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The Impact of Human Capital Development on Economic Growth in Ethiopia: *Evidence from ARDL Approach to Co-Integration*

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Abstract
The main objective of the study is to analyze the impact of human capital on economic growth in Ethiopia. The methodology used in this research is ARDL Approach to Co-integration. The finding of this research shows that there is a stable long run relationship between real GDP per capita, education human capital, health human capital, labor force, gross capital formation, government expenditure and official development assistance. The estimated long run model indicates that human capital in the form of health have big positive impact on real GDP per capita rise followed by education human capital. Such findings are consistent with the endogenous growth theories. In the short run, the coefficient of the error correction term is -0.7366 suggesting about 73.66 percent annual adjustment towards long run equilibrium. The findings of this paper imply that an economic performance can be improved significantly when the ratio of public expenditure on health to GDP increases and when secondary school enrolments get better.
Keywords: Economic Growth, Human capital, Education, Health, ARDL method of Co-integration.

1. INTRODUCTION

With its large reserves of human and natural resources, Ethiopia should have been a prosperous economy. However, it is one of the poorest countries in the world manifested by low per capita income and low human development index. (Word Bank, 2011; UNDP, 2011).

Modern theory of economic growth argues that human capital, especially education and health has the principal role on achieving economic growth and development (Gyimah-Brempong and Wilson, 2005). In line with this, Ethiopia has devoted much resource and efforts to the education and health sectors anticipating productivity improvement of the citizens and thereby economic growth. These resources are cost to the society not only because they are resources but also because they have alternative uses. Therefore, investigating the relationship between human capital (resources devoted to this sector) and economic growth may be a big concern to policy makers. As a result, the main objective of the study is to investigate the impact of human capital development on economic growth in Ethiopia over the period 1974/75-2010/11. In line with this general objective, the study will try to answer the following research questions:

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

Some researchers have attempted to investigate the relationship between human capital development and economic growth in Ethiopia. For instance, using school enrollment as a proxy for human capital, Seid (2000) found an insignificant impact of human capital on output level. Similarly Wubet (2006) has got the same result that proves the non-existence of any relationship between the two macroeconomic variables. But, their approach of measuring human capital ignores the health aspect of human capital development, while both education and health are an important component of human capital. On the other hand, using public spending on education and health sector as a proxy for investment in human capital development, Teshome (2006) found a positive impact of human capital development on economic growth in Ethiopia. This finding is reinforced by Tofik (2012) who found a positive and significant relationship between capital spending on human capital and economic growth. But both of them didn't show the separate impact of the health and education sector on economic growth. In addition, Tofik (2012) failed to incorporate the recurrent human capital expenditure account of the government.

Since both education and health are important elements of human capital, using both indicators is relatively better measure of human capital than using education or health indicators alone. Therefore, the author of this paper has used both the education and health indicators so as to empirically analyze the effects of human capital development on economic growth. To do this, secondary school enrolment rate and the ratio of public expenditure on health to GDP were taken as a proxy for human capital in the form of education and human capital in the form of health, respectively.

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

2. Empirical Literature

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

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

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

Some scholars like; Barro (1966; 2013) has formulated a model that includes physical capital inputs, level of education, health capital, and the quantity of hours worked. The model assumes that "people are born with initial endowments of health which depreciate with age and increases with investment in health." Based on his analysis, he concluded that an increase in health indicators or lowers the rate of depreciation of health capital. Taking life expectancy as an indicator of health, Bloom Canning, and Sevilla (2004) also found a strong positive and statistically significant effect on output. They suggest that each additional year of life expectancy improves the productivity of workers and leads to an increase of 4% in production.

Gyimah- Brempong and Wilson (2005) and Odior (2011) also argued that education captures just one aspect of human capital. Strauss and Thomas (1998) also argued that health explains the variations in wages at least as much as education. Gyimah-Brempong and Wilson (2005) find that health capital indicators positively influence aggregate output. They find that about 22 to 30 percent of the growth rate is attributed to health capital, and improvements in health conditions equivalent to one more year of life expectancy are associated with higher GDP growth of up to four percentage points per year.

Using other indicators of human capital, some researchers have analyzed the relationship between the two macroeconomic variables. For example, Odior (2011) made a research in Nigeria to provide empirical evidence on whether government expenditure on health can lead to economic growth or not. He used an integrated sequential dynamic computable general equilibrium (CGE) model and found a significant relationship between economic growth and government expenditure on health sector. In addition, taking government recurrent and capital expenditures on education and health, Oluwatobi & Ogunrinola (2011) and Umaru (2011) have made an econometric analysis in Nigeria , over the period 1970-2008 and 1977- 2007 respectively, to analyze the

relationship between government spending on education and health and economic growth. Kefela and Rena (2007) who made their study on North East African States also showed that 40 percent to 60 percent of growth rates in per capita GDP were resulted from investment in human capital.
Many researchers have used both of the education and health measures as a proxy for human capital. For instance, Karagiannis & Benos (2009) have used enrolment rates, student-teacher ratios for the educational indicators and number of medical doctors and hospital beds for the health indicators. On the other hand, Qadri and Waheed 2011) have used education indicator (enrolment rates) and health indicator (share of total government expenditure on health to GDP). Barro (2003) has also measured human capital using education (educational attainment) and health (life expectancy). Measuring human capital by taking both the education and health indicators are relatively better measure of human capital than using education or health indicators alone. Because it expresses the notion that both education and health are an important elements of human capital.

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

3. The Model, Method of estimation and Data description

3.1 The Model

Different scholars have designed conceptual frameworks that incorporate human capital as one of the determinant factors of economic growth differently. Among those scholars, Mankiw, Romer and Weil (1992) and Weil (2009) has accommodated human capital as an independent factor of production in their empirical analysis. Griffin and Knight (1990) as cited by Appleton and Teal (1998) has also used health and education as determinants of GDP per capita assuming education, good health and longevity are valuable output determinants. These researchers have employed the human capital augmented Solow growth model (Cobb- Douglas production function) as their framework, specifying output per worker as dependent variable while labor, physical capital and human capital are dependent variables.
Therefore, based on this theoretical framework developed by Mankiw, Romer and Weil (1992), the following empirically estimable log-linear type of model (with some modification to accommodate other additional variables) is specified.

$$\mathrm{LnGDPPC}_t = f(LnLAB_t, LnGCF_t, LnEHC_t, LnHHC_t, LnGOEX_t, LnODA_t, D_1, D_2) \ldots..(1)$$

Where:

$\mathrm{LnGDPPC}_t$ = Natural logarithm of real GDP per capita at time *t*.
LnLAB_t = Natural logarithm of labor force growth rate at time *t*.
LnGCF_t = Natural logarithm of gross capital formation at time *t*.
LnEHC_t = Natural logarithm of education human capital at time *t*.
LnHHC_t = Natural logarithm of health human capital at time *t*.
LnGOEX_t = Natural logarithm of total government expenditure at time *t*
LnODA_t = Natural logarithm of official development assistance at time *t*.
D_1 and D_2 are dummy variables for policy change and recurrent drought

3.2 Method of analysis

In this study, the **Autoregressive Distributed Lag (ARDL)** approach to cointegration , which is proposed by Pesaran and Shin (1997, 1999) and Pesaran, Shin, and Smith (2001) is used to test the long-run co-integration relationships between variables. Because, this approach has a lot of advantages over the Johansen maximum Likelihood (1988) cointegration method. Therefore, the following ARDL model is specified.

$$\begin{aligned}\Delta \mathrm{LnGDPPC}_t &= \beta_o + \lambda_1 \mathrm{LnGDPPC}_{t-1} + \lambda_2 \mathrm{LnLAB}_{t-1} + \lambda_3 \mathrm{LnGCF}_{t-1} \\ &+ \lambda_4 \mathrm{LnEHC}_{t-1} + \lambda_5 \mathrm{LnHHC}_{t-1} + \lambda_6 \mathrm{LnGOEX}_{t-1} + \lambda_7 \mathrm{LnODA}_{t-1} \\ &+ \beta_1 \sum_{i=1}^{n} \Delta \mathrm{LnGDPPC}_{t-i} + \beta_2 \sum_{i=0}^{n} \Delta \mathrm{LnLAB}_{t-i} + \beta_3 \sum_{i=0}^{n} \Delta \mathrm{LnGCF}_{t-i} \\ &+ \beta_4 \sum_{i=0}^{n} \Delta \mathrm{LnEHC}_{t-i} + \beta_5 \sum_{i=0}^{n} \Delta \mathrm{LnHHC}_{t-i} + \beta_6 \sum_{i=0}^{n} \Delta \mathrm{LnGOEX}_{t-i} \\ &+ \beta_7 \sum_{i=0}^{n} \Delta \mathrm{LnODA}_{t-i} + \beta_8 t + \beta_9 D_1 + \beta_{10} D_2 + e_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots. (2)\end{aligned}$$

Where:

$LnGDPPC_t$ = Natural logarithm of real GDP per capita at time *t*.
$LnLAB_t$ = Natural logarithm of labor force growth rate at time *t*.
$LnGCF_t$ = Natural logarithm of gross capital formation at time *t*.
$LnEHC_t$ = Natural logarithm of education human capital at time *t*.
$LnHHC_t$ = Natural logarithm of health human capital at time *t*.
$LnGOEX_t$ = Natural logarithm of total government expenditure at time *t*
$LnODA_t$ = Natural logarithm of official development assistance at time *t*.
D_1 and D_2 are dummy variables for policy change and recurrent drought
$\lambda_1, \lambda_2, \lambda_3, \lambda_4, \lambda_5, \lambda_6,$ and λ_7 are coefficients that measure long run relationships.
$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6,$ and β_7 are coefficients that measure short run relationships.
e_t is an error term and n denotes lag length of the autoregressive process.
t is the time trend of the model.

To test whether there is a long run equilibrium relationship between the variables; **bounds test for co-integration** is carried out as proposed by Pesaran and Shin (1999) and Pesaran, Shin, and Smith (2001).
After confirming the existence of long-run relationship among the variables, the following stable long-run model is estimated:

$$
\begin{aligned}
LnGDPPC_t = \beta_0 + \beta_1 \sum_{i=1}^{n} LnGDPPC_{t-i} + \beta_2 \sum_{i=0}^{n} LnLAB_{t-i} \\
+\beta_3 \sum_{i=0}^{n} LnGCF_{t-i} + \beta_4 \sum_{i=0}^{n} LnEHC_{t-i} + \beta_5 \sum_{i=0}^{n} LnHHC_{t-i} \\
+ \beta_6 \sum_{i=0}^{n} LnGOEX_{t-i} + \beta_7 \sum_{i=0}^{n} LnODA_{t-i} + \beta_8 t + \beta_9 D_1 + \beta_{10} D_2 + v_t \ldots\ldots (3)
\end{aligned}
$$

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

$$
\begin{aligned}
\Delta LnGDPPC_t = \beta_o + \beta_1 \sum_{i=1}^{a} \Delta LnGDPPC_{t-i} + \beta_2 \sum_{i=0}^{b} \Delta LnLAB_{t-i} \\
+\beta_3 \sum_{i=0}^{c} \Delta LnGCF_{t-i} + \beta_4 \sum_{i=0}^{d} \Delta LnEHC_{t-i} + \beta_5 \sum_{i=0}^{e} \Delta LnHHC_{t-i} \\
+\beta_6 \sum_{i=0}^{f} \Delta LnGOEX_{t-i} + \beta_7 \sum_{i=0}^{g} \Delta LnODA_{t-i} + \beta_8 t + \beta_9 D_1 \\
+\beta_{10} D_2 + \delta\, ECT_{t-1} + u_t \ldots\ldots (4)
\end{aligned}
$$

Where:

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6,$ and β_7 are coefficients that represent the short run dynamics of the model. ECT_{t-1} is error correction term lagged by one period. u_t is vector of white noise error terms and $(a-g)$ denotes the optimal lag length of each variable in the autoregressive process. D_1 and D_2 are dummy variables for policy change and recurrent drought. δ is error correction parameter that measure the speed of adjustment towards the long run equilibrium.

After estimating the long run and short run model, misspecification test, normality test, serial correlation test, heteroscedasticity test and cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) test for stability of the model is undertaken to check the robustness of the model. In order to estimate the models and to perform the pre-estimation and post-estimation diagnostic tests, *Microfit4.1* and *Eviews6* statistical packages are used.

3.3 Data Sources and description

The study has used 37 years annual data from 1975-2011. Most of the data are collected from Ministry of Finance and Economic Development (MOFED), Ethiopian Economic Association (EEA) and National Bank of Ethiopia (NBE). Some of the data are also collected from international organizations (such as, UNCTAD and World Bank CD–ROM). The descriptions and measurements of the variables explained as follows:

i. ***Real GDP Per Capita (GDPPCt)***

Like the studies made by Mankiw , Romer and Weil (1992), Barro and Lee (1993), Benhabib and Spiegel (1994) and Barro and Sala-i-Martin (1995; 2004), Real GDP per capita is taken as a proxy for economic growth (dependent variable).

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

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

iii. Labor

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

iv. Human Capital Development

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

v. Ratio of Government Expenditure to Real GDP

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

vi. Ratio of Official Development Assistance to Real GDP

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

vii. Dummy Variable

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

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

4. RESULTS AND DISCUSSION

4.1 Augmented Dicky-Fuller Unit Root Test

In order to determine the degree of stationarity, a unit root testing is carried out through the standard Augmented Dicky-Fuller (ADF) test. This test was undertaken to check the order of integration of the variables. The test was done for two alternative specifications. First it is tested with constant but no trend, and then it is tested with constant and trend (See Table.1).

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

Table 1: ADF unit root test results

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

Source: Author's Calculations.

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

4.2 Long run ARDL Bounds Tests For Co-integration

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

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

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

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

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

Table 5. Bounds test for co-integration analysis

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

Source: Author's Calculations.

4.3. Long-run Model Estimation.

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

As it is shown in Table-6, the estimated coefficients of the labor force, health human capital and education human capital, policy change dummy and drought dummy have the hypothesized signs while gross capital formation, government expenditure and official development assistance have unexpected signs.

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

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

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

Source: Author's Calculations.

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

In addition, the estimated coefficients of education human capital, health human capital, government expenditure, official development assistance, and drought dummy are statistically significant while labor force, gross capital formation, and policy dummy are not statistically significant.

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

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

4.3.1 Long-run diagnostic tests

To check the verifiability of the estimated long run model, some diagnostic test is undertaken. The results reported in Table-7 indicate that there is no error autocorrelation and heteroskedasticity, and the errors are normally distributed.

Table 7. Long-run diagnostic tests

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

Source: Author's Calculations.

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

The Ramsey functional form test confirms that the model is stated well .Hence; the relationship between the variables is verifiable or valid. In addition to the above diagnostic tests, the stability of long run estimates has been tested by applying the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) test. Such tests are recommended by Pesaran and Shin (1999, 2001).

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

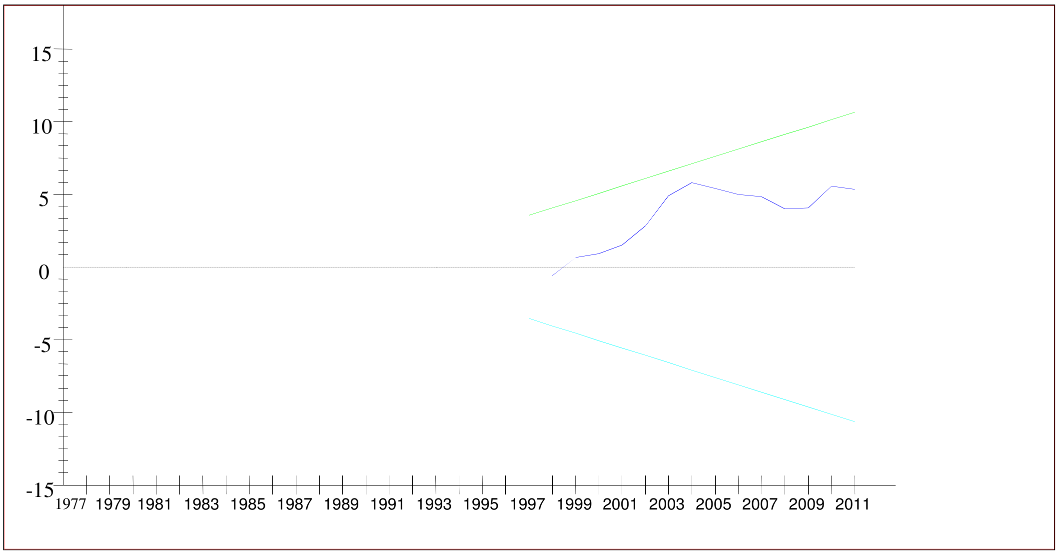

Fig 5. Plot of the cumulative sum of recursive residuals

Source: Author Calculations.

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

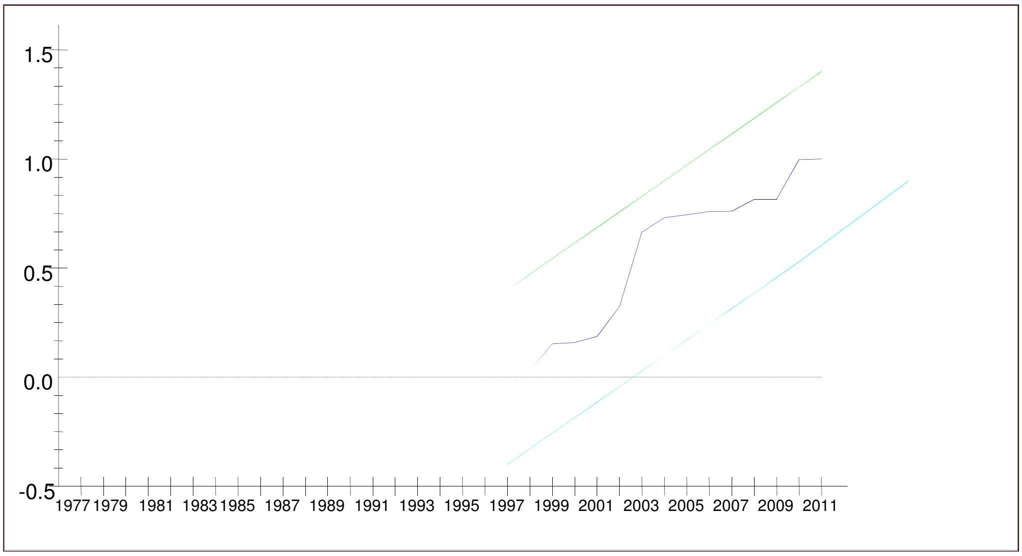

Fig 6. Plot of cumulative sum of squares of recursive residuals
Source: Author Calculations.
Note: The straight lines represent critical bounds at 5% significance level

The results of both CUSUM and CUSUMSQ test are reported in Figures 5 and 6 above. As can be seen from the first figure, the plot of the CUSUM test did not cross the critical limits. Similarly, the CUSUMSQ test shows that the graphs do not traverse the lower and upper critical limits. So, we can conclude that those long and short runs estimates are stable. Hence the results of the estimated model are reliable and efficient

4.4. Short run Error Correction Estimates

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

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

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

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

Where , *ECM* = RGDP-0.097240*LAB+ 0.74489*PCAP-0.50965*EHC-0.59292*HHC +0.45653*GOEX +0.17643*ODA -0.0080438* D1 + 0 .16527* D2 -4.2287* constant + 0.013072*Trend

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

Source: Author's Calculations.

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

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

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

*4.4.1 **Short-run diagnostic tests***

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

Table 9.Short run diagnostic test

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

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

4.5 The Pairwise Granger Causality Results

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

Table 10. Pairwise granger causality test

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

Source: Author's Calculations.
Note: The signs *** and ** indicate the significance of the coefficients at 1% and 5% level of significance respectively.

There is a Uni-directional causal relationship from health to real GDP per capita while a Bi-directional relationship is identified between real GDP per capita and education. The bidirectional relationship between real GDP per capita and education implies that education (secondary school enrolment) is not only the cause for real GDP per capita change but it is also an effect.

5. CONCLUSION AND POLICY IMPLICATION

5.1 Conclusion

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

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

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

5.2 Policy Implication

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

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

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