HUMAN CAPITAL, REGULATORY EFFICIENCY AND ECONOMIC GROWTH IN ETHIOPIA

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ABSTRACT

This study is based on a time-series data spanning from 1995 to 2019. In this study, we aim to contribute to the existing pool of literatures on the human capital and economic growth nexus in Ethiopia by emphasizing the importance of essential variables related to Regulatory Efficiency (institutional capability). The augmented Solow human-capital-growth model, the Auto Regressive Distributed Lag (ARDL) model and the Error Correction Method (ECM) are used for model specification, estimation, and adjustment of short-run errors respectively. Further tests of residual diagnostics and model stability are employed. In summary, the empirical findings of the study revealed that when an often-omitted variable bias, i.e., a regulatory efficiency is incorporated into the growth model, a long-run and stable relationship among education human capital, gross capital formation and regulatory efficiency with Gross Domestic Product (GDP) is established; structural stability of the model is confirmed. The residual diagnostic tests revealed that the residuals are not-serially correlated and that they are homoscedastic. The study further sheds light on the importance of the assumption that development in human capital and improvement of institutional capability should go hand in hand implying that inconsistent results in previous empirical studies on human capital and growth nexus are contributed in part by an omitted variable bias.

Keywords: Human Capital, Regulatory Efficiency, Institutional Capability, Economic Growth

INTRODUCTION

A nation's human capital endowment, the skills and capacities that reside in people and are put into productive use can be key determinants of its long-term economic success than virtually any other resources (World Economic Forum, 2016). Early neoclassical economic growth models

are based on the assumption that physical capital accumulation and technology play critical roles for economic growth. This is clearly indicated in Harrod (1939) and Domar (1946) models of economic growth cited in Todaro (2010) explain that countries with higher saving rate will grow faster than those with lower saving rates.

Capital accumulation results when some proportion of present income is saved and invested in order to augment future output and income (Todaro, 2012). Human capital is the term economists often use for education, health, and other human capacities that can raise productivity when increased "ibid". This way, human capital and its development in the growth equation can be understood as improving national economic performance through identifying and developing technology-friendly talent pool, acquiring requisite knowledge, identifying innovative skillsets and creating linkages between the human capital development program and the production process either by direct or indirect engagement.

With advance of technology and improvement of computerized systems at a rapid pace, bridging geographical divide and easing business processes, today's highly digitalized business world requires organizational structures to transform and adapt to changes at a speed of light leading to an efficient and effective institutional flexibility that would yield results and suitable for the operation of skilled human capital for increased productivity and innovation. Against the preceding argument, investment in education is an important and second to none decision at the table of policy makers . Investment in education can contribute to growth in two ways. First educated labor force can directly participate in the production process as a productive factor. In this sense, the accumulation of human capital directly generates the growth of output. According to Maria Jesus (2001), this is called the level effect (input level effect). On the other hand, human capital can also contribute to raising

technical progress (growth effect) since education can ease innovation, diffusion and adoption of new technologies thereby increasing productivity "Ibid". According to Mankiw (2013), improved education helps families escape some of the vicious circles of poverty in which they are trapped in. This suggests that economies that are growing rapidly are the ones that have given direct attention to their human capital and hence "…differences in income then must come from differences in capital, labor, and technology" (Mankiw 2013). With increased level of income, it is obvious that people and governments could have more to spend on education and hence human capital and with higher education level improved economic performance and per capita income are plausible.

This study endeavors to look at the relationship between human capital development and economic growth in Ethiopia by explaining the importance of key variables in relation to institutional capabilities in the growth equation. It considers investment in education as an aspect of human capital development. The results of the study are believed to contribute insights to the existing knowledge and understanding of the human capital economic growth nexus. Finally, the study is also believed to provoke a new challenge for future studies on the topic.

Education has been an issue of priority for the government of Ethiopia in the last three decades. This is evident from the fact that the country's education system has expanded rapidly in the decades after the overthrow of the Derg in 1991. The net enrollment rate (NER) in elementary education, for instance, increased from only 29 percent in 1989 to 86 percent in 2015 (UIS, 2020). The higher education sector, similarly, has gone through a long way since its humble takeoff. According to the MOE (2020) website, since 2004/05, the number of public higher education institutions has increased, from 8 to 36. The expansion of the private higher education institutions as well

during this period has also reached to 98 institutions in total, while contributing to the enrollment of 15% of all student by the end of the Education Sector Development Plan (ESDP) IV period “ibid”.

Empirical studies explaining the relationship between human capital and economic growth in a short as well as long-run time period are scarce and inconclusive. In line of the foregoing, this study endeavors to explain the long and short-run causality of human capital on a real GDP weighing on a regulatory efficiency a variable used to measure institutional capability, which is the sum average score of Business Freedom, Labor Freedom and Monetary Freedom as explained by Miller, B. Anthony and M. James (2019).

As such institutional capability is included into the growth equation assuming that inclusion of it would create conducive environment for human capital to operate. Conversely, if institutional capacity of a country to do business is inefficient and weak, this would rather lead to frustration and resentment on the workforce of the country than facilitating it for a full employment.

Benhabib and Spiegel (1994), in their cross-country data analysis tried to run the growth accounting regression implied by the Cob-Douglas function. In their work, they tried to differentiate between considering human capital as a primary factor of production in the production process and as a driver of growth accelerator i.e., Total Factor Productivity (TFP). Their findings reveal that when human capital is entered into the production process as an ordinary production input, it had an insignificant role in explaining per capita growth rate. On the contrary, when human capital is entered as a total factor productivity, it revealed that it has positive relationship with human capital stocks. The treatment of human capital as an independent input in the production function and considering it as a driver for productivity yield different results.

Recent studies in Ethiopia alike have shown to have inconsistent results. Dinkineh and Jiang (2015) for instance, showed that public expenditure on health and education, primary and secondary school enrolment have positive and statistically significant effect on economic growth both in the long and short-run while Kidanemariam (2015) using the ARDL approach to co-integration showed that government expenditure on human capital together with official development assistance have a significant negative impact on real GDP, implying that there is neither a general consensus on literature nor a conclusive result from the varying type of use of human capital specifications. The conventional approach to measuring the stock and development of human capital has frequently been those related to educational enrollment ratios, expenditures on education, life expectancy, "under 5" mortality ratios etc.

In line of the above, this study sheds light on the relationship between human capital explained in terms of government expenditure on education and economic growth as explained by real GDP emphasizing on the role of an often missing variable bias, a regulatory efficiency a measure for institutional capability, expressed in terms of business freedom, labor freedom and monetary freedom. Institutional capabilities may add up to other factors that ease the human capital to operate without major structural challenges that are often attributed to the common institutional traits. Apart from the required skillsets, educational qualifications and innovative capacity to accelerate production, it is believed that institutional capabilities play significant role in the economic performance of a nation.

In light of the above arguments and discourse, the general objective of this study is to explain the human capital-economic growth nexus with particular interest on role of a regulatory efficiency an omitted variable bias to explain the role of institutional capability. Other specific objectives are to determine as to whether there is a short and

long-run causal relationship between human capital development expressed in terms of government expenditure on education and economic growth in Ethiopia, to derive policy implications for future government spending on education and hence human capital.

While doing this, we are cognizant of the fact that the scope of the study is limited. As such, informal and non-informal learning activities which are critical aspects of human capital development are given little attention. Personal learning and short skill development programs are alike not the interest of this study either. In addition, most human capital development programs are believed to have a reversal effect. i.e., human capital will have an impact on the economic development of a country and vice-versa. However, this study is interested only on the unidirectional effect of variables. Furthermore, it also assumes that the productivity of human capital will remain to be constant overtime while increasing returns is a possibility.

LITERATURE REVIEW

The theoretical foundation of human capital theories and national development plans central to human capital development are in consideration of future return at the expense of today's needs. Nations and organizations alike invest in education, health, training and other skill development programs in anticipation of future monetary and non-monetary returns. Such investments include various aspects such as schooling, training, acquiring information, migration, and activities that improve an individual's health (Mikaela Backman, 2013).

Traditionally, economic theory emphasizes physical capital accumulation as a major and at times sole source of economic growth at least in the short-run. Exogenous technical progress is considered long-run determinant of growth. The exogeneity of technological progress in the

neoclassical growth model and the difficulty of explaining long-term economic growth (because of diminishing returns to physical capital) have restricted the analytical capacity of the neoclassical model and its empirical verification (Haldar, Sushil Kumar Giri Jasankar and Malik, 2010:7).

Human capital theory suggests that individuals and society derive economic benefits from investments in people. Accordingly, education is often referred to as key human capital component but many authors including Becker (1993) and Schultz (1997) cited in Ralph, H. (2013) have opined that health, as well as nutritional expenditure, can also be considered as part of human capital investment. The concept that investment in human capital promotes economic growth arguably goes back to the time of Adam Smith (1776) and to a period of the early classical economists who give emphasis to the importance of investing in human capital. Paul Romer (1990) argues that every nation's macroeconomic objective revolves around sustained economic growth accompanied with social development and in this regard, he opines human capital is deemed as an essential ingredient.

Several other studies have used a range of methods to explain the contribution of human capital on economic growth. Using school enrollments and life expectancy as proxy for human capital stock and public expenditure on education and health for human capital investment, Eggoh, Houeninvob & Sossoub (2015) found human capital stock (school enrollment and life expectancy at birth) have positive effect on economic growth while human capital investment (public expenditures on education and health) has a negative impact on economic growth.

Benhabib and Spiegel (1994), in their cross-country data analysis, tried to run the growth accounting regression implied by the Cob-Douglas function. In their work, they tried to differentiate between considering human capital as a primary factor of production in the production process

against as a driver of growth i.e., Total Factor Productivity (TFP). Human capital in this process is considered as the level of education attained. Economic growth hence and its determinants are explained by their use of cross-country estimates of physical and human capital stocks. The level of education, hence, human capital is assumed to affect productivity by determining the capacity of nations to innovate new technologies relevant to their context. In their analysis, they assumed that the ability of a nation to adopt and implement new technology from abroad is a function of its domestic human capital stock"ibid".

Atardi and Sala-i-Martin (2003) argue that Africa's growth tragedy of the 20th century can be explained by low endowments of human capital, poor external environment and political instability. Cited in Hippe (2013) according to Becker (2002), human capital is the most decisive type of capital in contemporary economies.

Despite the interlinkages between human capital and economic growth, most empirical studies have not considered the relative importance of other factors that play a key role for human capital to function. Ashton & Green (1996), acknowledged that the relationship between human capital and economic growth should be seen in a rather wider context of social and political paradigm to accurately account for human capital. Mohammed and et.al (2017), indicated a condition in which human capital and economic growth are robustly and positively related, i.e., the presence of better economic opportunities and high-quality legal institutions. This study in line of the foregoing, focuses on the human capital development (government expenditure on education) and economic growth nexus while highlighting the importance of a missing bias variable, regulatory efficiency (institutional capability), a composite of three factors, Economic freedom, labor freedom and Monetary freedom as explained by Miller, B. Anthony and M. James

(2019). In the Heritage Foundation. Index of Economic Freedom;

Economic Freedom

Economic Freedom comprises 12 areas categorized under four main groups. According to Miller, B. Anthony and M. James (2019), Ethiopia's economic freedom is 53.6, making its economy the 137th freest. This score has an increase of 0.8 point in comparison to the score of the previous year while the highest increases in scores being registered for business freedom and labor freedom collectively exceeding the decrease in monetary freedom.

Regulatory Efficiency

The Heritage Foundation's report's section for regulatory efficiency according to Miller, B. Anthony and M. James (2019) which comprises an aggregate score of three factors such as business freedom, labor freedom and monetary freedom, state that Ethiopia has made starting a business easier by removing the requirements to open a bank account for company registration and eliminating the paid-in minimum capital requirement. It also explains that the less developed labor market as having impact on employment growth, holding back much of the labor force in the informal economy and playing down measuring their contribution. Because of this, the government offered to do large scale reform programs including provision of subsidies for essential products such as fuel and providing subsidies to foreign investors to encourage foreign direct investment and offered tax breaks.

Recent research studies in Ethiopia have indicated inconsistent results reinforcing the argument that the conventional approach for human capital and economic growth nexus should be reexamined. For example, Dinkineh (2015) showed that public expenditure on health and education, primary and secondary school enrolment have

positive and statistically significant effect on economic growth both in the long and short-run and physical capital has shown positive whilst inflation has a negative effect on economic growth (ibid). Tertiary school enrolment on the other hand has shown insignificant effect on economic growth both in the long-run and short-run. Kidanemariam (2015), on the other hand using the ARDL approach to co-integration showed a stable long-run relationship between real GDP per capita, education human capital and health human Capital. Accordingly, the estimated long-run model indicated that human capital in the form of health has big positive impact on real GDP per capita rise followed by education human capital, among other things.

METHODS AND MODEL

Literature has emphasized that the notion of human capital is very important in economic theory. consequently, human capital needs to be measured quantitatively to validate theoretical models. Using a time-series data of 25 years from 1995 to 2019, this study highlights the human capital and economic growth nexus in Ethiopia considering a key and an often-omitted variable bias i.e., institutional capability (regulatory efficiency) into the growth equation.

Data Description, Sources and Tools

This study uses time-series annual secondary data from 1995 to 2019. Most of the data are collected from World Development Indicators (WB), MOFEC and the Heritage Foundation.

Table 1: Sources of data

#	Variable Name	Unit of Measurement	Source of Data
1	Real GDP	% Change in RGDP	MOFEC
2	GCF	% of RGDP	World Development Indicator (WB)
3	Education Expenditure	% of RGDP	MOFEC
4	Regulatory Efficiency (Institutional Capability)	Level of freedom	The Heritage Foundation
5	Employed population (LF)	Labor F. Growth rate	World Development Indicator (WB)

Specification

Economic models representing human capital have been evolving and increasingly become a research area of interest. The augmented Solow human-capital-growth model, an extension on Solow's initial growth model is popular in this regard. What was missing on Solow's initial model was the presence of human capital as a separate input. Building on what Solow has developed Mankiw, Romer, and Weil (1992) later developed the augmented Solow model which considers human capital as a separate input into the model and to appreciate the heterogeneous nature of labor force contribution justifying differences in skillset, level of education, etc.

The underlying assumption in this approach is that improvement in the productivity of workers as, as well as the quality of their performance, could be achieved through investment on education. This is consistent with the theory that human capital ensures greater productivity. The augmented Solow model using the standard Cobb Douglas production function is therefore specified as follows:

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

(1)

Where
Y=Real GDP an output level
K=Gross capital formation a measure of stock of Physical Capital,
H= Government expenditure on education, a measure of Human Capital
L=Labor force measured by growth rate of employed population
A=Level of total factor productivity
α =Elasticity of capital input with respect to output
β =Elasticity of Human Capital input with respect to output
U=is an error term
Econometric Equation

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

(2)

Transformed in to log linear

$$ln\, Y_t = \alpha\, ln\, K_t + \beta\, ln\, H_t + (1-\alpha-\beta)\, ln\, A\, L + V$$
$$where \quad V = ln\, U$$

(3)

In order to deal with the missing variable bias as a result of omission of institutional capability from the growth model, additional variable, i.e., regulatory efficiency which comprises the sum average value for business freedom, labor freedom and monetary freedom is included into the model.

The revised model after inclusion the regulatory efficiency is as follows.

$$ln\, Y = \quad \alpha\, ln\, K + \beta\, ln\, H + (1-\alpha-\beta)\, ln\, A\, L +$$
$$ln\, G\, ovE + ln\, RE + ln\, I + V \qquad (4)$$

We first run the model without Regulator Efficiency, which measures institutional capability and we will include it later in order to see how it affects the model in general and the human capital variable in particular.

Model Estimation

This study engages in a five-step procedure in order to determine the relationship between human capital development and economic growth in Ethiopia. These procedures are the stationarity test for variables, estimation for short-run causality, the bounds test to identify long-run cointegration, Error Correction Method (ECM) for short-run adjustment to the long-run and other diagnostic tests such as the serial correlation, residual diagnostics (normality), tests for homoscedasticity, Model stability and etc.. The ADF test is employed to determine the stationarity while the ARDL bounds test and ECM are employed to find out the long-run equilibrium convergence and the speed of disequilibrium adjustments respectively.

I. Results and Discussion

Optimum Lag Selection

From the available lag selection criteria listed below in Table 2, all but one has indicated lag three as an appropriate lag length. Most research works conventionally go for the Akaike Information Criteria (AIC) as a convenient method of lag selection criteria and this research uses same.

Table 2. ***Lag Selection Criteria***

VAR Lag Order Selection Criteria
Endogenous variables: RGDP EDU GCF L
Exogenous variables: C
Date: 03/25/20 Time: 23:47
Sample: 1 25
Included observations: 22

Lag	LogL	LR	FPE	AIC	SC	HQ
0	27.25358	NA	1.42e-06	-2.113962	-1.915591	-2.067232
1	110.7820	129.0894	3.16e-09	-8.252910	-7.261053	-8.019258
2	135.5151	29.23006*	1.70e-09	-9.046831	-7.261489	-8.626258
3	163.4718	22.87362	9.45e-10*	-10.13380*	-7.554971*	-9.526304*

* 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

***Model Estimation 1*:**

Regressors T statistics (short-run). The short-run causality of variables can be detected by using either the Regressors T statistics or the Wald Test. We use here the regressors T-statistics.

From the regressors' "T" statistic results under Table 3, we see that the P values for **RGDP at lag 1 and lag 2 ,** are statistically significant indicating a short-run causality on RGDP while education, labor and gross capital formation are statistically not significant as an aggregate indicating no short-run causality.

Table 3: ARDL model for short-run regressor's "t" test

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
RGDP(-1)	0.411135	0.177190	2.320308	0.0489
RGDP(-2)	-0.568688	0.171554	-3.314930	0.0106
EDU	0.106461	0.080696	1.319293	0.2236
EDU(-1)	0.139766	0.090451	1.545215	0.1609
EDU(-2)	-0.022790	0.075676	-0.301151	0.7710
EDU(-3)	0.215669	0.071365	3.022071	0.0165
GCF	-0.059280	0.049961	-1.186522	0.2695
GCF(-1)	0.009669	0.049639	0.194790	0.8504
GCF(-2)	0.108651	0.071744	1.514427	0.1684
L	-0.155911	0.134159	-1.162134	0.2787
L(-1)	0.014689	0.123740	0.118710	0.9084
L(-2)	-0.303127	0.114921	-2.637705	0.0298
C	20.82685	3.695779	5.635307	0.0005
@TREND	-0.013222	0.011238	-1.176532	0.2732

Pairwise Granger Causality Test. The Pairwise Granger Causality test indicates the direction of causality. Based on the Granger Causality test, the decision criteria is to reject the Null Hypothesis if the P value is less than 0.05 and vice versa. Accordingly, focusing on a unidirectional approach holding the RGDP (our target variable) as a dependent variable and all other variables as regressors, we see the following results

- Education Granger Causes RGDP and hence we reject the null hypothesis of Edu doesn't Granger Cause RGDP
- GCF doesn't Granger Cause RGDP: We accept the null hypothesis of no Granger Causality
- L doesn't Granger Cause RGDP: We accept the null hypothesis of no Granger Causality

The "t" statistics of the explanatory variables and the "F" statistics from the Granger test inconsistent results if human capital is concerned.

Table 4: Pairwise Granger Causality Test

Null Hypothesis:	Obs	F-Statistic	Prob.
GCF does not Granger Cause EDU	22	0.16800	0.9163
EDU does not Granger Cause GCF		1.85907	0.1799
L does not Granger Cause EDU	22	1.05388	0.3978
EDU does not Granger Cause L		0.31960	0.8111
RGDP does not Granger Cause EDU	22	1.78509	0.1932
EDU does not Granger Cause RGDP		4.37549	0.0211
L does not Granger Cause GCF	22	2.88033	0.0707
GCF does not Granger Cause L		2.12942	0.1393
RGDP does not Granger Cause GCF	22	2.02610	0.1535
GCF does not Granger Cause RGDP		0.26762	0.8477
RGDP does not Granger Cause L	22	3.99923	0.0282
L does not Granger Cause RGDP		1.30351	0.3098

Diagnostic Tests

Residual diagnostic: Null hypothesis: Residuals are normally distributed. Jarque-Bera test statistic is used to check the distribution of the residuals. In the situation of the null hypothesis where the residuals are normally distributed, the statistic is distributed with X^2 degrees of freedom. The reported Probability, in this case, is that the probability that the test statistic exceeds the observed value. If the probability value is small, we reject of the null hypothesis of a normal distribution.

For our series in consideration, we accept the null hypothesis of normal distribution of the error terms at 5% significance level.

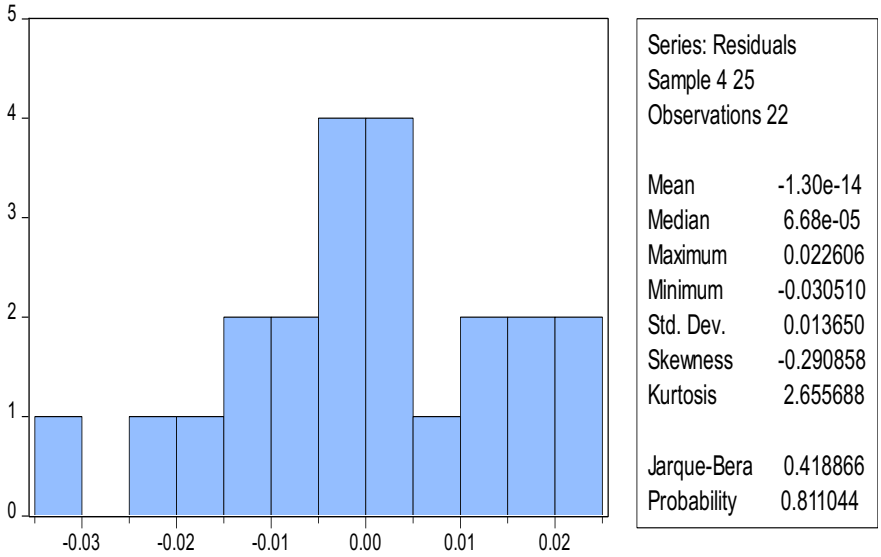

Fig 1. ***Residual distribution before Regulatory Efficiency***

Serial Correlation LM Test (Historical Correlation LM Test)

In order to check the residuals for evidence of serial correlation, this study uses the Breusch-Godfrey Serial Correlation method of the LM test.

The Null hypothesis = There is no serial correlation in the residuals up to the specified order.
Based on the test result (0.0018) we reject the null hypothesis of no serial correlation up to lag 3

Table 5. ***Results for serial correlation before Regulatory Efficiency***

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 3 lags

F-statistic	3.618138	Prob. F(3,5)	0.1001
Obs*R-squared	15.06187	Prob. Chi-Square(3)	0.0018

Heteroskedasticity

This test allows one to check for a range of specifications of heteroskedasticity in the residuals of the equation. Ordinary least squares estimates are consistent in the presence of heteroskedasticity, but the conventional computed standard errors are no longer valid. **Heteroskedasticity** has serious consequences for the OLS estimator. Although the OLS estimator remains unbiased, the estimated SE is wrong.

Table. 6: Results for Hetroskesedasticity

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	2.296393	Prob. F(13,8)	0.1208
Obs*R-squared	17.35045	Prob. Chi-Square(13)	0.1838
Scaled explained SS	1.899301	Prob. Chi-Square(13)	0.9998

Here the Null Hypothesis=The error terms are homoscedastic

The results of the test show that we reject the null hypothesis and that the model is Heteroskedastic

Model Stability

Without the inclusion of the missing variable bias, the model does seem to be unstable at least for some period at a 5% significance level. We use the **Cumulative SUM**-square (**CUSUM squared**) **tests** to see the constancy of the coefficients in a model.

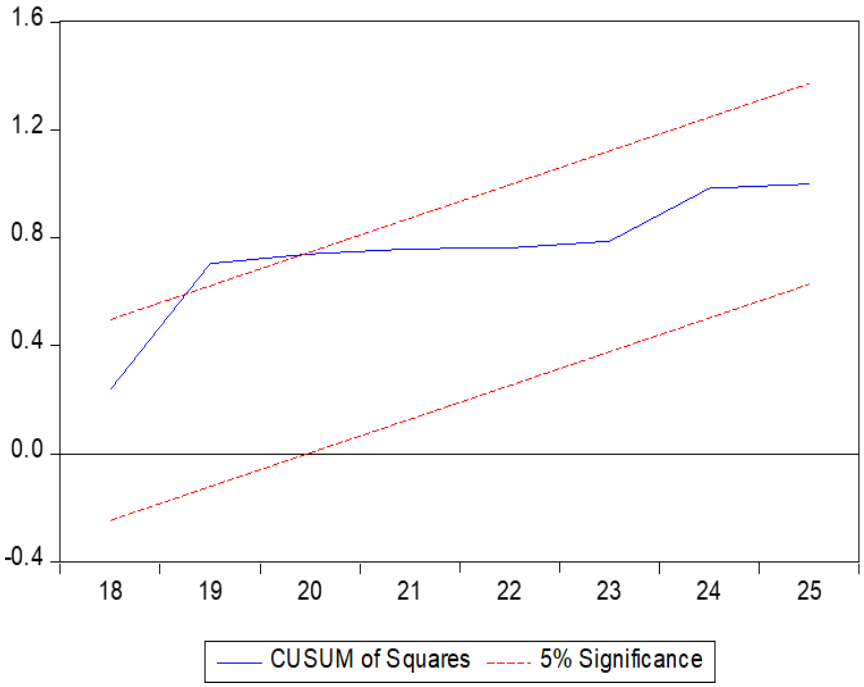

Fig 2. ***Results for model stability before Regulatory Efficiency***

Model Estimation 2: Including Regulatory Efficiency

After the inclusion of the missing variable bias Regulator Efficiency, to measure institutional capability, into a model, we see that

- Edu Granger causes RGDP implying long-run causality
- Regulatory Efficiency (Institutional Capability) Granger causes RGDP

Table 7. ***Pairwise Granger Causality test after Regulatory Efficiency***

Null Hypothesis:	Obs	F-Statistic	Prob.
GCF does not Granger Cause EDU	22	0.16800	0.9163
EDU does not Granger Cause GCF		1.85907	0.1799
L does not Granger Cause EDU	22	1.05388	0.3978
EDU does not Granger Cause L		0.31960	0.8111
RE does not Granger Cause EDU	22	1.55381	0.2419
EDU does not Granger Cause RE		1.04003	0.4033
RGDP does not Granger Cause EDU	22	1.78509	0.1932
EDU does not Granger Cause RGDP		4.37549	0.0211
L does not Granger Cause GCF	22	2.88033	0.0707
GCF does not Granger Cause L		2.12942	0.1393
RE does not Granger Cause GCF	22	2.82678	0.0741
GCF does not Granger Cause RE		0.21139	0.8869
RGDP does not Granger Cause GCF	22	2.02610	0.1535
GCF does not Granger Cause RGDP		0.26762	0.8477
RE does not Granger Cause L	22	8.80545	0.0013
L does not Granger Cause RE		0.42529	0.7377
RGDP does not Granger Cause L	22	3.99923	0.0282
L does not Granger Cause RGDP		1.30351	0.3098
RGDP does not Granger Cause RE	22	0.12684	0.9427
RE does not Granger Cause RGDP		6.09069	0.0064

Residual Diagnostic

Residual Diagnostic: Null Hypothesis: Residuals are normally distributed. Jarque-Bera test statistic is used to check the distribution of the residuals. In the situation of the null hypothesis where the residuals are normally distributed, the statistic is distributed with X^2 degrees of freedom. The reported Probability, in this case, is that the probability that the test statistic exceeds the observed value. If the probability value is small, we reject of the null hypothesis of a normal distribution.

For our series inconsideration, we accept the null hypothesis of normal distribution at the 5% significance level.

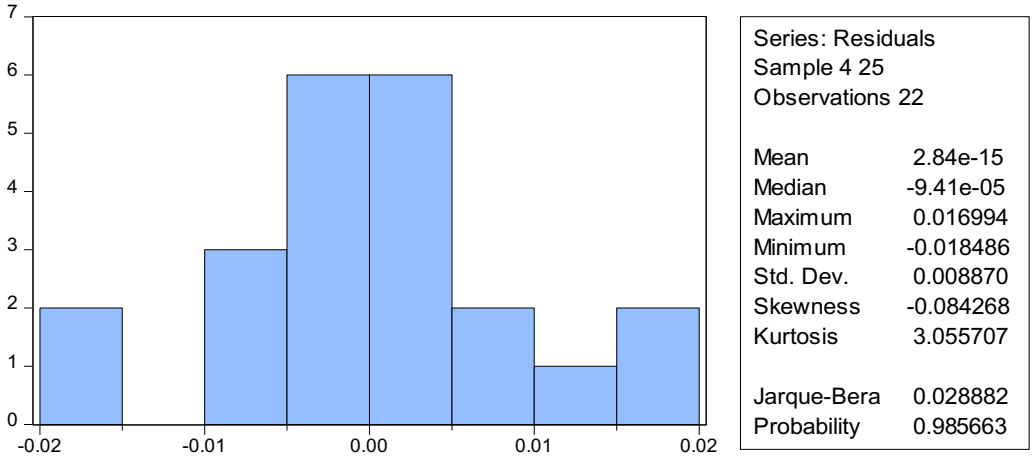

Fig.3. ***Residual distribution after Regulatory Efficiency***

Serial Correlation (Breusch-Godfrey Serial Correlation method of the LM test).

The Null hypothesis = There is no serial correlation in the residuals up to the specified order.

The test result (0.2531) confirms the hypothesis of no serial correlation up to lag 3

Table 8. ***Results for serial correlation after Regulatory Efficiency***

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 3 lags

F-statistic	7.992272	Prob. F(3,1)	0.2531
Obs*R-squared	21.11918	Prob. Chi-Square(3)	0.0001

Heteroskedasticity

Null Hypothesis=The error terms are homoscedastic
The results of the test show that we accept null hypothesis and that the model is homoscedastic

Table 9. ***Results for Heteroskedasticity after Regulatory Efficiency***

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	7.898754	Prob. F(17,4)	0.0292
Obs*R-squared	21.36360	Prob. Chi-Square(17)	0.2104
Scaled explained SS	0.725906	Prob. Chi-Square(17)	1.0000

Model Stability

From the results of the test after inclusion of the Regulatory Efficiency (Institutional capability), the model has become stable at 5%-degree level throughout the observation period.

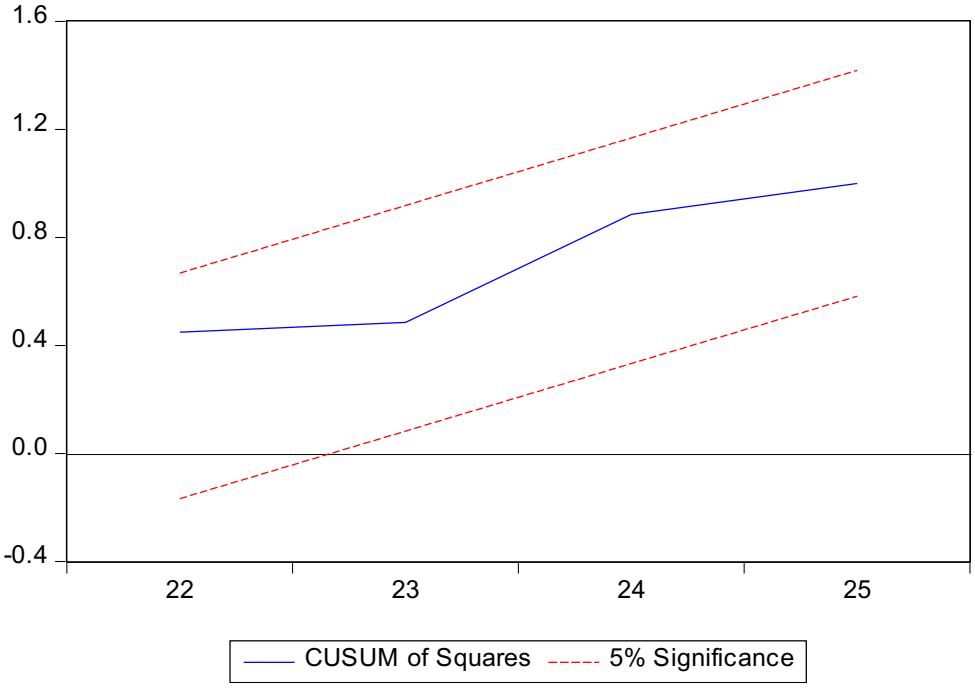

Fig 4. ***Results for model stability after Regulatory Efficiency***

Table. 10. ***Summary***

#	Variable Name	Without Regulatory Efficiency	With Regulatory Efficiency
2	Model Stability	Unstable	Stable
3	Long-run Cointegration	No long-run relation	Long-run relation
4	Short-run Causality of Human Capital	Yes	yes
5	Long-run causality of Human Capital		
6	Heteroscedasticity	Heteroscedastic	Homoscedastic

ARDL-VECM and Causal inference

In order to perform the ARDL method, we follow the following process

1. We Specify the Model
2. Perform Stationarity Test using Augmented Dickey-Fuller test
3. Determine Optimal Lag length
4. Estimate the ARDL Model (short-run)
5. Ensure if the errors of the model are not serially correlated
6. Perform the Bounds Cointegration test to see evidence of long-run relationship (Cointegration)
7. If the long-run relationship exists, we perform the Error Correction Model (ECM) or Restricted VAR Model
8. Use the results of the model estimated to measure short-run dynamic effects and the long-run equilibrium
9. Perform Diagnostic Tests (Normality, Serial Correlation, heteroscedasticity and etc)

As we have already specified the model, performed the stationary test and determined optimal lag length, we start by checking the bounds test.

Bounds Test (The long-run Equilibrium Test)

The Results of the F bound test and T test statistics confirm that there is a long-run relationship. The value of F statistics (6.633620) is greater than the upper bound I(1) value of the regressors statistics at the 5% level(4.57) indicating the presence of the long term relationship among variables. If the value is between the lower bound and the upper bound, the test is inconclusive.

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	6.633620	10%	3.03	4.06
k	4	5%	3.47	4.57
		2.5%	3.89	5.07
		1%	4.4	5.72

From the tabe below, In the long-run, education, gross capital formation and institutional capability (RE) will have a long-run causal effect on real GDP.

Table 11. ***Long-run levels equation***

Levels Equation
Case 5: Unrestricted Constant and Unrestricted Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EDU	0.449929	0.068168	6.600326	0.0027
GCF	0.147707	0.051966	2.842362	0.0468
L	-0.379912	0.163449	-2.324345	0.0808
RE	0.918410	0.205190	4.475907	0.0110

EC = RGDP - (0.4499*EDU + 0.1477*GCF -0.3799*L + 0.9184*RE)

The bounds test reveals that there is a stable long-run relationship among education human capital, gross capital

formation and regulatory efficiency with Gross Domestic Product (GDP).

Table. 12. ***Conditional Error Correction Regression***

Conditional Error Correction Regression				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	15.55197	5.690084	2.733170	0.0523
@TREND	-0.085385	0.028652	-2.980110	0.0407
RGDP(-1)*	-1.396503	0.411455	-3.394064	0.0274
EDU(-1)	0.628328	0.238171	2.638137	0.0577
GCF(-1)	0.206274	0.071495	2.885167	0.0448
L(-1)	-0.530549	0.319294	-1.661632	0.1719
RE(-1)	1.282563	0.290772	4.410880	0.0116
D(EDU)	0.132221	0.090011	1.468949	0.2158
D(EDU(-1))	-0.185655	0.138610	-1.339403	0.2515
D(GCF)	-0.291054	0.100326	-2.901091	0.0441
D(GCF(-1))	-0.560867	0.190350	-2.946506	0.0421
D(GCF(-2))	-0.291404	0.107966	-2.699040	0.0541
D(L)	0.098585	0.194143	0.507795	0.6383
D(L(-1))	0.820425	0.265215	3.093437	0.0365
D(L(-2))	0.587146	0.230238	2.550164	0.0633
D(RE)	0.117910	0.131043	0.899786	0.4191
D(RE(-1))	-0.758200	0.255976	-2.961995	0.0415
D(RE(-2))	-0.230228	0.144964	-1.588174	0.1874

* p-value incompatible with t-Bounds distribution.

The Error Correction Method (ECM)

EC=LRGDP-(0.4499*LEDU+0.1477*LGCF-0.3799*LNL+0.9184*LNRE)

Thus ECMs directly estimates the speed at which a dependent variable (RGDP) returns to equilibrium after a change in other variables

Table. 13. ***The Error Correction Method Regression***

ECM Regression
Case 5: Unrestricted Constant and Unrestricted Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	15.55197	1.912843	8.130290	0.0012
@TREND	-0.085385	0.010883	-7.845426	0.0014
D(GCF)	-0.291054	0.043429	-6.701799	0.0026
D(GCF(-1))	-0.560867	0.085848	-6.533281	0.0028
D(GCF(-2))	-0.291404	0.058119	-5.013895	0.0074
D(L)	0.098585	0.072689	1.356251	0.2465
D(L(-1))	0.820425	0.116021	7.071344	0.0021
D(L(-2))	0.587146	0.117400	5.001255	0.0075
D(RE)	0.117910	0.054354	2.169287	0.0959
D(RE(-1))	-0.758200	0.132193	-5.735570	0.0046
D(RE(-2))	-0.230228	0.077573	-2.967905	0.0412
D(EDU)	0.132221	0.039779	3.323919	0.0293
D(EDU(-1))	-0.185655	0.060719	-3.057599	0.0377
CointEq(-1)*	-1.396503	0.171462	-8.144704	0.0012

R-squared	0.958644	Mean dependent var	0.075731
Adjusted R-squared	0.891441	S.D. dependent var	0.043617
S.E. of regression	0.014371	Akaike info criterion	-5.386063
Sum squared resid	0.001652	Schwarz criterion	-4.691763
Log likelihood	73.24669	Hannan-Quinn criter.	-5.222507
F-statistic	14.26485	Durbin-Watson stat	3.473396
Prob(F-statistic)	0.000399		

* p-value incompatible with t-Bounds distribution.

CONCLUSION AND RECOMMENDATION

Interpretation

The coefficient of education (0.449929) in the long-run bounds test indicates a 1% change in education in the long-run results in a 0.45% increase in real GDP while the coefficient of GCF indicates a 1% increase in GCF results in 0.15% increase in real GDP and that of Regulatory

efficiency tells a 1% increase in Regulatory Efficiency results in approximately a 1% growth in RGDP

The negative sign of the regression sign tells that a long-run revision to the equilibrium. The adjustment term 1.39 tells that the long-run reversion to the equilibrium adjusts at the speed of 139%. That means the model adjusts at a very higher speed.

Conclusion

The overall objective of the study was to explain the human capital and economic growth nexus in Ethiopia using real GDP as proxy for economic growth and government expenditure on education as human capital. The study used the ARDL Approach to co-integration and the error correction model (ECM) as essential techniques.

The bounds test reveal that there is a stable long-run relationship among education human capital, gross capital formation and regulatory efficiency with Gross Domestic Product (GDP The major findings are that in the long there is a stable relationship among education human capital, gross capital formation and regulatory efficiency with real GDP. In other words, the result reveals that economic performance can be improved significantly when government expenditure on education and gross capital formation is increased and when regulatory efficiency at institutional level is improved. The coefficient of education (0.449929) in the long-run bounds test indicates that a 1% change in education in the long-run results in a 0.45% increase in real GDP while the coefficient of GCF indicates that a 1% increase in GCF results in 0.15% increase in real GDP and that of regulatory efficiency indicates that a 1% increase in regulatory efficiency results in approximately a 1% growth in real GDP.

In the short-run, the negative sign of the coefficient of error correction tells that a long-run revision to the equilibrium. The adjustment term of 1.39 tells that the long-

run reversion to the equilibrium adjusts at the speed of 139% in the short-run. That means in the short-run, the model adjusts at a very high-speed rate.

Policy Implication

The results of this study bear important policy implications. For an economy to improve, among other things, public expenditure needs to be geared towards basic human capital development components such as innovative skill development programs, basic education development and etc. However, expenditure on education sector alone is not a solution. Business and market should slowly and steadily be open to draw more and more investments to create employment and the lobar market should be developed progressively discharging those trapped in the informal sector. Institutional capability of the government has to be strong enough to respond to the increasing demand Hence policy makers should be able to create institutional capacity that can appreciate the changing external demand as well as the growing internal needs.

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