IMPACT OF HUMAN CAPITAL ON ECONOMIC GROWTH OF ETHIOPIA: ARDL APPROACH TO CO-INTEGRATION

A Research Paper submitted to the school of Graduate Studies of Jimma University for partial fulfillment of requirements for Masters of Science Degree in Economics (Development Economics)

BY: HINSENE LEMMA

JIMMA UNIVERSITY

BUSINESS AND ECONOMICS COLLEGE

DEPARTMENT OF ECONOMICS

JUNE, 2021

JIMMA, ETHIOPIA

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UNDER THE GUIDANCE OF

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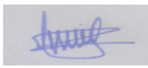
Declaration

I, the undersigned, declare that this research thesis entitled: "**Impact of Human capital on the economic growth of Ethiopia: ARDL Approach to Co-integration**" is my original work and has not been presented by any other person for an award of a degree in this or any other University. All sources of material used for this thesis have been duly acknowledged.

Hinsene Lemma  18/06/2021

Researcher Signature Date

As a research advisor, I hereby certify that I have read and evaluated this research thesis prepared under my guidance by Hinsene Lema entitled "Impact of Human capital on the economic growth of Ethiopia: ARDL Approach to co-integration."

I recommend that this thesis can be submitted as fulfilling the research thesis requirements.

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Co-Advisor Signature Date

Abstract

The study's primary goal was to look into the impact of human capital on the economic growth of Ethiopia from 1980 to 2020. To explore the long-run and short-run impact of human capital on economic growth, ARDL Approach to co-integration and error correction model was used. The Bounds test results reveal that real GDP, education expenditure, health expenditure, labor force, gross capital formation, total government expenditure, official development assistance, secondary school enrollment, consumer price index, drought, and policy change have a stable long-run connection. The finding shows significant positive impact of human capital on economic growth by confirming direct positive relationship between economic growth and measures of human capital (education and health). The estimated long-run model reveals that gross capital formation is the most significant contributor to real GDP growth, followed by human capital in health expenditure, secondary school enrollment, and education expenditure. In the short-run, the coefficient of error correction term is -0.9528, implying a 95.28 percent annual adjustment towards long-run equilibrium. This is another evidence of a steady long-run relationship between the variables. The estimated short-run model reveals that gross capital formation is the main contributor to real GDP change followed by policy change and secondary school enrollment. Health has no significant short-run impact on the economy. But its one-period lag has a significant and positive impact on the economy. The findings mentioned above have significant policy implications. This study suggests that increasing the ratio of health expenditure to GDP and increasing secondary school enrollment can significantly boost economic performance. Such improvements have a significant impact on human productivity, resulting in increased national output. By developing the infrastructure of educational and health institutions that produce quality human resources, the government should endeavor to establish institutional capacity that increases school enrollment and improves primary human health. In addition, the government should maintain its leadership role in establishing an enabling climate that encourages private sector investment in human capital (education and health).

Keywords: Economic Growth, Human capital, Education, Health, ARDL method of Co-integration, ECM model, Ethiopia

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Abbreviations

ADF	Augmented Dickey-Fuller
AIC	Akaike Information Criterion
ARDL	Autoregressive Distributed Lag
CLRM	Classical Linear Regression Model
CUSUM	Cumulative sum of squares of recursive
DW	Durbin Watson
ECM	Error Correction Model
ECT	Error correction term
EEA	Ethiopian Economic Association
EHC	Education Human Capital
ETB	Ethiopian Birr
E-VIEWS	Electronic Views
GCF	Gross Capital Formation
GDP	Gross Domestic Product
HDI	Human Development Index
HHC	Health Human Capital
HQ	Hannan and Quinn information criterion
I (0)	Integrated Order Zero
I(1)	Integrated order one
I (2)	Integrated Order two
IMF	International monetary fund
MoFEC	Ministry of Finance and Economic Cooperation
MOFED	Ministry of Finance and Economic Development
NBE	National Bank of Ethiopia
ODA	Official Development Assistance
OECD	Organization for Economic Cooperation and Development
PP	Phillips Perron
RGDP	Real Gross Domestic Product
OLS	Ordinary Least Square
SIC	Schwarz Information Criteria
SMLR	Sequential Modified Likelihood Ratio
TGE	Total Government Expenditure

VAR	Vector Autoregressive
VIF	Variance Inflation Factor
VECM	Vector of Error Correction Model

CHAPTER ONE

INTRODUCTION

1.1. Background of the study

Human capital is a term that combines the words "human" and "capital." Capital is defined as "factors of production used to create commodities or services that are not considerably consumed in the production process," according to Boldizzoni (2008). The human is the subject of all economic activity such as production, consumption, and transaction, in addition to the meaning of capital in economic terms. On establishing these concepts, it can be recognized that human capital means one of the production elements that can generate added values through inputting it.

The origin of human capital went back to classical economics's emergence in 1776 and developed a scientific theory of human capital, Fitzsimons (1999). As a theory, the human capital concept, Schultz(1961) recognized human capital as one of the most critical factors in modern economic progress. With the introduction and growth of human capital as an academic topic, some academics explored how human capital could contribute to sociopolitical progress and freedom, Grubb & Lazerson (2004); Sen (1996); Alexander (1996).

The calculation of physical capital stocks has been used in various studies to estimate a macroeconomic output function. For instance, Rome (1990) used the literacy rate and found a significant economic growth effect. He used the school enrollment rate and found a positive and significant effect of human capital on economic growth. Barro (1994), (Barro & X. Sala-i-Martin (1995), Barro (1999) used years of schooling to human capital. They found that male individuals with secondary and higher education levels have positive (significant) economic growth. The findings of Gemmell (1996) and Islam (1995) also revealed that human capital has a beneficial effect on economic or output growth. The idea that human capital plays an essential Impact in explaining income differences has been presented in economists' thinking for a long time. It can be traced directly to Adam Smith and Alfred Marshall's work Wobmann (2000), while Gary Becker (1975) and other scholars such as Schultz (1961) did not establish the theory of human capital until the middle of the twentieth century.

When looking at Ethiopia's human capital growth, one should go back to the sixth century, according to human capital theories, when the Sabean alphabet was introduced along with Christianity. The education was provided under religious auspices with the primary goal of preparing instructors to work in the church and mosque's various learning centers, Woubet

(2006). According to his findings, church education has not been impartial in providing public education and has not served the entire nation. Modern education started in the 20th century by the then government to fill the high demand of trained workers to establish modern institutions and industries. Modern education started in 1908 when emperor Minilik opened Minilik II School with other intellectuals turned from abroad.

The Italian occupation (1936-41) caused disruption, and the education system afterward collaborated to boost educated home residents to replace foreign labor once the occupation ended. Through the coordinated efforts, the educated people rose, and the economy failed to absorb. Post-1974, the structure, and organization of educational activities altered in tandem with the socialist government's goals. Except for church-affiliated schools, the new dictatorship nationalized all private institutions and integrated them into public schools Woubet (2006).

Health is another investment good that increases the future productive power of the workforce. As successful schooling depends, among other things, on appropriate health, health is a condition for increased productivity. It implies that healthier workers are more energetic and robust, and their productivity is high. In this regard, health has a broader concept than mere understanding of the absence of sickness. More significant health capital may improve the return to investments in education; in part, health is an essential factor in school attendance and a child's formal learning process. A longer life raises the return to investments in education; better health at any point during working life may, in effect, lower the rate of depreciation of education capital, Todaro et al., (2012). Moreover, a universal primary health care system has been introduced to increase access to essential health services. Hence, human capital has an impact on economic growth and can aid in the development of an economy by increasing people's knowledge and skills, Romer (1990).

1.2. Statements of the problem

According to Harbison & Charles A. Meyers (1964), human resource production is one of the prerequisites for all types of growth, whether social, political, cultural, or economic. The idea that investment in human capital promotes economic growth dates back to Early classical economists such as Adams (1976) and others who stressed the importance of investing in human resources. Every country's principal macroeconomic goal is sustained economic growth complemented by social development, and human capital is seen as a crucial factor in this regard. Thus, human capital has gained significant importance in growth theories.

However, its measurement is not appropriately addressed in economic literature. Various researchers have used various human capital proxies; for example, Mankiw et al.(1992) use secondary school enrollments. Average schooling years were used by Barro (1994) and Barro & X. Sala-i-Martin (1995).

In contrast, macroeconomists consider health as another essential component of human capital besides education. Micro economists believe that health plays a significant Impact informing human capital because people need to be healthy or protected from sickness to ensure productivity growth Lewin et al. (1983); Woodhall (2001).

In Ethiopia, researchers have attempted to look into the connection between human capital and economic growth. For example, using school enrollment as a proxy for human capital, Seid (2000) discovered that human capital has a negligible effect on performance levels. Woubet (2006) comes to the same conclusion, proving that there is no relationship between the two macroeconomic variables. However, their method of estimating human capital neglects to account for the health element of human capital growth, even though both education and health are critical components of human capital. Using public spending on education and health care as a proxy for human capital growth, Teshome (2006) discovered that human capital development had a favorable impact on Ethiopia's economic growth. Tofik (2012) reiterated this result, finding a positive and essential relationship between human capital investment and economic development. However, only some of them showed the effect of the health and education sectors on economic growth separately, so they are included in this report. Tewodros (2014) indicates that investment in education and health would affect further economic growth in the long run. Besides, he failed to incorporate the government's recurrent human capital expenditure account.

Dinkneh et al. (2015) found that public spending on health and education (primary and secondary school enrollment) positively and statistically significantly impacted economic growth in the long and short run. Kidanemariam (2015) showed a stable long-run relationship between real GDP, human education capital, and human health capital. Befekadu (2018) showed expenditure on education has a significant effect while expenditure on health has a statistically insignificant effect in the short-run only. Accordin to Shemsedin (2020), both the ratios of government spending on health and education to GDP, the labor force and policy change have a favorable impact on ethiopia's economy in the long run only.

All of the researchers except, Kidanemariam (2015), who attempted to establish a relation between human capital and economic growth in Ethiopia have used the same study method (Johnson's Co-integration technique). Even though Johnson's Co-integration technique is one of the widely used time series analysis methods, its outcome could not be reliable for the small size of the sample, Pesaran (1999); Narayan (2005); Odior (2011).

In contrast to the Johnsons approach, the Autoregressive distributed lag method of co-integration is more beneficial, Pesaran (1997); Pesaran (1999); Pesaran (2001); Harris (2003); Narayan (2005); Chaudhry (2009); Ang (2007) and Rahimi (2011). Hence, this study applied the ARDL Approach to Co-integration to provide valid empirical evidence on human capital effects on economic growth. Uncommon to previous studies, this study included other explanatory variables and many observations from 1980-2020 trends of data.

1.3. Research Questions

The research questions that the researcher attempted to be answered during the study period are;

1. What is the trend of human capital and economic growth in Ethiopia from 1980-2020?
2. Does human capital explain the economic growth of Ethiopia?
3. Does human capital have a significant long-run and short-run impact on the economic growth of Ethiopia?

1.4. Objectives of the study

1.4.1. General objective

The general objective of the study is to examine the impact of human capital on Ethiopia's economic growth using ARDL Approach to co-integration.

1.4.2. Specific objectives.

- To analyze trend of human capital and economic growth in Ethiopia from 1980-2020.
- To explain the economic growth of Ethiopia in terms of human capital.
- To examine the significant long-run and short-run impact of human capital on the economic growth of Ethiopia.

1.5. Significance of the study

It was evident that academics and institutions expanding education and health are instrumental in promoting higher economic growth. Unfortunately, there has not yet been clear and tangible empirical evidence to describe the contribution of education and health to economic integration. The paper assessed the particular conditions for Ethiopia. However, the theoretical arguments are usually based on empirical evidence that deals with education and health's direct and indirect efforts on economic growth. But this must be analyzed from a more directive or vast perspective in which researchers show the interactive relationship between human capital and economic growth. This one essential way to respect is analyzing the strategy and policy framework in which education and health are included to contribute human capital to economic growth.

1.6. Scope of the study

This study focused on the impact of human capital in Ethiopia's economic growth employing the ARDL Approach to Co-integration. The study examined the long-run and short-run relationship between human capital and Ethiopia's economic growth using only time-series data from 1980 to 2020. The period was chosen because policies on health and education are changed. Real GDP was used as the dependent variable. Labor force growth, gross capital formation, human education capital (proxied by secondary school enrolment and a ratio of education expenditure to real GDP), human health capital (proxied by the ratio of expenditure on health to real GDP), total government expenditure, official development assistance, consumer price index, policy change and drought were used as independent variables. The study confines itself by considering health and education as a proxy for human capital development. Eviews 10 have been used for the analysis of time-series data.

1.7. Organization of the paper

The research paper was thoroughly organized and classified into five chapters and its related topics as the usual procedure. The first chapter introduces the study's theoretical and empirical background, then a description of the problem, and finally the study's objectives, scope, and importance. In chapter two, the most related theoretical and empirical literature reviews are discussed. In chapter three, the methodology employed in undertaking the study, such as the description of the study, the research design, types and sources of data, data collections, and analysis methods, are discoursed. The descriptive method of data analysis of human capital trends associated with each explanatory variable is presented in chapter four. And also, the finding from econometric data analysis is presented and discussed in this chapter. Chapter five concludes and policy implications based on the finding(s) of the study. Lastly, appendixes are attached at the end after the bibliography.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Theoretical Literature Review

2.1.1 General

Before the publication of modern human capital theories, it was widely assumed that a particular economy relied solely on physical capital (land, technology, and equipment) and raw labor. Capital equipment investment was thought to be the primary source of output. For example, classical thinkers place a great deal of emphasis on capital's exploitation of labor Marimuthu et al. (2009). After the 1950s, however, some modern economists formally recognize education and health as essential variables in enhancing human capital and, as a result, promoting economic growth.

2.1.2 Human capital and neoclassical growth theories

According to the arguments of Schultz (1961) and Becker (1962), education improves an individual's skill and consequently his or her human capital. The production capacity of a workforce with a greater skill level improves. On the other hand, Schultz (1961), referenced by Xiao (2001), implies that education allows individual workers to adjust themselves. It understands any shocks, interpreting information, and reallocating resources in response to changing economic growth. Spence (1973), on the other hand, saw education as a market indicator for employees' prospective production. It can also be used as a screening technique to identify potential workers who can be trained for specific tasks faster and less money than their competitors. However, until the basic neoclassical growth model was altered, their reasoning was not practically incorporated into economic growth theories (Mankiw et al. (1992). These scholars have used a Cobb-Douglas production function to re-examine Spence's Solow growth model (1973). According to neoclassical growth theory, long-term economic growth is driven primarily by accumulating factor inputs such as physical capital and labor. Studies reveal technical progress, which is classified as an exogenous factor; Solow (1956) and Cass (1965) significantly impact studies. They offer the convergence theory of growth, which considers technology to be the sole long-term growth driver.

In general, they stated that a sustained positive growth rate of output per capita could only be achieved in the long run. It continues to improve only apparent if there are continues advances in technological knowledge in the form of new item goods, new markets, and new processes. If there is no technical advancement, the impacts will not occur, and the forces of diminishing returns will finally bring economic expansion to a standstill. When we continue to create more and more of the same capital goods without inventing new uses for the capital, the extra capital goods become obsolete. The marginal product of capital becomes negligible.

This theory is formalized by assuming that the marginal product of capital in the stock of capital is strict (Aghion & P. Howitt (2009). To put it another way, they assumed that as capital per worker increases, the economy's growth slows until it achieves a stable state. The higher the predicted growth rate, the lower the starting per capita income., Weil (2009). However, in East Asian developing nations, the model cannot explain ongoing economic improvement (F. Hosainpour & Zarra-Nazhad (2011).

2.1.3 Human capital and endogenous growth theories

In the mid-1980s, endogenous growth models were developed to address neoclassical theory's limits and answer the long-run causes of economic growth.

The notable proponents of this idea, Lucas (1988) and Rome (1990), include purposely manufactured technology advances as an explanatory variable in their development model. For endogenous growth theorists, technology isn't the only thing that drives a country's growth; the neoclassical development model doesn't represent other aspects (such as human capital). Human capital is defined by Lucas (1988) as a distinct input in the production function primarily generated by workers through education or on-the-job training. According to his result, the rate at which human capital is accumulated was a significant predictor of productivity increase in the Lucas (1988) model. Rather than addressing human capital as a direct input into product production, Rome (1990) examines it as a factor influencing innovation, which positively impacts the long-run productivity growth capital as a direct input to the production of goods. That means, for Romer, endogenous growth is produced by accumulating technology/knowledge, whereas, for Lucas, endogenous growth is caused by the non-decreasing marginal returns of human capital.

In general, they conclude that having a large population is insufficient to promote economic growth; instead, human capital and research and development are sources of growth. The law of diminishing returns to scale may not be accurate, according to these models, because the returns on physical and human capital assets do not necessarily decline over time. If the capital owner employs a skilled and healthy worker, the capital's and technology's productivity will improve. Similarly, to re-examine the Solow growth model and explain cross-country per capita income variation, Mankiw et al. (1992) proposed an enhanced Solow model. Human capital is added to physical capital and raw labor as a factor of production. They conclude that cross-country differences in income per capita are determined by differences in human capital, saving, and population growth. When human capital is factored into the equation, the accumulation of physical capital and population growth significantly affects income per capita. According to the researchers, leaving it out of the model could lead to skewed results.

2.1.4 Characteristic of Human capital

2.1.4.1 Indigenous Characteristics

According to Crawford (1991), human capital as broad meaning includes expandable, self-generating, transportable, and shareable characteristics compared to physical labor. To begin with, the expandable and self-generating properties of human capital are intimately tied to the possibility of people's human capital increasing as a result of the stock of knowledge. Furthermore, either endogenous or external variables might contribute to the growth of human capital. It is possible that actual knowledge can be continuously elaborated and developed through the relationship between external knowledge, information, skills, experiences, and other knowledge-based factors. From the economic perspective, the characteristic of human capital focusing on knowledge can be a core element to solve the 'problem of scarcity in which trim materials are equivalently distributed to economic agents. Throughout expanding and self-generating the human capital, it is sufficiently possible that the portion of that capital as an economic agent is extended.

Secondly, the transportable and shareable characteristics of human capital mean that the original holder of knowledge can distribute his/her knowledge to others. If the original knowledge holders' exclusive ownership is slightly acceptable, the equivalent distribution between the holders and the takers can be actualized. Consequently, the former two characteristics extend the 'volume' of human capital, and the latter two expand the 'range' of human capital.

2.1.4.2 Impacts of Human Capital

The impact of human capital is categorized mainly into three parts: individual, organization, and society. From the individual's perspective in the internal labor market, most researchers refer to the possibility of increasing individual income resulting from individual productivity, Schultz (1961) and Schultz (1971). Most employers desire high productive employees to optimize company profits because of the increase in an individual's productivity on human capital. Furthermore, it is considered that individual mobility increases due to improved productivity in the internal labor market. By increasing productivity in the workplace, the high-productive individual is recognized as the worker with many possibilities to move to a higher level in the internal market, Sicherman (1991).

From the perspective of an individual in the external market, an unemployed individual's human capital affects his/her job-seeking and employable opportunities; Greider, Denise-Neinhaus, & Statham (1992). On the internalized human capital, an individual easily holds the possibility to access job-related information with a high level of human capital. After that, he/she can quickly obtain occupational chances compared to otherwise.

Concerning organization, Lepak & Snell (1999) suggest that the potential of human capital is closely linked to the core competencies and competitiveness of the organization. Like this perspective, Edvison & Malone (1997) present that individual human capital can affect human organizational capital, such as 'collective competencies, organizational routines, company culture, and relational capital.'

Finally, the social perspective of human capital is the synthesis of both individual and organizational perspectives. McMahon (1999) depicts the possibility of human capital for 'democracy, human rights, and political stability on ordinary consciousness of social constituents. According to Beach (2009), human capital can increase the social consciousness of constituents within the community. As a result, the relationship between human capital and social consciousness is founded on a close interdependence that leads to sociopolitical progress, Alexander (1996).

2.1.4.3 Division of Human Capital

Generally, some researchers present three distinguished kinds of human capital: general, firm-specific, and task-specific human capital; Gibbons & Waldman (2004), Hatch & Dyer (2004). Otherwise, Becker (1964) delineates that human capital is categorized into general and specific ones. General human capital is defined by generic knowledge and skill, not specific to a task or a company, usually accumulated through working experiences and education, Alan et al. (2008). The general human capital holds 'transferable' characteristics across jobs, firms, and industries. It is relatively easy for the general human capital embedded in an individual to transfer to different industries.

In contrast to the general human capital, firm/task-specific human capital is usually accumulated through education, training, working experience on 'knowledge specific to a firm/task' (Alan et al., 2008). Becker (1964, 1976) pointed out that specific human capital is rarely transferable to other jobs, firms, and industries. Thus it is impossible to transfer much income in the labor market. Furthermore, human capital is 'specific if it increases a worker's productivity only at the firm' (Becker, 1964). Consequently, it is demanding that the specific human capital embedded in an individual transfer to different industries.

2.1.5 Investment in education and rate of returns to education

The critical investments in education include time and money spent on formal schooling, on-the-job training, and off-the-job training are significant investments in education. These investments involve direct tuition expenditures, foregone earnings during schooling, and reduced wages during training incurred to order to gain a return on this investment in the future. Becker & G. S (1993) contend that various human capital investments include schooling, medical care, job training, etc. In other words, activities that influence future real income through the embedding of resources in people are referred to as human capital investments. As a result, he believes that investing in education and training is the most crucial factor in developing human capital. Putting a greater focus on education, he argued that education and training increase worker productivity by equipping them with helpful information and skills.

In general, education prices and post-education employment chances are the two most important two critical determinants of the private returns to education, Rephann (2002), quoted in Fitzsimons, (1999). Like physical capital investments, human capital investments are only made if the expected return on investment is high enough (equal to the net internal rate of return) to be greater than the market rate of interest. That is to say; schooling is an investment made with the expectation of future earnings for those who get it. Increased earnings for the worker, improved productivity for the firm, and increased employment prospects are all ways in which education pays off (Ibid).

The quantity of a worker's human capital stock determines his or her wages/return, according to Mincer (1981), Mincer (1989), and Mincer, J, (1996). There may be spillovers from education to other people, in which case the societal benefits would outweigh the total of educated, McMahon (1998) and McMahon (2010) people's returns. According to their belief, the returns to education have been characterized as monetary and non-monetary and private and societal. Wages are the monetary and private returns on investment from education. Other monetary societal benefits/returns include education on GDP growth and others' wages (making them more productive). Education may offer non-monetary benefits for both people and society as a whole, in addition to monetary rewards (2010, ibid.)

Improved health, more efficient family management, lifelong adaptation, and continued learning at home (using new technologies such as the Internet, radio and television, instructive reading, and so on). Non-monetary job satisfaction facilitates the development of democratic institutions, human rights, political stability, lower stock can be increased through investment in the prevention and treatment of illness. Gardner & D. Gardner (2001) argued that health determines the total working hour that an individual wants to spent to generate income.

2.1.6 Health and human capital

Human capital development encompasses more than just education. Individuals' health status can impact their human capital and, as a result, on a country's growth. Productive efficiency, life expectancy, learning capacity, inventiveness, and other factors can all impact economic growth Howitt (2015). With any given combination of skills, technological knowledge, physical capital, and healthier workers will become stronger, more energetic, creative, attentive, and so on, making them more effective in the production process. That is, improved health promotes the practical and long-term application of knowledge and skills acquired via education. Investing in the prevention and treatment of illness can raise the amount and quality of the human capital pool, just as it can with education and training, Gardner & D. Gardner (2001). As a result, some scholars incorporate health into their models, arguing that health impacts the total number of working hours an individual wishes to spend to earn money, Basov (2002).

2.1.7 The rationale for public intervention in education and health

Education policy can influence educational outcomes by changing the amount or quality of education. Enrolment levels, average years of schooling, and literacy rates are common ways to measure educational quantity. Input indicators such as teacher-student ratios and total public education spending have typically been used to assess educational quality. However, a more contemporary technique is to evaluate educational quality in terms of output indicators, which measure students' and graduates' performance through test scores in math, reading, and science (Patron (2006).

Market failures and equality considerations are the most compelling reasons for government intervention in education and health care (Ibid). Externalities or market failures in education and health arise when the benefits of individually acquired education and health do not just benefit the person but also benefit others, accruing at higher levels of aggregation (e.g., the public). For example, crime reduction, better health outcomes, improved home management, and increases in GDP or productivity are all externalities of education, Moretti (2006) and Hanushek & L. Wobmann (2007). If public action does not absorb these spillovers, a barrier between the social and private rate of return to education may be created. When non-pecuniary spillovers are taken into account, social returns to education may exceed private returns.

2.1.8 Measuring human capital

There are numerous viewpoints on how to assess human capital. According to Le et al. (2003), there are three basic techniques to measuring human capital: outcome-based, income-based, and cost-based. Some researchers use just educational indicators (outcome-based method) to quantify a country's human capital, such as school enrollment, educational attainment, or literacy rates. For instance, Mankiw et al. (1992), Barro et al. (2003), and Pleijt & A.M (2011) have used the average level of schooling (or educational attainment) as a proxy for human capital. However, utilizing these metrics as a proxy for human capital has some drawbacks. First, it jeopardizes educational quality, which is influenced by educational facilities and access to educational services.

Second, it is assumed that worker productivity varies with their level of education and is proportionate to the number of years they have in school (Mulligan et al., (2000). That is to say, a worker with ten years of education is expected to have ten times the amount of human capital as a worker with only one year of education, Jones & V. Fender (2011).

On the other hand, individual efficacy can be determined after participating in production activities, Diewert (2008). Similarly, Levine (1992) calculated human capital using school enrolment rates. Enrollment rates, it is assumed, measure the current investment in human capital that will be reflected in the stock of human capital at some point in the future. However, because there is a substantial time lag between educational investment and additions to the human capital pool, current enrollment rates may not reflect the current workforce's schooling level but rather the future labor force's (Le et al. (2003). Furthermore, because graduates may not join the labor force, current students' education levels may not be fully added to the future productive human capital stock.

However, in some nations, enrolment rates can be acceptable proxies for human capital, notwithstanding their shortcomings Judson (2002; as mentioned by Jones & V. Fender (2011).

Another option is an income-based approach, which assesses human capital stock based on an individual's earnings from the labor market. According to Mulligan et al.(2000), the overall stock of human capital is equal to individual incomes. In recent applications, the income-based strategy has been the most popular. In the United Kingdom, United States, China, Australia, New Zealand, Sweden, and Norway, it has recently been used to assess human capital (Christian (2011). On the other hand, salary inequalities may not correctly reflect differences in production due to various factors. Furthermore, data on earnings are scarce, particularly in developing nations where the wage rate is frequently unobservable (Le et al. (2003).

One alternate measure of human capital stock is the cost-based (traditional) method. It is an indirect metric of human capital calculated by adding the costs of human capital creation; Dae-Bong (2009), Kendrick (1976), Eisner (1988), and Oluwatobi & I. Ogunrinola (2011) are some of the most well-known examples of methodically analyzing the stock of human capital utilizing the cost of educating and training personnel, Umaru (2011). Several OECD countries have adopted this cost-based approach to measuring education services. According to Schreyer (2008) and Diewert (2008), the cost-based method is the second-best option for valuing production, with final demand prices being the best option. However, it is not without its drawbacks. For example, it has been critiqued by Appleton & F. Teal (1998) and Dae-Bong (2009) because it is a measure that identifies human capital inputs rather than results. As a result, it is impossible to precisely characterize the boundary between investment and consumption in terms of human capital costs.

Furthermore, because there is a long time lag between education investment and additions to the human capital stock, the current investment may not reflect current human capital levels. Because education investments may be partially squandered due to corruption, grade repetition, and dropouts, they may not be used efficiently to create productive human capital stock.

Outcome indicators and input indicators can both be used to calculate the stock of health capital. Though challenging to implement, the best technique to measure outcome indicators is through the population's self-reported health status, CSLS (2001).

Second alternative health outcome indicators include the population's average life expectancy at birth, infant mortality rate, morbidity rate, and the risk of financial insecurity due to disease, among others CSLS (2001), Howitt (2015).

However, using life expectancy as a proxy for health neglects to account for all aspects of health. Only mortality (mortality, morbidity, disability, and discomfort) is considered when calculating life expectancy (Evans et al.(1994).

Furthermore, life expectancy exposes only the stock of human capital's lifetime, meaning that nothing will change in the labor force or population over time. As a result, because the inputs allocated to the health sector can alter the outcome indicators. As a result, we may quantify it using input indicators such as total government and individual resources devoted to the health system, resources devoted to medical knowledge advancement, and resources committed to infrastructure influencing health, among others CSLS (2001).

2.2 Empirical Literature

2.2.1 Empirical findings around the world

Different researchers have used different measurements to see the contribution of Human capital. They used school enrollments and life expectancy as a metric for the stock of human capital and public spending on education and health for investment in human capital. Eggoha et al. (2015) found human capital stock (school enrollment and life expectancy at birth) positively affects economic growth. In contrast, human capital investment (expenditures on education and health) harms economic growth. Literacy rates and educational attainments are other alternatives sought by other authors.

Benhabib & Mark M. Spiegel (1994) have attempted to empirically distinguish between considering human capital as a standard input in the production process and total factor productivity growth as a feature of the human capital level. They have considered human capital as the level of education attained only. Instead, they have considered human capital as the level of education attained only

Noting what has been cast by Nelson & Phelps, E (1966), they have shed their doubt on the specification of treating human capital only as another factor in growth accounting. In their assumption, the level of human capital affects productivity by determining nations' capacity to innovate new technologies suited to domestic production. Furthermore, they adapted the model to allow human capital levels to affect technological catch-up and diffusion speed. Hence, they assumed that a nation's ability to adapt and The purpose of its domestic human capital stock is to introduce new technologies from abroad.

Artardi et al. (2003) argue that low human capital resources can explain the development tragedy of the 20th century in Africa, weak external climate, and political uncertainty. However, according to Becker (1993), human capital is the most decisive capital in contemporary economies. He refers to studies showing that human capital accounts for over 70% of total capital accumulation in the US, representing more than a fifth of total GDP.

Consequently, "technology may be the driver of a modern economy, especially of its high-tech sector, but human capital is certainly the fuel" (ibid). On the other hand, Paul (1990) notes that an important distinction should be made between human capital and abstract technological knowledge. He further notes that although human capital involves acquiring knowledge, it differs in one respect from abstract knowledge such as invention. Human capital is a private good because it is linked to a person, and thus, rivalry and vulnerability exist. The use of education and health interventions has been By many academics as a metric for human capital. For example, Karagiannis & K. Benos (2009) used enrollment rates, student-teacher ratios, health indicators, multiple medical doctors, and hospital beds for the educational indicators.

Qadri & Waheed (2011), on the other hand, have used education indicators (enrolment rates) and health indicators (Proportion of total government health expenditure to GDP). Human capital has also been measured using education (educational achievement) and health, Barro et al.(2003) (life expectancy). Human capital is a relatively better measure by taking education and health indicators than using education or health indicators alone. Because it articulates the concept that both education and education are a relatively better measure of human capital than using schooling or metrics of health alone, this represents the belief that both education and health are essential components of human capital.

2.2.2 Empirical findings in Ethiopia

Related and recent studies in Ethiopia have shown consistent results. For example, using school enrollment as a proxy for human capital, Seid (2000) discovered that human capital has a negligible effect on production. Similarly, Woubet (2006) has the same result that proves the non-existence of any relationship between the two macroeconomic variables. But, their approach to measuring human capital ignores the health aspect of human capital development, while both education and health are essential components of human capital.

Teshome (2006) revealed a favorable impact of human capital development on Ethiopian economic growth using expenditures on education and health as a proxy for investment in human capital development. This conclusion is supported by Tofik (2012), who discovered a positive and significant association between human capital investment and economic growth.

Tewodros (2014) investigated the impact of human capital on Ethiopia's economic growth using the Johansen Co-integration Approach. The results of his study indicate that investment in education and health would affect further economic growth in the long run.

Dinkneh, Borojo, & Jiang Y (2015) investigated the role of human capital in Ethiopia's economic growth. His research found that government spending on health and education and elementary and secondary school enrollment has statistically significant and a positive impact on economic growth in both the long and short-run.

In Ethiopia, the impact of human capital development on economic growth has also been investigated, Kidanemariam (2015). His study showed a stable long-run relationship between Real GDP, human education capital, and human health capital. Accordingly, the estimated long-run model indicated that human capital in health has a significant positive effect on real per capita GDP growth, followed by real per capita GDP growth in human education capital, among other things. Thus, a country can raise its human capital by providing education and training.

Befekadu (2018) employs the Co-integrated VAR approach to investigate the impact of human capital on economic growth in Ethiopia. The short-run causality tests show that expenditure on education has a significant effect while expenditure on health has a statistically insignificant effect.

Shemsedin (2020) used a co-integrated VAR approach to the impact of human capital development on economic growth in Ethiopia. According to the findings of this study, in the long run, both the ratios of government spending on health and education to GDP, the labor force and policy change dummies have a favorable impact on Ethiopia's economy. However, in the short-run, gross primary school enrollment is the main contributor to real GDP. Furthermore, government spending on health and labor force ratios harms the economy.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Description of the study area

Ethiopia is located in the Horn of Africa, bordering on the west with South and North Sudan, the north with Eritrea, the northeast with Djibouti, and the east with Somalia. The country's population estimated in 2021 is 117.8 million, and its capital city is Addis Ababa that serves as the capital of Africa and home for the African Union. Ethiopia got UN membership on 13 November 1945. Ethiopia is one of the world's multi-ethnic and multilingual countries.

Ethiopia is home to 54 ethnic groups and more than 80 languages. Its economy is built on agriculture, and around 85% of the population works in the industry, with current efforts to diversify into manufacturing, textiles, and energy generation. Coffee is a major export crop. Birr (ETB) serves as domestic currency for domestic exchange. Ethiopia's Gross Domestic Product (GDP) was valued at 96.61 billion dollars in 2020.

Figure 3- 1: Geographical map of Ethiopia and its neighboring countries

3.2 Type of Data

The researcher has employed secondary quantitative data to realize the defined study's objective. The rationale of using this type of data lies in nature or subject matter (i.e., both dependent and independent variables) themselves requires numerical data which have already been collected by an individual(s) or particular institution(s). This type of data has an advantage because it less expensiveness and time-consuming to obtain when compared to primary data. The supporting data and information for the investigation were obtained from relevant secondary data sources such as related publications, annual reports, and bulletins.

3.3 Source of Data

Since the research entirely applies secondary data, data extraction is not as exhaustive as the primary data to collect and organize. The secondary data for both dependent variable (Real GDP) and independent variables such as Labour force (LF), Capital Gross Formation (GCF), Education Expenditure (EDX), Health Expenditure (HEX), Total Government Expenditure (TGE), Secondary School Enrollment (SSE), Official Development Assistant (ODA) and Consumer Price Index (CPI) were acquired from concerned institutions and organizations. These institutions and organizations include the National Bank of Ethiopia (NBE), and World Economic Outlook (WEO) of IMF, the World Development Indicators (WDI) of World Bank (WB), PES, CSA, and MoFED.

Table 3- 1: Specific sources of data

S.N	Variables	Source of data
1.	Real gross domestic product (RGDP)	NBE
2.	Labour force (LF)	NBE and CSA
3.	Gross capital formation(GCF)	Planning and economic commission
4.	Education expenditure (EDX)	MoE and WDI
6	Health expenditure (HEX)	MOFED
5.	Total government expenditure (TGE)	NBE and MoFED
6.	Secondary school enrollment (SSE)	MoE and EES
7.	Official development assistant(ODA)	IMF
8	Consumer price index (CPI)	NBE

3.4 Method of data analysis

Two data analysis methods, namely, descriptive and inferential data analysis methods, were used for this study. The trends of Real GDP, Labor force growth, gross capital formation, human education capital, human health capital, total government expenditure, official development assistance, and consumer price index were depicted using the descriptive method. In addition, to examine the short-run and long-run relationship among human capital, the bound test of the ARDL model of the time series econometric method of data analysis was employed.

In econometrics procedures, the unit root test was conducted first to check for the stationarity of the time series model using the Augmented Dickey-Fuller (ADF) test and Phillips-Perron Test (PP). Then, the Co-integration test was applied using ARDL bound co-integration approach to examine whether the variables have a long-run relationship.

3.5 Model Specification

One of the primary essential stages of research in establishing the relationship among variables is to express their association in the mathematical form upon which the model was set up. The number of methods followed in measuring and estimating human capital contributions are as many as the number of literature works done in the area depending on context-specific situations. A relatively simple adoption is the use of the augmented Solow human-capital-growth model. This model is an improvement on the Solow growth model. Solow's original model did not explicitly incorporate human capital. To do that, Mankiw et al. (1992) came up with the augmented Solow model, which incorporates human capital as a separate input into the model. Labor possesses the heterogeneous level of education, skills, and health condition, which were assumed to be homogeneous in the original Solow model.

Hence, the Solow model's modification serves the suitability and, hence, the adaptation of the model for our context. This approach's basic assumption is that increased workers' quality through improved education and health improves output. Thus, it supports the human capital theory, which postulates that the education and healthcare of workers ensure greater productivity. The augmented Solow model using the standard Cobb Douglas production function is therefore specified as follows:

$$Y_t = K_t^{\alpha} H_t^{\beta} (AL)^{1-\alpha-\beta} \tag{3.1}$$

By converting the equation to log-linear form, we can:

$$\ln Y_t = \alpha \ln H_t + \beta \ln H_t + (1-\alpha-\beta)\ln(AL_t) + V \qquad (3.2)$$

Where,

K is the level of physical capital. β is the Elasticity of Human capital for output.

His level of Human Capital V is an error term

L is the level labor force, α+β < 1

A is level of Productivity/technology

The following equations can be used to approximate the above model empirically:

According to Mankiw et al. (1992), labor and technology are assumed to grow at the rates n and g, and the number of functional units of labor (ALt) 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 and 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 IKt and SkYt are investments in physical capital and human capital, respectively.

Letting k= KAL as the stock of physical capital per effective unit of labor h= HAL as the stock of human capital per effective unit of labor, y= YAL as the level of output per effective unit of labor, n is the growth rate of labor,d is the standard (time-invariant) depreciation rate and g is the rate of technological change and, we can derive the time path (differentiation with respect to time) of and as follows, Mankiw et al., (1992).

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

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

Under the assumption that α + β < 1 (*i.e.*, decreasing returns to scale), this system of equations can be solved to obtain steady-state values of $\dot{k}$ and $\dot{h}$ 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:

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

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

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

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

$$ln\ y_t^* = ln \frac{Y_t}{L_t}\ = lnA_t + g_t - \frac{\alpha}{1-\alpha-\beta}\ \ln(n+g+d) + \frac{\alpha}{1-\alpha-\beta} \ln S_k + \frac{\beta}{1-\alpha-\beta} \ln S_h$$

Since it is not observable, Mankiw et al. (1992) will capture the error term.

Similarly, it is not observable, and its parameter cannot be distinguished from the constant term empirically (Bassanini & S. Scarpetta (2001). Hence, the estimated basic empirical growth equation could be expressed as follows:

$$ln\ y_t^* = ln \frac{Y_t}{L_t}\ = C + \frac{\alpha}{1-\alpha-\beta}\ \ln(n+g+d) + \frac{\alpha}{1-\alpha-\beta} \ln S_k + \frac{\beta}{1-\alpha-\beta} \ln S_h$$

The following empirically valuable log-linear form of model (with some adjustment to accommodate other additional variables) is defined based on this theoretical framework (Mankiw et al., (1992). The autocorrelation between each variable was checked, and For those correlating with each other, they were dropped.

LnRGDP=f(LnLFt,LnGCFt,LnEDXt, LnHEXt, LnTGEt, $LnSSE_t$*, LnODAt, LnCPIt,*D_1,D_2*)*.…(3.2)

Where,

- ✓ LnRGDPt is the Natural logarithm of real GDP at time t.
- ✓ LnLFt is a Natural logarithm of labor force growth rate at time t.
- ✓ LnGCFt is the natural logarithm of gross capital formation at time t.
- ✓ LnEDXt is a Natural logarithm of education expenditure at time t.
- ✓ LnHEXt is a Natural logarithm of health expenditure at time t.
- ✓ LnTGEt is a Natural logarithm of total government expenditure at time t
- ✓ LnSSEt is a Natural logarithm of secondary school enrollment at time t
- ✓ LnODAt is a Natural logarithm of official development assistance at time t.
- ✓ LnCPIt is a Natural logarithm of consumer price index at time t.
- ✓ D_1 and D_2 are dummy variables for drought and policy change, respectively.

3.5.1 Descriptions and measurements of the variables

i. Real Gross Domestic Product (RGDP)

Gross domestic product is the value of all final goods and services produced in the country for a given period. The market value of GDP depends on the actual quantity of goods and services produced and their price. The actual quantity of goods produced sometimes is called the volume. Therefore, real GDP is used to capture the overall economic performance.

ii. Share of Real Gross Capital Formation to RGDP (GCFt)

It is a proxy for the economy's physical capital stock, extracted by dividing the total fixed capital formation adjusted for real GDP through the GDP deflator. According to Barro & X. Sala-i-Martin (1995), the predicted sign of the GCF coefficient is positive because capital accumulation favors real GDP growth by fostering the further development of new goods and services.

iii. Labour force

Theoretically, labor is an essential factor in the sustainable pace of economic growth. For labor-intensive economies such as Ethiopia, it could be the growth engine. On the other hand, it may be a burden for the economy and less productive because of the high unemployment rate. Therefore, it is integrated into its growth rate in the model.

iv. Human Capital

Human capital impacts labor efficiency because it allows new technologies to be absorbed, increases the rate of innovation, and encourages successful management, Adamu (2003); as cited in Sankay et al. (2010). Consequently, investment in human capital is the endogenous factor for high labor productivity, which increases the accumulation of physical capital through the expertise, abilities, attitudes, and health status of the individuals involved in the economic process. Therefore, this variable is included in the model to represent the "knowledge, abilities, competence and attributes embodied in people. Furthermore, it is represented by the share of health expenditure to GDP, education expenditure to GDP, and secondary school enrollment. Therefore, a higher level of human capital in education and health is expected to impact economic growth positively.

v. The percentage of Total Government Expenditure to Real GDP

This variable refers to the sum of the Ethiopian government's recurrent and capital budget to real GDP. To avoid double-counting, government expenditure on human capital is exempt from total government spending. Similarly, since ODA is used in the model as one explanatory variable, only domestic sources' expenditures are taken away from government spending(excluding the external assistance and loan). As a share of GDP, it is inserted into the model.

vi. The ratio of Official Development Assistance to Real GDP

It is possible to categorize the relationship between official aid for development assistance and economic growth into three. The first view is that aid contributes positively to the recipient country's socio-economic status. The second argument is based on the idea that aid could lead to low or negative productivity by discouraging alternative policies and institutions for development Rajan & A. Subramanian (2005); Ekanayake et al. (2008). The other argument is that the marginal aid contribution depends on the recipient country's institutional environment (policy). If an excellent economic policy environment exists, the efficient allocation of investment aid, which positively affects the economy, is crucial. However, if institutional destruction and capacity constraints are destroyed, they will have little or no impact on economic growth (Hansen & F. Tarp (2000). Ethiopia is among the significant aid recipient countries in Africa; it is entered into the model as one control variable.

vii. Inflation (CPI)

It measures changes in the prices of a basket of goods and services that households consume. Such changes affect the real purchasing power of consumers' incomes and their welfare. When different goods and services vary by different rates, a price index can only reflect their average movement. Therefore, a price index is given a value of unity, or 100, in some reference period. The index values for other periods are intended to show the average proportionate or percentage change in prices from this price reference period, Fitsum (2013). In the study, the annual average of CPI for each year was used.

viii. Dummy Variable

Economic policy changes can influence the economy's performance by investing in human capital and infrastructure, improving political and legal institutions, etc.; Easterly (1993). Recurrent droughts and unfavorable weather conditions, on the other hand, are harming the economy, particularly in developing countries, which are mainly dependent on agriculture. Therefore, the drought dummy (D1), policy change dummy (D2), is introduced into the model.

The dummy for economic policy changes takes zero for the period 1980-2020 and one otherwise. Similarly, if there are relatively good weather conditions, the drought dummy takes zero and one if there is a drought. Then, based on Webb et al. (1992) and Viste et al. (2012), the drought periods are determined. Thus far, all of the variables covered have been expressed in the logarithmic form (except the policy change and drought). The log-linear specification form allows the researcher to interpret the dependent variables' coefficient as elasticity about independent variables. Besides, it is also helpful for accommodating the heteroskedasticity problem (Goldsteine & M. Khan (1976).

Table 3-2: Summary of variables' description

Variables	Description	Unit of measurement
RGDP	Real Gross Domestic Product	The ratio change in Real GDP
GCF	Gross Capita formation	The ratio of real gross capital formation to GDP
LF	Labor force	Labor force growth rate
EDX	Education expenditure	The ratio of government expenditure on education to GDP
HEX	Health expenditure	The ratio of government expenditure on health to GDP
SSE	Secondary school enrollment	Secondary school enrollment growth rate
TGE	Total government expenditure	The ratio of total government expenditure to GDP
ODA	Official development assistant	The ratio of official development assistant to GDP
CPI	Consumer price index	Price index

3.6 Model Estimation

Since time series data exhibit a consistent trend over time, a potential problem can arise when the classical regression model is applied to the variable.

The econometric data analysis in the research encompasses procedures: unit root test, lag length selection, and ARDL co-integration approach, identification and estimation of the long-run model, vector error correction model of short-run dynamics, and finally, the validity of all diagnostic tests. If the ARDL Approach to Co-integration (i.e., bound co-integration testing) identifies a single co-integrating vector which means one long-run relationship equation, then the ARDL model of the co-integrating vector is re-parameterized into ECM. The single models result of short-run dynamics (i.e., traditional ARDL) and long-run relationship of the variables are obtained from the re-parameterized result. Data processing was carried out using E-view 10 software package.

3.6.1 Stationary test

i. Augmented Dickey-Fuller (ADF)

Augmented Dicky-Fuller (ADF) test is one of the widely used approaches of unit root testing. The most straightforward 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: $Yt = \delta Yt\text{-}1 + ut$ ……………….....................(3.3)

Yt is a random walk with drift: $Yt = \beta 1 + \delta Yt - 1 + ut$……………… …....(3.4)

Yt is a random walk with drift and trend: $Yt = \beta 1 + \beta 2t + \delta Yt - 1 + ut$… ………….(3.5)

where t is the time or trend variable, and ut is a white noise error term.

For simplicity, let us consider equation (3.3), a random walk autoregressive model: A convenient technique for carrying out the unit root test is to subtract $Y_{t\text{-}1}$ from both sides of equation (3.3) and to define $\Phi = \delta\text{-}1$

Subtracting Yt-1 from both sides of equation (4) gives:

$Yt - Yt\text{-}1 = \delta Yt\text{-}1 - Yt\text{-}1 + ut$ ....(3.6)

$\Delta Yt = (\delta\text{-}1)\ Yt\text{-}1 + ut$

$\Delta Yt = \Phi\ Yt\text{-}1 + ut$…………………………………..……………....……..(3.7)

Where $\Phi = (\delta\text{-}1)$, Δ is the first difference operator and ut ~IN[0, σ2]

The fundamental idea behind the Dickey-Fuller (DF) unit root test for stationarity is to regress ΔY_t on a 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 Dickey-Fuller (DF) critical values of the (tau) statistic are used to determine whether or not to reject the null hypothesis, and the test procedure for unit roots is shown as follows:

Ø Set the null and alternative hypothesis as:

- Set the null and alternative hypothesis as:

$$H_o: \Phi = 0$$

$$H_a: \Phi < 0$$

- Calculate the test statistic using

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

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

To calculate the critical values of the τ (tau) statistic, Dicky-Fuller assumes that the error terms (ut) 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 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 difficulty, Green (2004). In the ADF test, the lags of the first difference dependent variable are added in the regression equation until the autocorrelation problem will be resolved. The regression equation is presented in the following form:

$$\Delta Y_t = \Phi Y_{t-1} + \beta \sum_{i=1}^{p} \Delta Y_{t-i} + u_t \quad \text{……………………………………………}(3.8)$$

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

$$\Delta Y_t = \beta_t + \beta_2 t + \Phi Y_{t-1} + \beta \sum_{i=1}^{p} \Delta Y_{t-i} + u_t \quad \text{…………………….……….}(3.9)$$

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 changing 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 tautest to test the hypothesis that Φ = 0 are different for each of the three specifications.

(Gujarati., 2004). Hence, due to the above advantages over the 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).

ii. Phillips-Perron (PP)

Although there are various types of unit-root tests, Phillips-Perron (PP) test will be conducted for the same purpose as the side to Augmented-Dickey-Fuller (ADF) test. Gujarati (2004) described that non-parametric statistical methods are used in the Phillips and Perron test to consider the serial correlation of the error terms. This means the test does not add lagged difference terms. The further explanation need not be gone to show how it works since the asymptotic distribution of the PP test is the same as the ADF test statistic.

3.6.2 The Autoregressive distributed lag Model (ARDL)

There are several advantages of using the ARDL model, also called 'Bound Testing Approach' instead of the conventional Engle-Granger two-step procedure (1987), Maximum likelihood methods of co-integration, Jones & V. Fender (2011). First, the ARDL model is the more statistically practical approach to determine the co-integration relation in small samples, as in this study, Pesaran (2001) and Narayan (2005). A second advantage of the ARDL Approach to Co-integration is that other co-integration techniques require all regressors to be integrated of the same order. Whether the regressors are entirely ordered zero [I(0)], purely ordered one [I(1)], or a mixture of both, the ARDL technique can be used. Third, with the ARDL Approach to Co-integration, it is possible to capture a different optimum number of lengths for different variables, Nasiru (2012) cited in Tsadkin (2013). Finally, the ARDL Approach to Co-integration allows for the inclusion of a dummy variable in the co-integration test procedure, which is impossible with Johansen's, Rahimi (2011).

Finally, Appling the ARDL technique, we can obtain unbiased and efficient estimators of the model, Narayan (2005), Harris (2003); and Pesaran (1999).

Therefore, this approach becomes prevalent and appropriate for investigating the long-run relationship and extensively applied in empirical research in recent years.

The study used Autoregressive Distributed Lag (ARDL) approach to test the long-run co-integration relationships between variables.

Therefore, the following ARDL model is specified.

$$\begin{aligned} LnRGDP_t = {} & \beta_0 + \lambda_1 LnRGDP_{t-i} + \lambda_2 LnLF_{t-i} + \lambda_3 LnGCF_{t-i} + \lambda_4 LnEDX_{t-i} + \lambda_5 LnHEX_{t-i} \\ & + \lambda_6 LnTGE_{t-i} + \lambda_7 LnSSE_{t-i} + \lambda_8 LnODA_{t-i} + \lambda_9 LnCPI_{t-i} + \beta_1 \sum_{i=0}^{n} \Delta LnRGDP_{t-i} \\ & + \beta_2 \sum_{i=0}^{n} \Delta LnLF_{t-i} + \beta_3 \sum_{i=0}^{n} \Delta LnGCF_{t-i} + \beta_4 \sum_{i=0}^{n} \Delta LnEDX_{t-i} + \beta_5 \sum_{i=0}^{n} \Delta LnHEX_{t-i} \\ & + \beta_6 \sum_{i=0}^{n} \Delta LnTGE_{t-i} \\ & + \beta_7 \sum_{i=0}^{n} \Delta LnSSE_{t-i} + \beta_8 \sum_{i=0}^{n} \Delta LnODA_{t-i} + \beta_9 \sum_{i=0}^{n} \Delta LnCPI_{t-i} + \beta_{10} D_1 + \beta_{11} D_2 \\ & + e_t \; \ldots\ldots (2) \end{aligned}$$

Where,

- ✓ LnGDPt is the Natural logarithm of real GDP at time t.
- ✓ LnLFt is a Natural logarithm of labor force growth rate at time t.
- ✓ LnGCFt is the natural logarithm of gross capital formation at time t.
- ✓ LnEDXt is a Natural logarithm of education expenditure at time t.
- ✓ LnHEXt is a Natural logarithm of health expenditure at time t.
- ✓ LnTGEt is a Natural logarithm of total government expenditure at time t
- ✓ LnSSEt is a Natural logarithm of secondary school enrollment at time t
- ✓ LnODAt is a Natural logarithm of official development assistance at time t.
- ✓ LnCPIt is a Natural logarithm of consumer price index at time t.
- ✓ D_1 and D_2 are dummy variables for drought and policy change, respectively
- ✓ The coefficients measuring long-run relationships are λ_1, λ_2, λ_3, λ_4,λ_5,λ_6,λ_7,λ_8,and λ_9
- ✓ The coefficients measuring short-run relationships are β_1,β_2,β_3,β_4,β_5,β_6,β_7,β_8, β_9, β_{10} and β_{11}
- ✓ n denotes the lag length of the autoregressive process.
- ✓ et it is an error term.

To see if the variables have a long-run equilibrium relationship, the limits test for co-integration is used, as presented by Pesaran (1999) and Pesaran (2001). The hypotheses are shown below:

Ho: $\lambda_1=\lambda_2= \lambda_3= \lambda_4=\lambda_5= \lambda_6= \lambda_7= \lambda_8= \lambda_9=0$ means there is no long-run relationship among the variables.

Ha: $\lambda_1\neq\lambda_2\neq\lambda_3\neq\lambda_4\neq=\lambda_5\neq\lambda_6\neq\lambda_7\neq\lambda_8\neq\lambda_9\neq0$ means there is a long-run relationship among the variables. The above hypothesis is tested using non-standard F-statistics. The F-statistics critical values for this test can be found in Pesaran (2001). On the other hand, Narayan (2005) calculated his critical values based on the argument that Pesaran's (2001) critical values are appropriate for relatively large sample sizes. He believes that employing such crucial values for such a small sample size can lead to erroneous results.

As a result, based on a similar methodology used by Pesaran (2001), developed a new set of critical values for small sample sizes spanning from 30 to 80 observations. They provide two sets of essential values: upper bound values and lower bound values.

The null hypothesis of no co-integration will be rejected if the estimated F-statistics are higher than the critical value's relevant upper bound. The null hypothesis cannot be rejected if it falls below the proper lower bound, and if it falls between the upper and lower bounds, the result will be inconclusive. In this paper, the computed F-statistics are compared with both critical values provided by Pesaran (2001) and Narayan (2005).

I) Long-run model analysis

To test whether a long-run equilibrium relationship between the variables abounds co-integration test is performed, Pesaran (1997) and Pesaran (2001) suggested. Therefore, the following long-run stable model was calculated after verifying a long-run relationship between the variables.

$$\begin{aligned}\mathrm{LnRGDP_t} &= \beta_0 + \beta_1 \sum_{i=0}^{n} \mathrm{LnRGDP}_{t-i} + \beta_2 \sum_{i=0}^{n} \mathrm{LnLF}_{t-i} + \beta_3 \sum_{i=0}^{n} \mathrm{LnGCF}_{t-i} + \beta_4 \sum_{i=0}^{n} \mathrm{LnEDX}_{t-i} \\ &+ \beta_5 \sum_{i=0}^{n} \mathrm{LnHEX}_{t-i} + \beta_6 \sum_{i=0}^{n} \mathrm{LnTGE}_{t-i} \\ &+ \beta_7 \sum_{i=0}^{n} \mathrm{LnSSE}_{t-i} + \beta_8 \sum_{i=0}^{n} \mathrm{LnODA}_{t-i} + \beta_9 \sum_{i=0}^{n} \mathrm{LnCPI}_{t-i} + \beta_{10} D_1 + \beta_{11} D_2 \\ &+ v_t \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \ (3)\end{aligned}$$

II) Short-run model analysis

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

$$\begin{aligned}\Delta\mathrm{LnRGDP_t} &= \beta_0 + \beta_1 \sum_{i=0}^{a} \mathrm{LnRGDP}_{t-i} + \beta_2 \sum_{i=0}^{b} \mathrm{LnLF}_{t-i} + \beta_3 \sum_{i=0}^{c} \Delta\mathrm{LnGCF}_{t-i} + \beta_4 \sum_{i=0}^{d} \Delta\mathrm{LnEDX}_{t-i} \\ &+ \beta_5 \sum_{i=0}^{e} \Delta\mathrm{LnHEX}_{t-i} + \beta_6 \sum_{i=0}^{f} \Delta\mathrm{LnTGE}_{t-i}\, \beta_7 \sum_{i=0}^{g} \Delta\mathrm{LnSSE}_{t-i} \\ &+ \beta_8 \sum_{i=0}^{h} \Delta\mathrm{LnODA}_{t-i} + \beta_9 \sum_{i=0}^{h} \Delta\mathrm{LnCPI}_{t-i} + \beta_{10} D_1 + \beta_{11} D_2 + \delta \mathrm{ECT}_{t-1} \\ &+ U_t \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots .. (4)\end{aligned}$$

Where: β_1, β_2,β_3',β_4, β_5, β_6, β_7, $\beta_{8,}$ β_9, $\beta_{10,}$ and β_{11} are coefficients that represent the short-run dynamics of the model. It is a vector of white noise error terms, and (a−h) denotes the optimal lag length of each variable in the autoregressive process. The dummy variables for recurrent drought and policy change are D_1 and D_2.

ECT is the error correction term with one period lag; δ is a parameter of error correction that measures the adjustment speed towards the long-run equilibrium.

The error correction term (ECT) captures the relationship between the short-run and the long-run. It is derived from the long-run model and shows how variables quickly converge to equilibrium. The coefficient of ECT should also be statistically significant. If the coefficient has a negative sign, it confirms the existence of a co-integrating relationship; however, if the sign of the coefficient is positive, the model is explosive that there is no convergence. If the estimates of ECT = 1, then 100% of the adjustment takes place within the period, the adjustment is rapid and complete, and if the estimate of ECT = 0.5, then 50% of the adjustment takes place each year. ECT = 0, indicates non-existence of adjustment.

3.6.3 Diagnostic tests

The estimation tests are required to check the reliability of the estimated result. The most commonly used tests in dynamic models are the autocorrelation test, heteroscedasticity test, normality test, and model stability test. The types of tests going to be employed to examine their corresponding hypothesis are briefly discussed below.

- **Autocorrelation test**

Autocorrelation is one diagnostic test for evaluating an econometric model result's complete specification and robustness. Autocorrelation is a particular case of correlation that refers to the relationship between successive values of the same variable. In this case, however, the serial correlation of the residuals will be tested. Conducting this test is needed because autocorrelation causes the variance of OLS estimates to be inefficient. This makes estimates of beta in the regression model underestimated. Therefore, testing whether the model regression suffered from this problem is essential.

There are many tests for autocorrelation, but the study will use Breusch-Godfrey Lagrange Multiplier (LM) test due to its relevancy to multivariate test for residual serial correlation up to some specified lag order. If the null hypothesis is rejected at common critical values, we conclude a serial correlation among the residuals.

- **Heteroscedasticity test**

A heteroscedasticity problem arises when the variance of the error term is not constant. In other words, the distribution of the residual around the mean varies with time. In the presence of this problem, the OLS estimators are still consistent and unbiased, but it makes the minimum variance property of the OLS not to be maintained, Wooldridge (2013).

Unlike the Breusch-Pagan test, which helps detect any linear forms of heteroscedasticity, the White test allows for testing nonlinearities. The procedure of testing the null hypothesis is:

Null hypothesis (H0): The error variance is homoscedastic.

Alternative hypothesis (H1): The error variance is not homoscedastic,

Decision rule: If the computed Chi-square is higher than the critical value at the chosen level of significance, usually 5%, the null hypothesis of homoscedasticity is rejected. Otherwise, we can accept the alternative hypothesis.

- **Normality Test**

Another econometrics analysis criterion is the normality test. It is the test of whether data are symmetrically distributed or skewed. The Jarque-Bera probability was used to conduct the normality test of the model. If the probability of Jarque-Bera is greater than 5%, then we say that the model is standard and skewed otherwise.

- **Model stability test**

The most commonly used to test the stability of the model is the Cumulative sum of squares of recursive (CUSUM). The test is based on the residuals from the recursive estimates and presented by figure.

Null hypothesis H0: CUSUM distribution is asymmetrically centered at 0.

Alternative hypothesis H1: CUSUM is not symmetrically distributed.

Decision rule: The null hypothesis of the normal distribution fails to be rejected when the graph of CUSUM statistics lies within the bounds of the critical region at a 5% level of significance. The alternative hypothesis is not symmetrically distributed is accepted otherwise.

CHAPTER FOUR

DATA ANALYSIS, RESULTS, AND DISCUSSION

4.1 Introduction

This chapter discusses the results obtained from both descriptive and econometric analysis from econometric regression models by logically classifying them into sections. It aims to provide an answer to the stated research question through testing the hypothesis in each step. The chapter begins by analyzing the brief history and trends of dependent and independent variables from 1980-2020. The next section of this chapter is an econometric analysis. It started with a unit root test and was followed by selecting optimum lags using appropriate criteria. In the other third section, the estimated result from the ARDL model was presented along with the statistical significance of each variable. Estimated regression output of the bound test and long-run and short-run were. Finally, the diagnostic tests of which the model reliability is decided were summarized.

4.2 Data Overview and Descriptive Analysis

4.2.1 Expenditure on Education and Health in Ethiopia.

It is important to look at trends in education and health spending in real terms rather than nominal terms. However, there is no trustworthy price index used as a deflator to convert nominal public spending into real terms. As a result, one measure used to see changes in improving reliable price index can serve as the deflator. Thus, expenditure on education and health sectors is expenditure onto GDP the education and health sector.

As shown in Figure 4-1, the share of total expenditure on education to GDP slightly increases from an average of 2.51 percent in the years 1980-1982 to an average of 3.65 in 1982- 1992. During 1992-1998, the share has also increased to an average value of 4.5 percent. However, forward and backward moves in the educational indicator's annual values during the military period. After 1992, total expenditure on education as a percentage of GDP has increased continuously (except for 1999-200 and 2007) and almost tripled within twelve years (from 2008 to 2020).

As depicted in Figure 4-1, between 2000 and 2006, the average share of total expenditure on education to GDP was 5.66 percent. After, it has increased from an average of 7.56 percent in the years 2007-2010 to an average of 9.13 percent in the year 2010-2020.

Between 1980 and 1989, however, the average amount of health expenditure as a percentage of GDP was 3.1 percent. It climbed during the next six years, reaching an average of 5.54 percent. Between 1989 and 1991, health spending as a proportion of GDP maintained a very stable trend, averaging of GDP had shown almost a constant trend recording an average value of 3.78 percent. Following the collapse of the military administration, the proportion of health spending in GDP has risen steadily.

It had increased with some oscillations. Between the years 1991 and 1997, its average share was 5.56 percent from 1991 and 1997. It averaged 8.46 percent from 2000 to 2016 and 10.05 percent from 2016 to 2020. Because total education spending exceeds total health spending, expenditure on education and health as a proportion of GDP has followed the same pattern as the share of education spending in GDP.

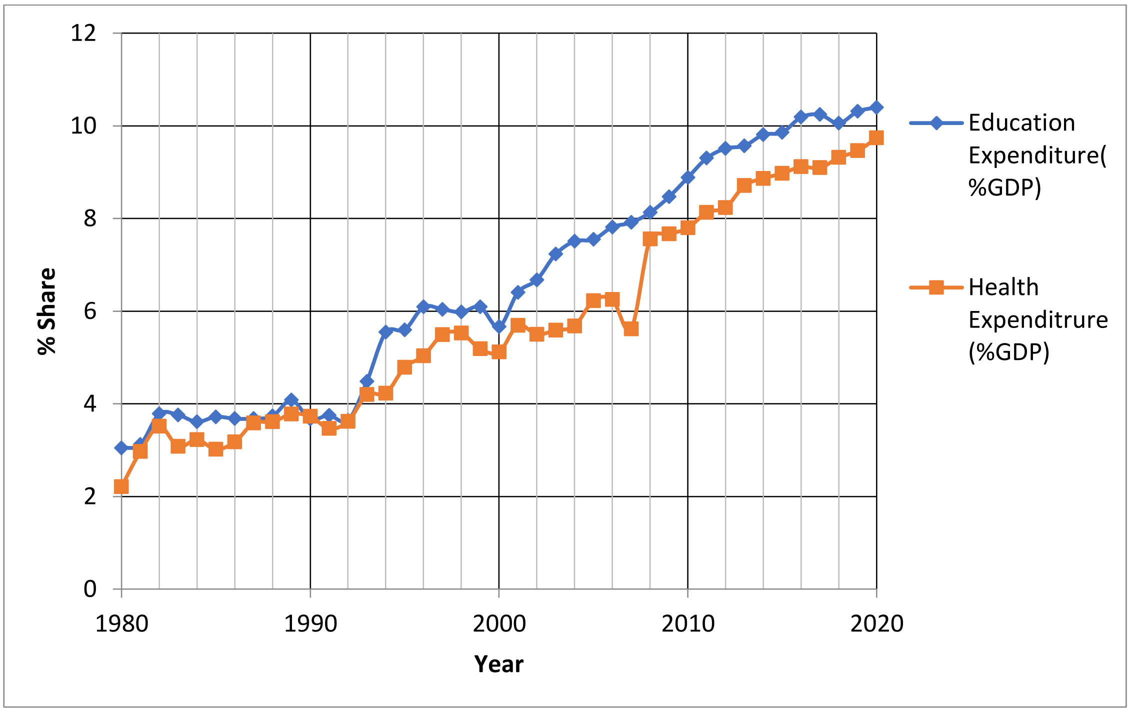

Figure 4- 1: Trends in the share of gov. exp on education and health to GDP in Ethiopia
Source: *Own calculation based on MoFED, 2021*.

4.2.2 Real GDP and Its Trend in Ethiopia

Trends of Real GDP show the change in the Real GDP over the years. Looking at Real GDP trends can help the reader comprehend how Real GDP has changed over time within the research period. Therefore it is interesting to note that growth trends are highly irregular. Agricultural sector performance, which is related to the vagaries of nature, could be one reason for such irregularities. In addition, repeated war and instabilities in the country are the other factors responsible for such a collapsided economic trend. After the collapse of the military rule in 1991, the transitional government of Ethiopia took over the economy.

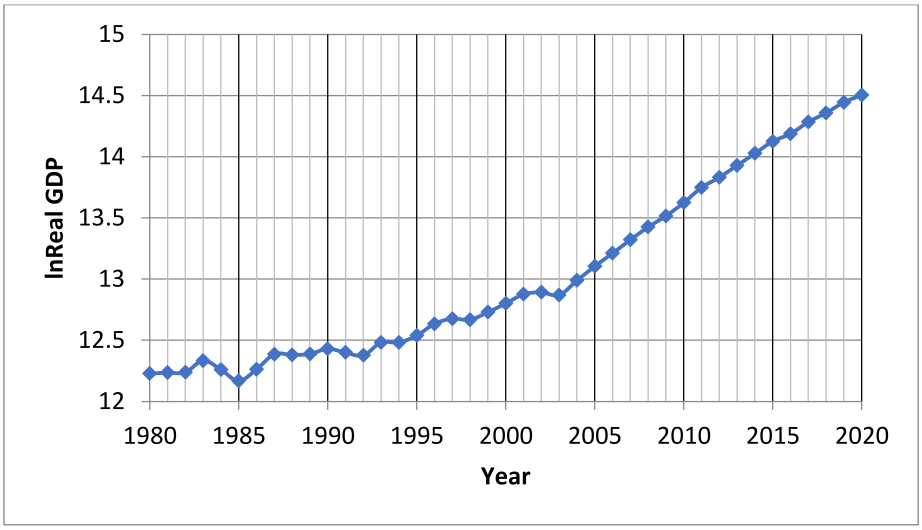

Figure 4- 2: Trends of Real GDP in Ethiopia (1980-2020)

Source: Own calculation based on National Bank of Ethiopia data (2020).

From 1992-2003, Real GDP is increasing by small rate. Though Ethiopia's real GDP growth fluctuated substantially in recent years, it tended to increase through the 2003 - 2020 period with abrupt change.

4.2.3 Labor force growth rate

The labor force growth rate is the number of people available to work as a percentage of the total population. The rate increased between 1980 and 1991 from 3.12 in 1980 to 4.89 in 1991 and then after that it is almost constant at an average rate of 3.5 until 2000. After 2000, the rate increase continuously and reach 3.7 in 2006. As shown in figure 4-2, the labor participation rate starts to decline to reach 3.67 in a year between 2006 to 2009 due to the lowered financial crisis. After 2009, the participation rate showed 4.09 in 2020.

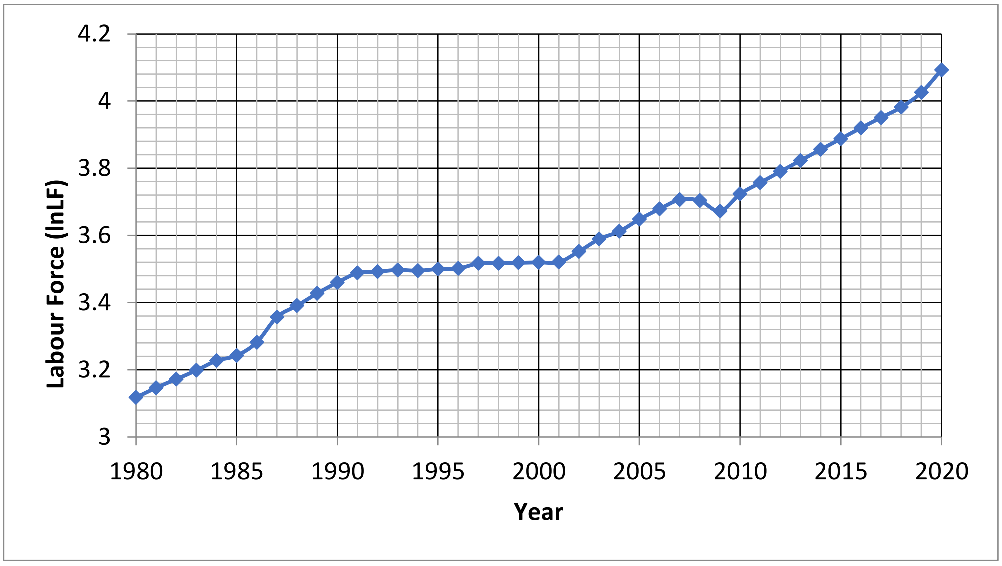

Figure 4- 3: Trends of Labor force growth rate in Ethiopia
Source: Own calculation based on NBE and CSA, 2021.

4.2.4 Gross capital formation

From figure 4-4, one can observe that Gross capital formation is almost constant during the first four years starting from 1980. After 1982, it increases one unit and then decreases by one unit next year. From 1985 to 1988, It shows rapid increment and followed by rapid decrement for the next four years. One can observe that there is an unstoppable increment of gross capital formation for the next 20 years, from 1992 to 2020.

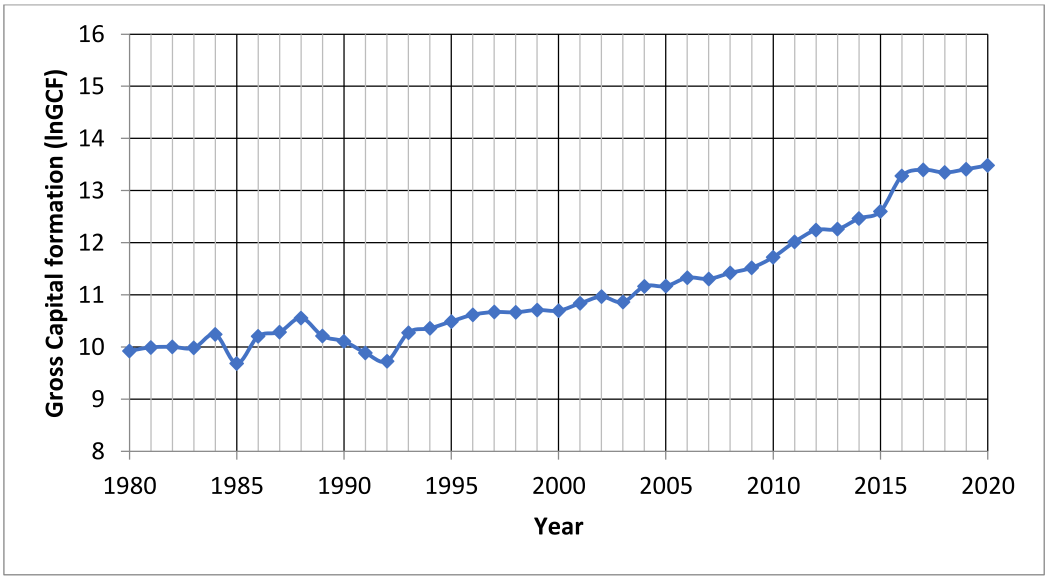

Figure 4- 4: Trends of gross capital formation in Ethiopia from 1980-2020
Source: Own calculation based on WDI, 2021.

4.2.5 Total Government Expenditure

In 2020, government expenditure in Ethiopia amounted to about 14.47 percent of the country's gross domestic product. Figure 4-5 shows the ratio of government expenditure to gross domestic product (GDP) in Ethiopia from 1980 to 2020.

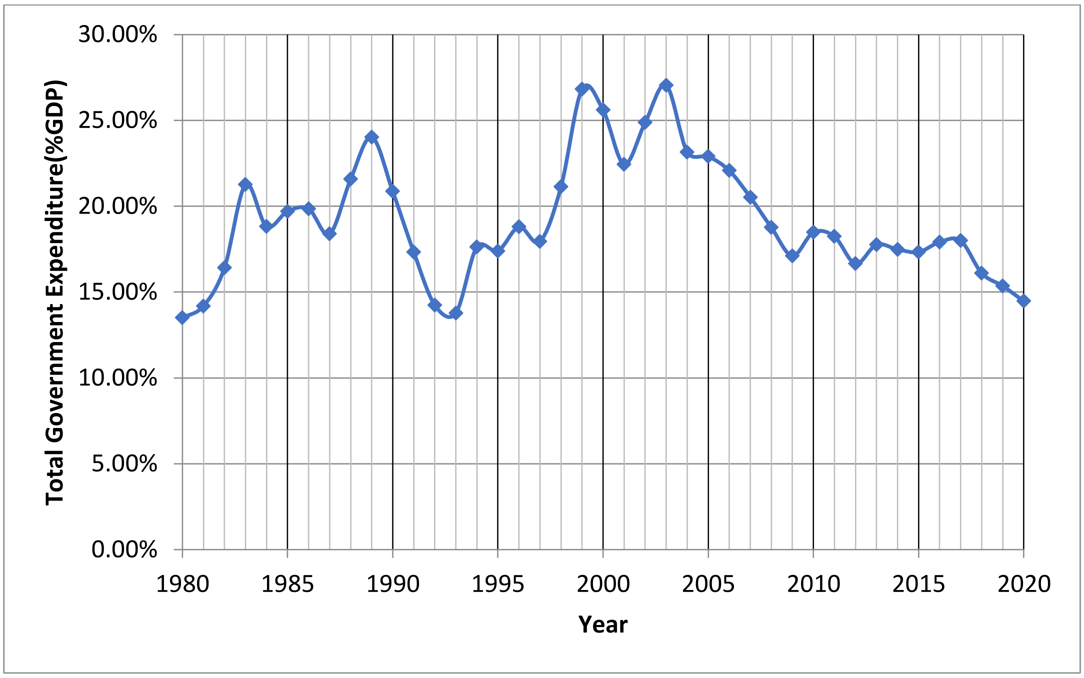

Figure 4- 5: Trends of total government expenditure in Ethiopia from 1980-2020

Source: Own calculation based on NBE,Ethiopia 2021.

Unlike other explanatory variables of Human capital, the trend of total government expenditure in Ethiopia is fluctuating from 1980-2020. During the first four years, it increased from 13.5% in 1980 to 21.25 percent in 1983. From 1983 to 1987, it kept on the constant average percent of 19. In 1989 it rose to 24.02% and then after, it decreased to 13.77 percent in 1993. From 1993 to 1999, there is a short increment of government expenditure of about 13 percent, and it is decreased to 22.44 percent in 2001, followed by an increment to 27.04 percent. Unlike the previous year's trend, total government expenditure for 20 years from 27.07 percent in 2001 to 14.47 percent in 2020.

4.2.6 Life Expectancy and Death Rate

As shown in Figure 4-6, from 1980 to 1985, life expectancy was almost constant, showing slight fluctuations around an average value of 43.2 years. Then, this figure has continuously increased and reached 60.9 years in 2010. Between 1980 and 1990, Ethiopia's life expectancy at birth has increased by almost three years while it has increased by 11.4 years from 1990 to 2010. From 2015-2020 life expectancy at birth increase and, on average, 67.4 years.

Similarly, from 1980 to 1985, the crude death rate was almost constant, around an average value of 21. In the following years, this value has continuously declined and reached 6.56 in 2020. Between 1980 and 1990, the number of deaths per 1,000 midyear population decreased by two while it declined by eight from 1991 to 2020.

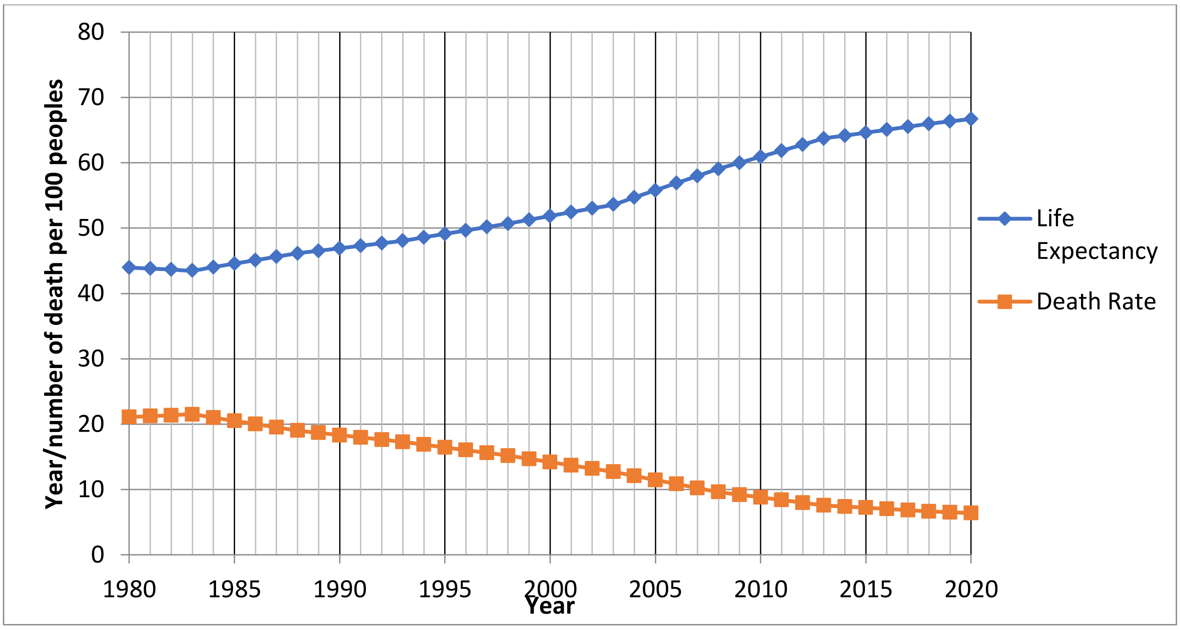

Figure 4- 6: Trends of life expectancy and death rate (1980-2020)
Source*: Own calculation based on MoH data, 2021*

4.2.7 Secondary school enrollment rate

During 1985-1988, the secondary school gross enrollment rate increased from 11.23 percent to 15.06 percent. However, it has generally decreased during the transitional government periods (1990-1995). But it has declined for the next four years.

As shown in figure 4-7, the gross enrolment ratio in secondary education for Ethiopia was 35.2 % in 2015. The total enrolment ratio in secondary education of Ethiopia increased from 12.2 % to 35.2 % in 1992 with growth at an average annual rate of 6.06% in 2015.

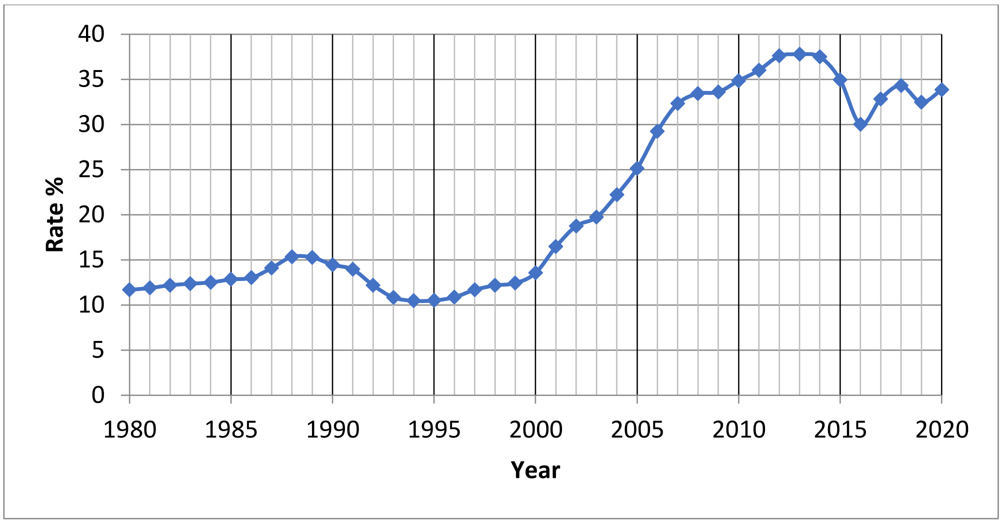

Figure 4- 7: Trends of secondary school enrolment rate in Ethiopia (1980-2020)

Source: *Own calculation from MoE and EES(2021) database*

As Figure 4-7 demonstrates, after 1995, it has increased continuously for the next sixteen years and reached 37.6 percent in 2010. It is decreased from 30 percent in 2016 and then increased to 33.3 percent in 2020.

4.2.8 Inflation and its trend in Ethiopia

Trend inflation is commonly described as a common factor taken from observed inflation rates after removing cyclical impacts from economic cycles and other transient distortions. The infinitely long-term inflation rate projected by private economic agents can alternatively be regarded as trend inflation.

The average inflation rate in Ethiopia by 2020 amounted to about 20.35 percent compared to the previous year. According to the trend illustrated by actual data and the IMF (2018) report, the country has been experiencing growing price levels since 2003. The General inflation rate was negative in 1996 and 2001 with the value of 8.9 and 10.8 respectively. However, the general inflation rate amplified to 17.7 in 2003 and then gone down in 2004 to 2.4 percent due to agricultural output recovery and better economic growth performance, Fitsum (2013).

Between 2004 and 2008, inflation has been growing at a rising rate. In 2008, general inflation rates surged to 55.51 & 78.28 percent, respectively. In contrast, figures from international institutions show that Ethiopia's general CPI rise is 44.38 percent, despite the fact that the trend is the highest for both databases. According to Durevall, Loening, and Yohannes (2013), high inflation during this period was caused by a combination of an agricultural supply shock, money growth, and imported inflation caused by foreign prices.

From 1981 to 2013, the distinictive character of the inflation pattern of increase and decline was observed. In 2009/10, it was reduced to 2.7 percent, and then to 8% in 2010. In 2011 and 2012, the rate increased to 38 percent and 20.8 percent, respectively.

From 2012 to 2016, however, general inflation has been in the single digits. The pattern then flipped in 2017, when inflation began to rise in double digits until the end of the study period (2020), with growth rates of 10.7% and 21.5 percent in these years, respectively.

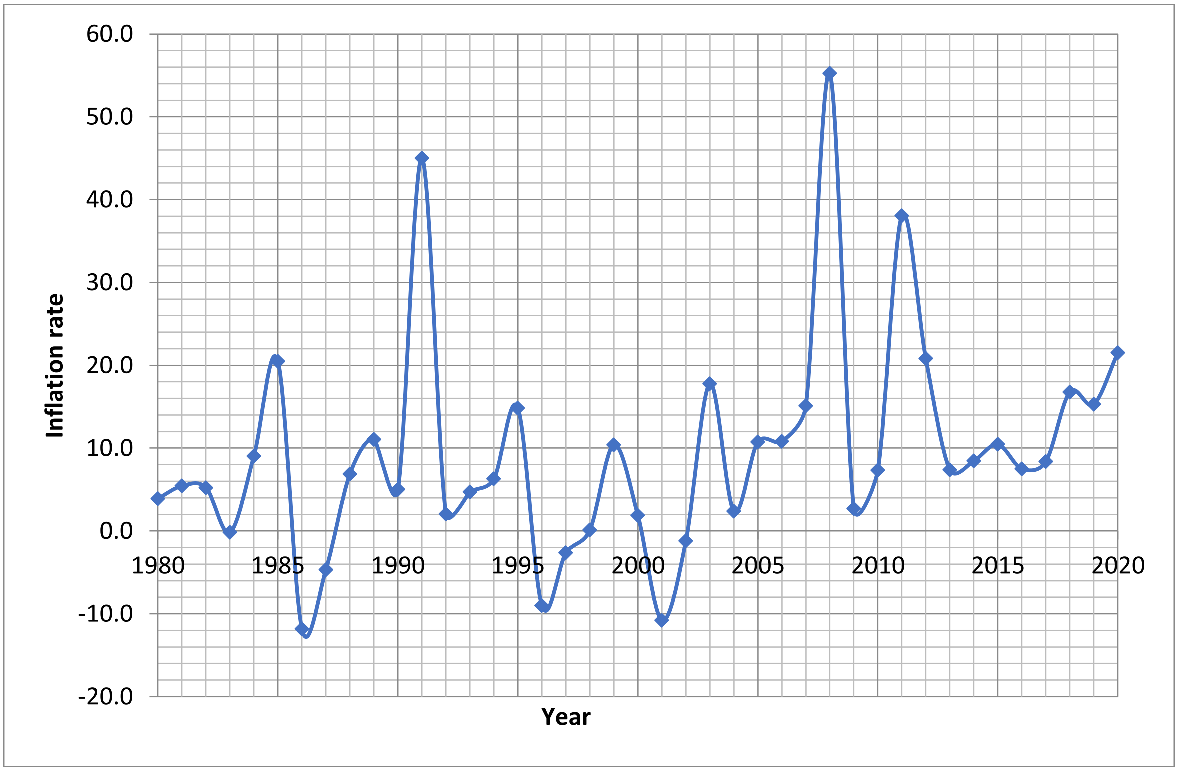

Figure 4- 8: Inflation annual percentage change trend, Ethiopia (1980-2020)

Source: own computation from NBE data, 2021

4.2.9 Official Development Assistant and its trends

Official development assistance (ODA) consists of loans made on favorable terms (net of principal repayments) and grants made by official agencies of Development Assistance Committee (DAC) members, multilateral institutions, and non-DAC countries to promote economic development. It comprises loans with at least a 25% grant component (calculated at a rate of discount of 10 percent).

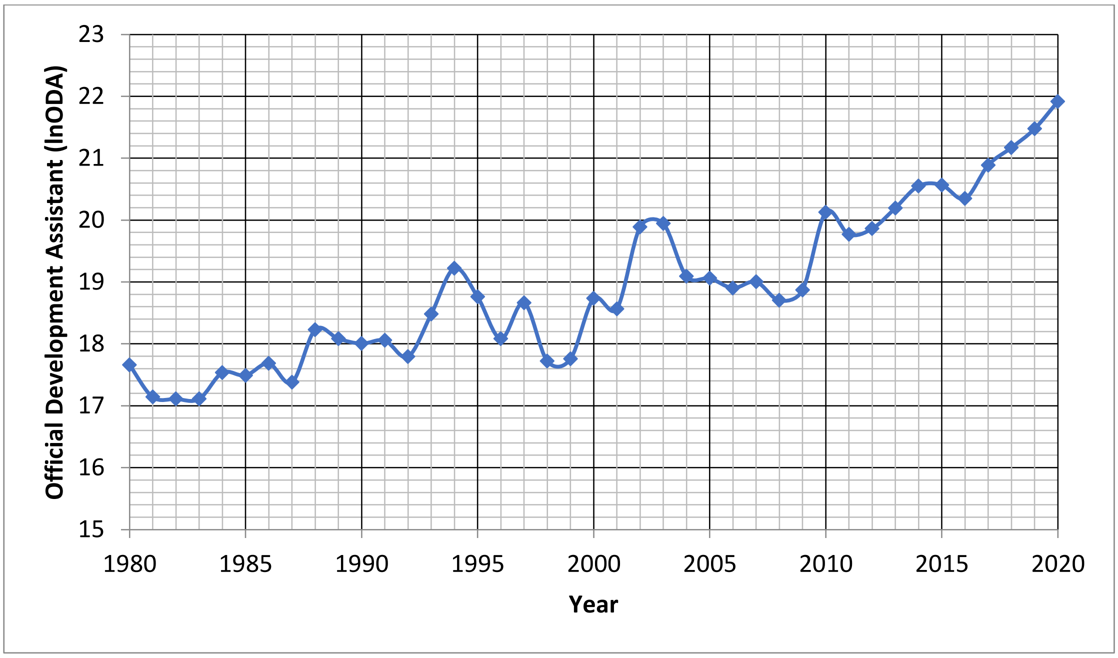

Figure 4- 9: Trends of Official Development Assistance in Ethiopia from 1980-2020

Source: Own calculation based on IMF 2021.

In the last two decades, Ethiopia's ODA has increased considerably. ODA net disbursements had risen from just over 22 million USD in 1980 to 4.8 billion USD in 2020. Ethiopia's ODA appears to be reasonably predictable, according to the data.According to above figure 4-9, ODA in Ethiopia was flactuting. Thus, from 1980 to 1981, it decline and reamin constant upto 1983. From 1983 to 1994, it increase by 2.1 rate. There is sudden decline from 1994 to 1999 and start to increase upto 2003. However, after the disputed election in 2005, there was a significant decline in ODA, demonstrating the country's vulnerability to ODA financing/aid-dependency due to governance concerns. This contrasts with other emerging sources of finance, such as those from China, where flows are insensitive to such governance issues (Alemayehu Geda (2011). From 2010 to 2020, ODA was increasing with constant rate.

4.3 Econometrics Analysis and Results

4.3.1 Stationarity tests

Many tests could be employed to check for stationarity, while the most widely known and commonly used approach is to do the Dickey-Fuller test or the ADF Test in case of collinearity of the error terms. For non-stationary time series, we can only investigate its behavior for the period in question, and we can't extrapolate its behavior to other periods. That means forecasting is difficult. Hence, to check for stationarity, The Augmented Dickey-Fuller (ADF) and the Phillips Perron (PP) unit root testing methods were employed for this purpose. In the ADF test, the Akaike information criterion (AIC) was selected because the lag length of the time series was determined based on this criterion due to its good performance in a small finite sample size. On the other hand, Newey-West bandwidth automatically selects lag for Phillips-Perron (PP) unit root test.

Table 4- 1: Augmented Dickey-Fuller and Phillips-Perron Unit Root Tests

	At level		At first difference	
Series	Intercept	Intercept & trend	Intercept	Intercept & trend
		ADF unit root test		
lnRGDP	2.071	-0.930	-5.18***	-6.23***
lnGCF	1.27	-1.64	-7.42***	-7.92**
lnLF	0.65	-1.09	-3.28***	-3.31***
lnODA	-0.33	-3.31	-7.44***	-5.77***
lnTGE	0.87	-1.52	-5.49***	-5.92***
lnHEX	0.92	-2.96	-8.03***	-8.02***
lnEDX	-0.11	-2.35	-5.97***	-5.88***
lnSSE	-0.024	-1.53	-5.19***	-5.19***
lnCPI	1.91	-0.67	-4.71***	-5.21***
D_1	-6.64	-6.61	-6.49**	-6.38***
D_2	-5.72*	-5.74	-8.63***	-8.52***
		Philips-Perron		
lnRGDP	2.21	-0.880	-5.32***	-6.24***
lnGCF	2.04	-1.34	-7.40***	-14.56**
lnLF	0.38	-1.14	-3.27***	-3.30***
lnODA	-3.30	-3.35	-7.66**	-7.76***

lnTGE	1.74	-1.34	-6.19***	-7.36***
lnHEXP	-0.05	-2.57	-8.40***	-8.78***
lnEDEXP	-0.12	-2.43	-5.98***	-5.90***
lnSSE	-0.28	-1.79	-5.37***	-5.37***
lnCPI	1.68	-0.86	-4.73***	-5.17***
D_1	-22.19	-24.12	-39.58**	-39.81***
D_1	-6.69	-8.55	-24.14***	-24.19***

Source: Author computation based on the result of EViews 10 computation.

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

The ADF and Phillips-Perron (PP) unit root tests reveal all model variables except policy change (D2), which is stationary under the ADF unit root test with an intercept at 10 percent level of significance are non-stationary at the level. We can see from the PPF test that all variables become stationary at least at a 5% significance level for both intercept and intercept & trend situations after the first difference.

The results from this test show that nine of the variables are non-stationary in their levels form. All of the variables, on the other hand, are stationary in their first differences.

These findings show that nine variables are I(1), and one is I(2), with intercept and trend (0). Such results of the stationarity test would not allow us to apply the Johansen approach of co-integration. This is one of the critical motivations for employing ARDL methodology (bounds test methodology of co-integration) (Pesaran (2001).

4.3.2 Lag length selection

As the estimation results are susceptible to lags length of variables, the optimum number of lags needs to be determined early. This lag number is determined by information criterions Akaike Information Criterion (AIC), Schwartz-Bayesian Information Criterion (SBIC), Final prediction error (FPE), Hannan-Quinn information criterion (HQ). These criteria automatically select the maximum lag length to be incorporated. But, they may not necessarily give the same result due to their applicability in different samples size. For example, AIC and FPE are appropriate for small sample sizes (60 or less), while SBIC and HQIC better perform for large (greater than 60) sample sizes, Liew (2004). Therefore, this study used AIC due to its better performance than other information criteria when a relatively small sample size is used, i.e., n < 60 observations. The following table shows a computed result using E-view 10.

Table 4- 2: Lag order selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-141.8175	NA	7.02e-11	7.836796	8.306006	8.005145
1	205.3712	480.7229	8.07e-16	-3.762626	1.867891*	-1.742445
2	400.4398	160.0563*	9.89e-17*	-7.561017*	3.230806	-3.689004*

* indicates lag order selected by the criterion

From the above table 4-2, the asterisks (*) mark the maximum lag length automatically selected by the criteria. Accordingly, all criteria except SC indicated that the optimum lag that minimizes their corresponding values is two. However, we should note that it does not necessarily mean each variable has two lag lengths. It instead shows the highest length above which lag should not be included.

Therefore, some variables can have lower than the automatically determined lag length. Each of them individually tested, dummy variable, and logarithmic form of other variables; RGDP, EDX, TGE, SSE, ODA, CPI - have one maximum lag length. In contrast, the rest explanatory variables have two.

4.3.3 ARDL Model Estimation Results

The study employed autoregressive distributive lag (ARDL) model of 'Bounds Testing Approach' to co-integration which was developed by Pesaran (1997), Pesaran and Shin (1999) and Pesaran et al. (2001). Prior to estimation the optimum lag length was chosen using Akaike information criterion (AIC). Accordingly, dependent and independent variables take one and two lag orders respectively. Then, the ARDL parameters' estimates with RGDP as dependent variables are estimated.

From table 4- 3 bellow, Real GDP coefficient is not significant at level. In addition, variables such as HEX and EDX are highly significant at level. At first lag, Official Development Assistance (ODA) is significant at five percent and Policy change (D2) is significant at 10 percent. At second lag, Gross capital formation (GCF) is significant at one percent and Secondary School enrollment (SSE) and Consumer Price Index (CPI) are significant at 5 percent.

Finally we can note that the model has constant as reflected by their statistical significance at 1 percent level of significance. Therefore, economic growth can be explained interms of human capital with their positive relationships.

Table 4- 3: ARDL model estimation result

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNRGDP(-1)	0.047146	0.209278	0.225278	0.8244
LNLF	0.203755	0.124250	1.639882	0.1194
LNGCF	0.064973	0.044204	1.469838	0.1599
LNGCF(-1)	0.073215	0.055936	1.308910	0.2080
LNGCF(-2)	0.187491	0.058864	3.185131	0.0054***
LNEDX	0.073258	0.025716	2.848781	0.0111**
LNHEX	0.012495	0.024793	0.503981	0.0207**
LNHEX(-1)	-0.044823	0.028709	-1.561295	0.1369
LNHEX(-2)	-0.026239	0.023380	-1.122310	0.2773
LNTGE	-0.022062	0.037936	-0.581558	0.5685
LNSSE	0.006373	0.004343	1.467373	0.1605
LNSSE(-1)	-0.001077	0.006811	-0.158199	0.8762
LNSSE(-2)	0.012243	0.005772	2.121087	0.0489**
LNODA	-0.018337	0.016620	-1.103326	0.2853
LNODA(-1)	-0.038699	0.017770	-2.177719	0.0438**
LNCPI	-0.013965	0.108505	-0.128700	0.8991
LNCPI(-1)	-0.197856	0.175526	-1.127217	0.2753
LNCPI(-2)	0.473676	0.168719	2.807491	0.0121**
D1	-0.014112	0.018528	-0.761700	0.4567
D2	0.024881	0.019520	1.274661	0.2196
D2(-1)	0.040430	0.022915	1.764389	0.0956*
C	6.168178	1.402220	4.398866	0.0004***

R-squared	0.999061	Mean dependent var	11.07910
Adjusted R-squared	0.997901	S.D. dependent var	0.722231
S.E. of regression	0.033087	Akaike info criterion	-3.681490
Sum squared resid	0.018611	Schwarz criterion	-2.743071
Log-likelihood	93.78906	Hannan-Quinn criter.	-3.344794
F-statistic	861.3726	Durbin-Watson stat	2.272350
Prob(F-statistic)	0.000000		

Notes: Sample period used for estimation is 1980 - 2020. The asterisks ***, ** and * marks statistical significance of coefficients at, 1, 5 and 10 percent level of significance respectively.

Source: Own computation using *EViews 10*, 2021.

4.3.4 Long-run ARDL Bounds Tests For Co-integration

To check the presence of co-integration, Pesaran, Shin, and Smith (2001) developed the bound test, which was later improved by Narayan (2005) for small sample sizes. Having lower and upper values, the Bound test depends on F-statistics. The value of F-statistics is computed using Wald-test from the null hypothesis by making long-run coefficients equal zero. If the computed F-statistics lies below the lower bound, the null hypothesis of no co-integration will be failed to be rejected. Contrarily, suppose the value is greater than the upper bound of the statistics. In that case, the null hypothesis of no co-integration is rejected to conclude the existence of the long-run relationship.

The following table presents the result from the bound test. 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 expenditure, health expenditure, total government expenditure, secondary school enrollment, official development assistance, consumer price index, drought, policy change.

Table 4- 4: ARDL Bound test for Long-run relationship

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	4.161872	10%	1.83	2.94
K	10	5%	2.06	3.24
		2.5%	2.28	3.5
		1%	2.54	3.86

Source: own computation using EViews 10.

F-statistics from the above table 4.3 reveal that the F- value (4.16) exceeds the upper bound values at all levels of significance. This leads us to reject the null hypothesis of no level relationship in favor of the alternative hypothesis. The evidence strongly confirms the existence of co-integration between the variables.

4.3.5 Long-run ARDL Model Estimation

This result indicates a long-run relationship among Real GDP, labor force, gross capital formation, education expenditure, health expenditure, total government expenditure, secondary school enrollment, official development assistance, consumer price index, D_1, and D_2 (drought and policy change). After confirming the existence of a long-run co-integration relationship among the variables, the estimated long-run relationship between the variables is estimated, and the estimated coefficients after normalizing on real GDP (RGDP) are reported in Table 4.4.

Table 4- 5: The Long-run ARDL parameter estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNLF	0.213836	0.139033	1.538021	0.1424
LNGCF	0.341793	0.041216	8.292720	0.0000***
LNEDX	0.076883	0.031692	2.425922	0.0267**
LNHEX	0.087692	0.056267	1.558506	0.0375**
LNTGE	-0.023153	0.039738	-0.582653	0.5678
LNSSE	0.018406	0.002784	6.611950	0.0000***
LNODA	-0.059858	0.023822	-2.512720	0.0224**
LNCPI	0.274811	0.082891	3.315335	0.0041***
D1	-0.014811	0.020473	-0.723423	0.4793
D2	0.068543	0.032472	2.110818	0.0499**
C	6.168178	1.402220	4.398866	0.0004***

R-squared	0.999061	Mean dependent var	11.07910
Adjusted R-squared	0.997901	S.D. dependent var	0.722231
S.E. of regression	0.033087	Akaike info criterion	-3.681490
Sum squared resid	0.018611	Schwarz criterion	-2.743071
Log-likelihood	93.78906	Hannan-Quinn criter.	-3.344794
F-statistic	861.3726	Durbin-Watson stat	2.272350
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

Notes: The sample period used for estimation is 1980 - 2020. The asterisks ***, **, and * mark statistical significance of coefficients at 1, 5, and 10 percent level of significance, respectively.

Source: Own computation using EViews 10, 2021.

Table 4.4 presents the long-run result of the ARDL model with the real gross domestic product (LNRGDP) as the dependent variable. In contrast, rest variables: Labor force (LNLF), gross capital formation (LNGCF), education expenditure (LNEDX), health expenditure (LNHEX), total government expenditure (LNTGE), secondary school enrollment (LNSSE), official development assistant (LNODA), consumer price index (LNCPI), drought (D1) and policy change (D2) are explanatory variables. All variables are expressed in logarithm form except dummy variables. The last variable, the drought dummy (D1)and policy change dummy (D2) is introduced. The dummy for economic policy changes takes one for the period 1980-2020 and zero otherwise. Similarly, if there are relatively good weather conditions, the drought dummy takes zero and one if there is a drought. Thus, we do not need to express the last two variables in logarithm form. Overall, these regressors explained the model 99.9 percent of the variation.

Now let us turn to describe each variable in terms of sign and statistical significance. In the long-run, the labor force (LNLF), total government expenditure (LNTGE), and drought dummy (D_1) are not statistically significant. Gross capital formation (LNGCF), secondary school enrollment (LNSSE), and consumer price index (LNCPI) are positive and found to be highly significant at a 1% level of significance. In addition, education expenditure (LNEDX), health expenditure (LNHEX), and policy change (D_2) are positive and significant at 5%.On the other hand, the official development assistant (LNODA) is negative and significant at 5%.

The coefficient of the dependent variable can be read as elasticity with respect to real GDP because the researcher provided the growth model in log-linear form. Gross capital formation is the main contributor to Real GDP. The coefficient of GCF is 0.341793, which indicates that holding other things constant in the long run, a one percent change in GCF brought a 0.341793 percent change in real GDP. According to Barro & X. Sala-i-Martin (1995), the predicted sign of the GCF coefficient is positive because capital accumulation favors real GDP growth by fostering the further development of new goods and services.

The coefficient of health is 0.087692, which indicates that keeping other things constant in the long run, a one % change in health (proxied by the ratio of health expenditure to GDP) brought a 0.087692 percent change in real GDP. Next to health, education has a significant long-run impact on the Ethiopian economy proxied by a one percent increase in education expenditure has resulted in a 0.076883 percent change in real GDP and a one percent increase in secondary school enrollment 0.018406 percent change in real GDP.

The findings of this study, which show that education and healthy human capital have a long-term positive influence, are consistent with endogenous growth theories (primarily promoted and developed by Lucas(1988), Romer(1990), Mankiw, et al. (1992). They argue that improvement in human capital (skilled and healthy workers) leads to productivity improvement that enhances output. Concerning the researches made in Ethiopia, the finding of this research is also similar to Teshome (2006), Tofik (2012), Kidanemariam (2015), Tewodros (2014), Dinkneh et al. (2015), and Shemsedin (2020).

Official development assistance has a significant negative impact on the Ethiopian economy. The finding of this research concerning ODA is also similar to the findings of Rajan & A. Subramanian (2005), Ekanayake et al. (2008), and Kidanemariam (2015). Labor force growth has no significant impact on real GDP, which is similar to the findings of Kidanemariam (2015). This is because of the combined effect of high population growth and low labor force productivity. CPI and policy change dummies have a positive impact on Ethiopian economic growth. This is consistent with the finding of Shemsedin (2020).

4.3.6 Short-run ARDL model estimation result

The short-run ECM model is computed once the long-run coefficients of the growth equation have been accepted. Estimating an error correction version of a model is reasonable once the long-run relationship between the variables is confirmed through a co-integration test.

Table 4- 6: ECM Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.168178	0.721084	8.554031	0.0000***
D(LNGCF)	0.064973	0.024677	2.632922	0.0174**
D(LNGCF(-1))	-0.187491	0.040788	-4.596668	0.0003***
D(LNHEX)	-0.012495	0.012768	-0.978635	0.3415
D(LNHEX(-1))	0.026239	0.013610	1.927873	0.0707*
D(LNSSE)	0.006373	0.002735	2.330218	0.0324**
D(LNSSE(-1))	-0.012243	0.003850	-3.179814	0.0055***
D(LNODA)	-0.018337	0.009722	-1.886114	0.0765*
D(LNCPI)	-0.013965	0.058662	-0.238053	0.8147
D(LNCPI(-1))	-0.473676	0.093163	-5.084405	0.0001***
D(D2)	0.024881	0.008829	2.818129	0.0118**
CointEq (-1)*	-0.952854	0.111745	-8.527036	0.0000***

R-squared	0.861643	Mean dependent var	0.056578
Adjusted R-squared	0.805276	S.D. dependent var	0.059496
S.E. of regression	0.026254	Akaike info criterion	-4.194311
Sum squared resid	0.018611	Schwarz criterion	-3.682446
Log-likelihood	93.78906	Hannan-Quinn criter.	-4.010658
F-statistic	15.28614	Durbin-Watson stat	2.272350
Prob(F-statistic)	0.000000		

Note: The dependent variable is DCPIt over the sample period 1981-2020. The asterisks ***, **, and * marks the statistical significance of coefficients at 1, 5, and 10 percent level of significance, respectively

Sources: own computation using EViews 10

Now let us turn to describe each variable in terms of sign and statistical significance. Gross capital formation D(LNGCF), secondary school enrollment D(LNSSE), and Policy change D(D_2) are positive and significant at 5%. Health expenditure at one lag period value (D(LNHEX(-1)) is positive and significant at 10%. Official development assistant, D(LNODA) is negative and significant at 10%. Consumer price index at one lag period value, D(LNCPI(-1)) is negative and significant at 1%. The coefficient of determination (R-squared) is high, explaining that about 86.16 % of the variation in the real GDP is attributed to variations in the explanatory variables in the model.

Furthermore, the DW statistic does not indicate autocorrelation, and the F-statistic is quite reliable. The equilibrium error correction coefficient estimated -0.9528 is highly significant, has the correct sign, and implies a very high speed of adjustment to equilibrium after a shock. Approximately 95.28 percent of the disequilibrium from the previous year's shock converges back to the long-run equilibrium in the current year. Such a 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 gross capital formation is the main contributor to real GDP change followed by policy change and secondary school enrollment. When secondary school enrollment increases by one percent, real GDP increases by 0.006373. The result of Dinkneh (2015) and Kidanemariam (2015) support this findings. Health has no significant short-run impact on the economy. This result is supported by the findings of Befikadu (2018) and Shemsedin (2020). But its one-period lag has a significant positive impact on the economy. When health expenditure (one lag period value) increases by one percent, real GDP increases by 0.026239; like its negative long-run effect, official development assistance has a significant effect on the economy in the short run.

4.3.7 Diagnostics and stability tests

The Diagnostics and stability tests are required to check the reliability of the estimated result. The most commonly used tests in dynamic models are normality, autocorrelation, heteroskedasticity, model specification, and stability tests. Such tests are undertaken to guarantee the regression of the model that the obtained results are free from spurious regression. Additionally, they warrant the robustness of the model. Summary statistics of these diagnostics tests are reported in the below table, but the actual output of these tests is attached in the paper's appendix heading.

Table 4- 7: Summary of diagnostics tests

Types of tests	F-statistics	Df	Prob.	Prob.Chi-Square
Breusch-Godfrey test	2.87	F(2,15)	0.0877	0.0645
Heteroskedasticity (BPG)	1.083605	F(21,17)	0.4383	0.3811
Heteroskedasticity (ARCH)	0.434389	F(1,36)	0.5140	0.5009
Normality test (JB-statistics)	0.63		0.72	
Ramsey RESET Test	1.186353	(1, 16)	0.2922	
Durbin-Watson test	2.27 (d-stat)			

Autocorrelation test

Conducting this test is needed because autocorrelation causes the variance of OLS estimates to be inefficient. This makes estimates of beta in the regression model underestimated. Therefore, testing whether the model regression suffered from this problem is essential. As indicated in the table, the model is not suffered from serial correlation. Breusch-Godfrey Lagrange multiplier test fails to reject the null hypothesis of no residual autocorrelation at a 5% significance level. In addition, Durbin-Watson's d-statistics lies between 1.7 and 2.3, which supports the evidence from the Breusch-Godfrey LM test. Besides, the d-statistics confirms the non-spuriousness of the regression since the value exceeds the adjusted R- squared.

Heteroskedastcity test

A heteroscedasticity problem arises when the variance of the error term is not constant. In other words, the distribution of the residual around the mean varies with time. In the presence of this problem, the OLS estimators are still consistent and unbiased, but it makes the minimum variance property of the OLS not to be maintained, Wooldridge (2013). Breusch-Pagan-Godfrey test from the above table 4.7 conveys that both standard (0.43) and Chi-squared probability (0.38) values are more significant than the 5% significance level. This result leads to the decision of failing to reject the null hypothesis of homoscedastic nature error variance. At F(1, 36) degrees of freedom, both standard (0.51) and Chi-squared (0.50) probabilities of the ARCH test support robustness of the result from the Breusch-Pagan-Godfrey test. Hence, we can conclude that the variance of the error term is uniformly distributed around the mean.

Normality Test

The Jarque-Bera (JB) probability was used to conduct a normality test of residuals. In the above diagnostics test summary table, the probability of JB (0.72) is much higher than the standard level of significance (see appendix to visualize the JB graph). Therefore, since the residuals are normality distributed, we can claim that the hypotheses of coefficient estimates are validly tested.

Model specification test

Ramsey RESET test checks whether the model is correctly specified or there exists omitted variable. The idea behind the test is to examine the constructed functional form between dependent and independent variables. The decision criterion is: accept the null hypothesis of no omitted variable if Ramsey RESET p-value is more significant than 0.05. Contrarily, if the p-value of the test becomes equal or less than 0.05, we conclude the model is miss-specified. As indicated in the above table, the result from this test shows RESET test p-value (0.29) highly exceeds the significance level. Thus, the specified model has no omitted variable(s).

Model stability test

The most commonly used to test the stability of the model is the Cumulative sum of squares of recursive (CUSUM). The test is based on the residuals from the recursive estimates and presented by figure.

Null hypothesis H_0: CUSUM distribution is asymmetrically centered at 0.

Alternative hypothesis H_1: CUSUM is not symmetrically distributed.

Decision rule: The null hypothesis of the normal distribution fails to be rejected when the graph of CUSUM statistics lies within the bounds of the critical region at a 5% level of significance, and the alternative hypothesis is not symmetrically distributed is accepted otherwise. The evidence from Figure 4.9 leads us to accept the null hypothesis that the cumulative sum of squares of recursive (CUSUM) is symmetrically distributed. At the same level of significance, the CUSUM test (see a non-squared version of the statistics in the appendix) confirms a similar result in robust support of model stability. Since the model passes all diagnostic tests and co-integration tests, both the long-run and short-run versions are now reasonably run.

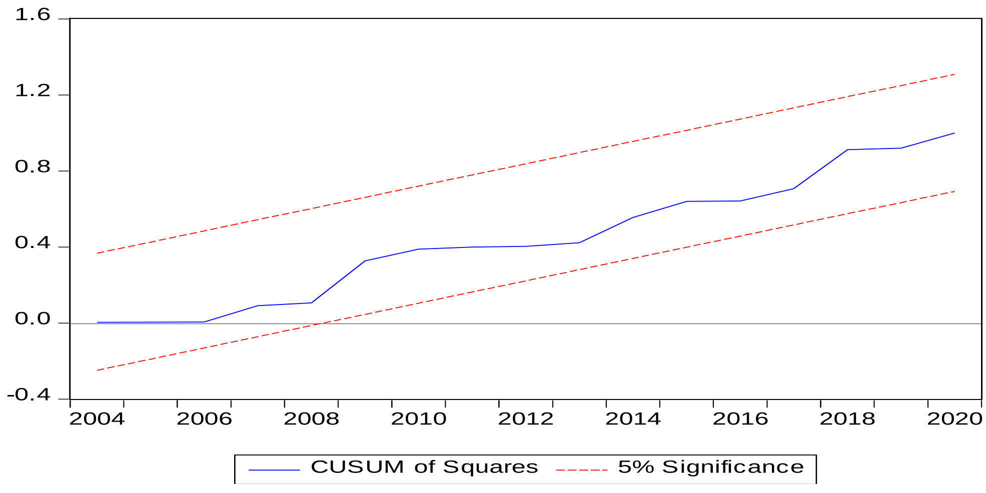

Figure 4- 10: CUSUM of Squares for model stability test
Source: Model diagnostics test result using Eview 10.

CHAPTER FIVE

CONCLUSIONS AND POLICY IMPLICATION

5.1 Conclusions

The study's objective was to analyze the impact of human capital on economic growth in Ethiopia using Real GDP as a proxy for economic growth over the period 1980-2020. To study the impact of human capital on economic growth (real GDP), the study has used the ARDL Approach to co-integration and the error correction model (ECM).

Bounds test results reveal that real GDP, education expenditure, health expenditure, labor force, gross capital formation, total government expenditure, official development assistance, secondary school enrollment, consumer price index, drought, and policy change have a stable long-run connection. The finding shows significant positive impact of human capital on economic growth by confirming direct positive relationship between economic growth and measures of human capital (education and health).

The main conclusion is that in the long run, gross capital formation followed by human health capital (as measured by the ratio of health expenditure to GDP) and human education capital (as measured by education expenditure and secondary school enrolment) are the most important contributors to the rise in Real GDP. In other words, the results show that as the ratio of expenditure on health services to GDP rises, when the ratio of education expenditure to GDP rises, and when secondary school enrolment rises, economic performance improves dramatically. Holding other things constant, the one percent change in health (proxied by health expenditure to real GDP) brought a 0.088 percent change in real GDP. Next to health, education has a significant long-run impact on the Ethiopian economy. One percent increase in education expenditure and secondary school enrolment has resulted in 0.077 percent and 0.02 percent change in Real GDP, respectively. However, Official development assistance a negative impact on the economy. Consumer price index (CPI) and policy change have a positive impact on Ethiopian economic growth

The findings of this research concerning the long-run analysis have a positive impact on education, and human health capital is consistent with the endogenous growth theories (mainly advocated and developed by Lucas (1988), Romer (1990), and Mankiw et al. (1992). Concerning the researches made in Ethiopia, the finding of this research is also similar to Teshome (2006), Tofik (2012), (Kidanemariam, 2015), Tewodros (2014), Dinkneh et al. (2015), and Shemsedin (2020).

The coefficient of error correction term in the short-run analysis is -0.9528, suggesting about 95.28 percent annual adjustment towards long-run equilibrium. This was another proof for the existence of a stable long-run relationship among the variables. The estimated short-run model reveals that gross capital formation is the main contributor to real GDP change followed by policy change and secondary school enrollment. When secondary school enrollment increases by one percent, real GDP increases by 0.006373. The result of Dinkneh (2015) and Kidanemariam (2015) support this findings. Health has no significant short-run impact on the economy. This result is supported by the findings of Befikadu (2018) and Shemsedin (2020). But its one-period lag has a significant positive impact on the economy. When health expenditure (one lag period value) increases by one percent, real GDP increases by 0.026239.

In the short-run, policy change is also a significant and positive effect on the economic growth of Ethiopia. Like its negative long-run effect, official development assistance has a significant effect on the economy in the short run. Consumer Price Index at one period lag has a negative and significant effect on the economic growth of Ethiopia. Therefore this study show that, there is long run and short run impact of human capital on economic growth of Ethiopia.

5.2 Policy Implications

The findings of this research have significant policy consequences. In to boost economic growth, expenditures on vital health services must be prioritized. Furthermore, more resources should be allocated to educating the country's inhabitants to accomplish economic progress. Furthermore, more resources should be allocated to educating the country's inhabitants in order to accomplish economic progress. These policies have a significant impact on human productivity, resulting in higher national output per capita. To put it another way, as more people get educated and healthier, their production will rise in the long run.

As a result, policymakers and the government should build institutional capacity that boosts school enrolment and enhances critical health services. That means the policymakers and government should secure more resources and structures essential for better school enrollment and improved primary 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 Ethiopia's education and health sectors that produce quality human resources. In addition, the government should also continue its leadership Impact in creating enabling environment that encourages 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 creating human capital in Ethiopia.

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APPENDICES

Regression results and diagnostic tests

Appendix 1: Lag length selection and unit root tests

1. Lag length selection

VAR Lag Order Selection Criteria
Endogenous variables: LNRGDP LNLF LNGCF LNEDX LNHEX LNTGE LNSSE LNODA LNCPI D1 D2
Exogenous variables: C
Date: 06/01/21 Time: 09:43
Sample: 1980 2020
Included observations: 39

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-141.8175	NA	7.02e-11	7.836796	8.306006	8.005145
1	205.3712	480.7229	8.07e-16	-3.762626	1.867891*	-1.742445
2	400.4398	160.0563*	9.89e-17*	-7.561017*	3.230806	-3.689004*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

2. Unit root test

a) ADF Unit root test

Null Hypothesis: Unit root (individual unit root process)
Series: LNRGDP, LNLF, LNGCF, LNEDX, LNHEX, LNSSE, LNTGE, LNODA, LNCPI, D1, D2
Date: 06/01/21 Time: 09:55
Sample: 1980 2020
Exogenous variables: Individual effects, individual linear trends
User-specified maximum lags
Automatic lag length selection based on AIC: 0 to 2
Total number of observations: 422
Cross-sections included: 11

Method	Statistic	Prob.**
ADF - Fisher Chi-square	216.015	0.0000
ADF - Choi Z-stat	-12.4149	0.0000

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Intermediate ADF test results D(UNTITLED)

Series	Prob.	Lag	Max Lag	Obs
D(LNRGDP)	0.0009	1	2	38
D(LNLF)	0.0803	0	2	39
D(LNGCF)	0.0000	0	2	39
D(LNEDX)	0.0001	0	2	39
D(LNHEX)	0.0000	0	2	39

D(LNSSE)	0.0007	0	2	39
D(LNTGE)	0.0001	1	2	38
D(LNODA)	0.0002	1	2	38
D(LNCPI)	0.0007	0	2	39
D(D1)	0.0000	2	2	37
D(D2)	0.0000	2	2	37

b) Philips- Perron unit root test

Null Hypothesis: Unit root (individual unit root process)
Series: LNRGDP, LNLF, LNGCF, LNEDX, LNHEX, LNSSE, LNTGE, LNODA, LNCPI, D1, D2
Date: 06/01/21 Time: 09:57
Sample: 1980 2020
Exogenous variables: Individual effects
Newey-West automatic bandwidth selection and Bartlett kernel
Total (balanced) observations: 429
Cross-sections included: 11

Method	Statistic	Prob.**
PP - Fisher Chi-square	243.389	0.0000
PP - Choi Z-stat	-13.4878	0.0000

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Intermediate Phillips-Perron test results D(UNTITLED)

Series	Prob.	Bandwidth	Obs
D(LNRGDP)	0.0001	4.0	39
D(LNLF)	0.0232	1.0	39
D(LNGCF)	0.0000	3.0	39
D(LNEDX)	0.0000	2.0	39
D(LNHEX)	0.0000	2.0	39
D(LNSSE)	0.0001	4.0	39
D(LNTGE)	0.0000	3.0	39
D(LNODA)	0.0000	2.0	39
D(LNCPI)	0.0004	3.0	39
D(D1)	0.0001	38.0	39
D(D2)	0.0001	18.0	39

Appendix 2: ARDL regression output

Dependent Variable: LNRGDP
Method: ARDL
Date: 06/01/21 Time: 09:20
Sample (adjusted): 1982 2020
Included observations: 39 after adjustments
Maximum dependent lags: 1 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (2 lags, automatic): LNLF LNGCF LNEDX LNHEX
LNTGE LNSSE LNODA LNCPI D1 D2
Fixed regressors: C
Number of models evalulated: 59049
Selected Model: ARDL(1, 0, 2, 0, 2, 0, 2, 1, 2, 0, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNRGDP(-1)	0.047146	0.209278	0.225278	0.8244
LNLF	0.203755	0.124250	1.639882	0.1194
LNGCF	0.064973	0.044204	1.469838	0.1599
LNGCF(-1)	0.073215	0.055936	1.308910	0.2080
LNGCF(-2)	0.187491	0.058864	3.185131	0.0054
LNEDX	0.073258	0.025716	2.848781	0.0111
LNHEX	0.012495	0.024793	0.503981	0.0207
LNHEX(-1)	-0.044823	0.028709	-1.561295	0.1369
LNHEX(-2)	-0.026239	0.023380	-1.122310	0.2773
LNTGE	-0.022062	0.037936	-0.581558	0.5685
LNSSE	0.006373	0.004343	1.467373	0.1605
LNSSE(-1)	-0.001077	0.006811	-0.158199	0.8762
LNSSE(-2)	0.012243	0.005772	2.121087	0.0489
LNODA	-0.018337	0.016620	-1.103326	0.2853
LNODA(-1)	-0.038699	0.017770	-2.177719	0.0438
LNCPI	-0.013965	0.108505	-0.128700	0.8991
LNCPI(-1)	-0.197856	0.175526	-1.127217	0.2753
LNCPI(-2)	0.473676	0.168719	2.807491	0.0121
D1	-0.014112	0.018528	-0.761700	0.4567
D2	0.024881	0.019520	1.274661	0.2196
D2(-1)	0.040430	0.022915	1.764389	0.0956
C	6.168178	1.402220	4.398866	0.0004

R-squared	0.999061	Mean dependent var	11.07910
Adjusted R-squared	0.997901	S.D. dependent var	0.722231
S.E. of regression	0.033087	Akaike info criterion	-3.681490
Sum squared resid	0.018611	Schwarz criterion	-2.743071
Log-likelihood	93.78906	Hannan-Quinn criter.	-3.344794
F-statistic	861.3726	Durbin-Watson stat	2.272350
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

1. Bound test and Long-run equation form

ARDL Long-run Form and Bounds Test
Dependent Variable: D(LNRGDP)
Selected Model: ARDL(1, 0, 2, 0, 2, 0, 2, 1, 2, 0, 1)
Case 3: Unrestricted Constant and No Trend
Date: 06/01/21 Time: 09:23
Sample: 1980 2020
Included observations: 39

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.168178	1.402220	4.398866	0.0004
LNRGDP(-1)*	-0.952854	0.209278	-4.553051	0.0003
LNLF**	0.203755	0.124250	1.639882	0.1194
LNGCF(-1)	0.325679	0.078047	4.172862	0.0006
LNEDX**	0.073258	0.025716	2.848781	0.0111
LNHEX(-1)	-0.083558	0.046149	-1.810612	0.0879
LNTGE**	-0.022062	0.037936	-0.581558	0.5685
LNSSE(-1)	0.017538	0.003304	5.307585	0.0001
LNODA(-1)	-0.057036	0.019059	-2.992645	0.0082
LNCPI(-1)	0.261855	0.082209	3.185223	0.0054
D1**	-0.014112	0.018528	-0.761700	0.4567
D2(-1)	0.065311	0.032168	2.030337	0.0583
D(LNGCF)	0.064973	0.044204	1.469838	0.1599
D(LNGCF(-1))	-0.187491	0.058864	-3.185131	0.0054
D(LNHEX)	-0.012495	0.024793	-0.503981	0.6207
D(LNHEX(-1))	0.026239	0.023380	1.122310	0.2773
D(LNSSE)	0.006373	0.004343	1.467373	0.1605
D(LNSSE(-1))	-0.012243	0.005772	-2.121087	0.0489
D(LNODA)	-0.018337	0.016620	-1.103326	0.2853
D(LNCPI)	-0.013965	0.108505	-0.128700	0.8991
D(LNCPI(-1))	-0.473676	0.168719	-2.807491	0.0121
D(D2)	0.024881	0.019520	1.274661	0.2196

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 3: Unrestricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNLF	0.213836	0.139033	1.538021	0.1424
LNGCF	0.341793	0.041216	8.292720	0.0000
LNEDX	0.076883	0.031692	2.425922	0.0267
LNHEX	0.087692	0.056267	1.558506	0.0375
LNTGE	-0.023153	0.039738	-0.582653	0.5678
LNSSE	0.018406	0.002784	6.611950	0.0000
LNODA	-0.059858	0.023822	-2.512720	0.0224
LNCPI	0.274811	0.082891	3.315335	0.0041
D1	-0.014811	0.020473	-0.723423	0.4793
D2	0.068543	0.032472	2.110818	0.0499

EC = LNRGDP - (0.2138*LNLF + 0.3418*LNGCF + 0.0769*LNEDX -0.0877
*LNHEX -0.0232*LNTGE + 0.0184*LNSSE -0.0599*LNODA + 0.2748
*LNCPI -0.0148*D1 + 0.0685*D2)

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	4.161872	10%	1.83	2.94
k	10	5%	2.06	3.24
		2.5%	2.28	3.5
		1%	2.54	3.86
			Finite Sample: n=40	
Actual Sample Size	39			
		10%	-1	-1
		5%	-1	-1
		1%	-1	-1
			Finite Sample: n=35	
		10%	-1	-1
		5%	-1	-1
		1%	-1	-1

Appendix 3: ARDL Short-run form (ECM)

ARDL Error Correction Regression
Dependent Variable: D(LNRGDP)
Selected Model: ARDL(1, 0, 2, 0, 2, 0, 2, 1, 2, 0, 1)
Case 3: Unrestricted Constant and No Trend
Date: 06/01/21 Time: 09:25
Sample: 1980 2020
Included observations: 39

ECM Regression
Case 3: Unrestricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.168178	0.721084	8.554031	0.0000
D(LNGCF)	0.064973	0.024677	2.632922	0.0174
D(LNGCF(-1))	-0.187491	0.040788	-4.596668	0.0003
D(LNHEX)	-0.012495	0.012768	-0.978635	0.3415
D(LNHEX(-1))	0.026239	0.013610	1.927873	0.0707
D(LNSSE)	0.006373	0.002735	2.330218	0.0324
D(LNSSE(-1))	-0.012243	0.003850	-3.179814	0.0055
D(LNODA)	-0.018337	0.009722	-1.886114	0.0765
D(LNCPI)	-0.013965	0.058662	-0.238053	0.8147
D(LNCPI(-1))	-0.473676	0.093163	-5.084405	0.0001
D(D2)	0.024881	0.008829	2.818129	0.0118
CointEq(-1)*	-0.952854	0.111745	-8.527036	0.0000

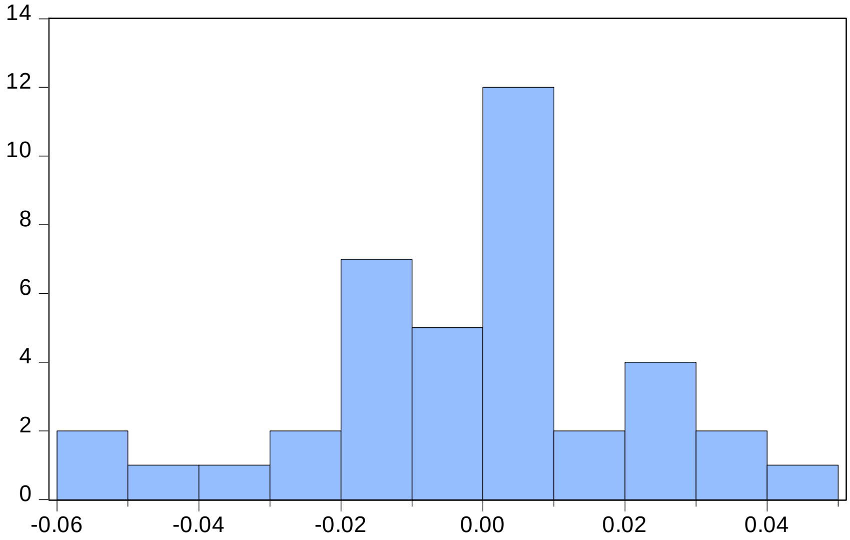
R-squared	0.861643	Mean dependent var	0.056578
Adjusted R-squared	0.805276	S.D. dependent var	0.059496
S.E. of regression	0.026254	Akaike info criterion	-4.194311
Sum squared resid	0.018611	Schwarz criterion	-3.682446
Log-likelihood	93.78906	Hannan-Quinn criter.	-4.010658
F-statistic	15.28614	Durbin-Watson stat	2.272350
Prob(F-statistic)	0.000000		

* p-value incompatible with t-Bounds distribution.

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	4.161872	10%	1.83	2.94
k	10	5%	2.06	3.24
		2.5%	2.28	3.5
		1%	2.54	3.86

Appendix 4: Diagnostics tests

a) Normality test



Series: Residuals	
Sample 1982 2020	
Observations 39	
Mean	-7.06e-16
Median	0.001286
Maximum	0.048057
Minimum	-0.051482
Std. Dev.	0.022130
Skewness	-0.288508
Kurtosis	3.238852
Jarque-Bera	0.633748
Probability	0.728422

b) Serial correlation test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	2.875382	Prob. F(2,15)	0.0877
Obs*R-squared	10.80827	Prob. Chi-Square(2)	0.0645

c) Heteroskedasticity

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.083605	Prob. F(21,17)	0.4383
Obs*R-squared	22.32315	Prob. Chi-Square(21)	0.3811
Scaled explained SS	4.748096	Prob. Chi-Square(21)	0.9999

ARCH TEST

Heteroskedasticity Test: ARCH

F-statistic	0.434389	Prob. F(1,36)	0.5140
Obs*R-squared	0.453055	Prob. Chi-Square(1)	0.5009

Appendix 5: Stability test

5.1 Model specification test

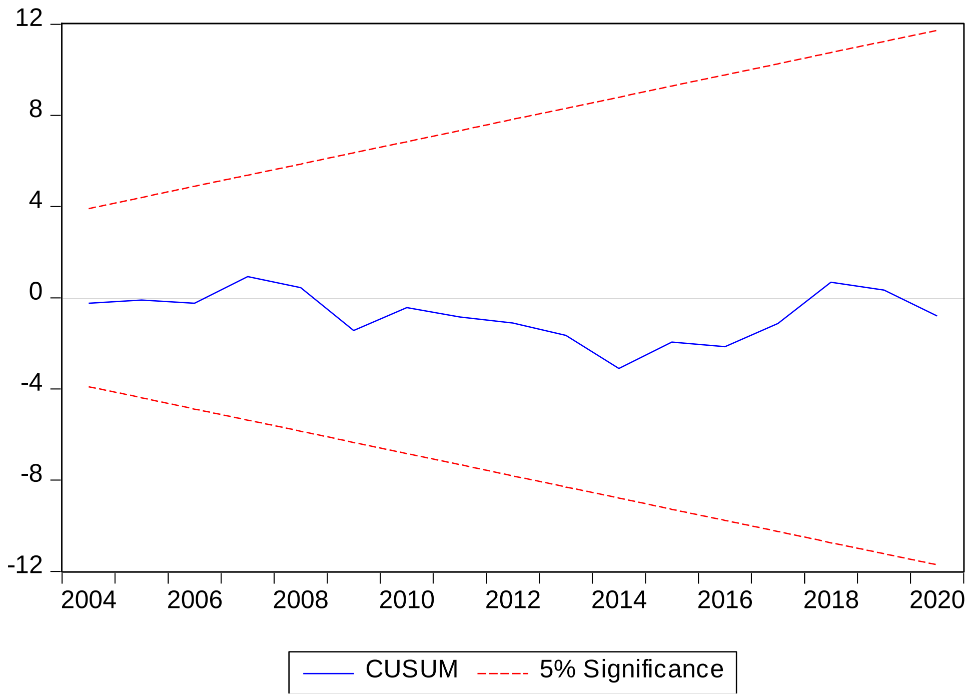
Ramsey RESET Test
Equation: UNTITLED
Specification: LNRGDP LNRGDP(-1) LNLF LNGCF LNGCF(-1) LNGCF(-2) LNEDX LNHEX LNHEX(-1) LNHEX(-2) LNTGE LNSSE LNSSE(-1) LNSSE(-2) LNODA LNODA(-1) LNCPI LNCPI(-1) LNCPI(-2) D1 D2 D2(-1) C
Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	1.089199	16	0.2922
F-statistic	1.186353	(1, 16)	0.2922

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	0.001285	1	0.001285
Restricted SSR	0.018611	17	0.001095
Unrestricted SSR	0.017326	16	0.001083

5.2 CUSUM test



5.3 CUSUM of Square test