures have a large impact on human productivity which leads to improved national output per capita. In other words, as more people become educated and healthy, they will increase their productivity in the long run. Although not investigated in this paper, one of the ways through which education and health affects economic wellbeing is its externalities effect. That means, education and health may have indirect benefits (positive spillovers) that enhance productivity in the long run.

Hence policy makers and / or the government should strive to create institutional capacity that increase school enrolment and improve basic health service. That means, the policy makers and the government should center on securing more resources and structures that are essential and appropriate for better school enrolment and improved basic health service provision. Such measures should focus not only on creating new institutional capacity, but also on strengthening and changing the existing institutional setups of the education and health sectors of Ethiopia that produce quality manpower. In addition, the government should also continue its leadership role in creating enabling environment that encourage better investment in education and health by the private sector. Because, healthier participation of the private sector in the education and health sectors can speed up the creation of human capital in Ethiopia.

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ANNEX

Table-A. Autoregressive Distributed Lag estimates (Dynamic estimation Results) ARDL(1,0,2, 2,2,2,1) selected based on Akaike information Criterion

Dependent variable is LnGDPPC				
Regressor	**Coefficient**	**Standard Error**	**T-Ratio**	**Prob**
LnGDPPC(-1)	0.2634	0.1922	1.3706	0.191
LnLAB	0.0716	0.0910	0.7869	0.444
LnGCF	0.1154	0.0797	1.4492	0.168
LnGCF(-1)	-0.3481	0.1221	-2.8501	0.012**
LnGCF (-2)	-0.3161	0.1066	-2.9648	0.010***
LnEHC	0.7687	0.2188	3.5136	0.003***
LnEHC(-1)	0.3218	0.2214	1.4534	0.167
LnEHC(-2)	-0.7150	0.2221	-3.2194	0.006***
LnHHC	-0.0659	0.0720	-0.9095	0.377
LnHHC(-1)	0.3194	0.1120	2.9878	0.011**
LnHHC(-2)	0.1833	0.0812	2.2560	0.039**
LnGOEX	-0.1086	0.1307	-0.8314	0.419
LnGOEX(-1)	0.0305	0.1177	0.2591	0.799
LnGOEX(-2)	-0.2581	0.1082	-2.3854	0.031**
LnODA	-0.0382	0.0586	-0.6501	0.525
LnODA(-1)	-0.0918	0.0673	-1.3636	0.193
Policy change dummy(D1)	0.0059	0.0750	0.0790	0.938
Drought dummy (D2)	-0.1217	0.0287	-4.2405	0.001***
Conctant	-3.1149	1.5811	1.9701	0.068*
Trend	-0.0096	0.0147	-0.6573	0.521

R-Squared	0.98729	S.D. of Dependent Variable	0.23960
R-Bar-Squared	0.97118	Residual Sum of Squares	0.02482
S.E. of Regression	0.04068	Equation Log-likelihood	77.2398
F-stat.	61.3046[.000]	Akaike Info. Criterion	57.2398
DW-statistics	2.1965	Schwarz Bayesian Criterion	41.6863
Mean of Dep. Variable	7.0529		

Diagnostic tests

Test Statistics	**LM Version**	**F Version**
Serial Correlation test	CHSQ(1)= 0.58187[0.446]**	F(1, 14) = 0.23668[0.634]**
Functional Form test	CHSQ(1)= 1.06340[0.302]**	F(1, 14) = 0.43869[0.519]**
Normality test	CHSQ(2)= 0.79174[0.673]**	Not applicable
Heteroscedasticity test	CHSQ(1)= 0.00974[0.921]**	F(1, 33) = 0.00919[0.924]**

Source: Author's Calculations.

Table-B. Estimated model for Wald test (Bound test)

Dependent Variable: Δ (GDPPC) Method: Least Squares, Included observations: 34 after adjustments				
Variables	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
GDPPC(-1)	-1.104085	0.228872	-4.824025	0.0170
GCF(-1)	-2.160438	0.560328	-3.855665	0.0308
LAB(-1)	0.057786	0.128485	0.449748	0.6834
HHC(-1)	0.939590	0.302394	3.107171	0.0530
EHC(-1)	1.094549	0.220404	4.966099	0.0157
ODA(-1)	0.043176	0.083182	0.519051	0.6396
GOEX(-1)	0.214299	0.287374	0.745713	0.5100
Δ(PCAP)	0.201688	0.074389	2.711273	0.0731
Δ (LAB)	0.322890	0.120570	2.678029	0.0752
Δ (EHC)	1.554877	0.248026	6.268996	0.0082
Δ (HHC)	-0.011941	0.060132	-0.198583	0.8553
Δ (ODA)	-0.097219	0.056548	-1.719236	0.1841
Δ (GOEX)	0.545869	0.179531	3.040525	0.0558
Δ (GDPPC(-1))	-0.586560	0.246184	-2.382608	0.0974
Δ (GCF(-1))	1.607739	0.424163	3.790379	0.0322
Δ (LAB(-1))	0.253491	0.074404	3.406950	0.0422
Δ (HHC(-1))	-0.505216	0.168145	-3.004638	0.0575
Δ (EHC(-1))	1.145734	0.269748	4.247425	0.0239
Δ (ODA(-1))	-0.391221	0.113192	-3.456257	0.0408
Δ (GOEX(-1))	0.325803	0.135489	2.404651	0.0955
Δ (GDPPC(-2))	-0.239669	0.162575	-1.474205	0.2369
Δ (GCF(-2))	0.287883	0.146950	1.959056	0.1450
Δ (LAB(-2))	0.179930	0.069755	2.579451	0.0818
Δ (HHC(-2))	-0.149354	0.081369	-1.835517	0.1638
Δ (EHC(-2))	0.759719	0.232133	3.272775	0.0467
Δ (ODA(-2))	-0.148140	0.079559	-1.862026	0.1595
Δ (GOEX(-2))	0.208115	0.111335	1.869277	0.1584
Constant	-0.488530	1.941708	-0.251598	0.8176
D1	0.137103	0.079049	1.734402	0.1813
D2	-0.195315	0.033199	-5.883104	0.0098
Trend	-0.046724	0.020873	-2.238541	0.1111
R-squared	0.993925	Mean dependent var		0.014118
Adjusted R-quared	0.933178	S.D. dependent var		0.087564
S.E. of regression	0.022635	Akaike info criterion		-5.342851
Sum squared resid	0.001537	Schwarz criterion		-3.951169
Log likelihood	121.8285	Hannan-Quinn criter.		-4.868247
F-statistic	16.36174	Durbin-Watson stat		2.612301
Prob(F-statistic)	0.020152			

Source: Author's Calculations.