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Dynamics of Economic Growth and Education in India: The ARDL Approach

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Abstract

To attain maximum benefits of the demographic dividend which India can enjoy due to its huge working-age pollution, it is crucial to have a highly educated and skilled labour force. In this context, the current analysis focuses on understanding the potential impact of education on the nation's economic well-being. The study attempts to examine the relationship between education and economic growth of India using time-series data from the period 1980-81 to 2019-20. The dependent variable is Real GDP per capita, while the independent variables include total labour force, gross capital formation and gross enrollment ratios at the primary, secondary, and higher education levels, with labour force and gross capital formation as control variables. The study employs the Autoregressive Distributed Lag (ARDL) methodology to explore the dynamics of the association among the concerned variables in short and long run. In the short run, gross capital formation and primary education show a positive and significant relationship with India's economic growth. ARDL Bounds test confirms the existence of a long run relationship existing between economic growth and the independent variables. Secondary and higher education are found to have statistically significant impact on economic growth of India in the long run which discloses the relevance of education for economic well-being of the nation. Consequently, it is recommended that the government focuses on promoting post-elementary education.

Keywords: ARDL, Economic Growth, GCF, GDP per Capita, Gross Enrolment Ratio, Labour Force.

Introduction

Education in today's highly competitive and progressive world is no less than a fundamental requirement of any individual. It serves as a powerful weapon which has the capability to combat social issues without resorting to any violence by transforming the mindset of people and enabling them to see the thin line between what is right and what is not. From a national standpoint, having educated citizens who can quickly learn and utilize new technologies accelerates economic growth and prosperity. This, in turn, enhances workforce productivity and innovation capacity. Labour is considered to be a crucial factor of production for any economy. Hence it is quite important that every nation spends significantly on harnessing their skills which can be done by giving them proper education and training which gives great boost to building up human capital in the nation. Human capital theory highlights the significance of expenditure on education considering it to be an investment which is expected to increase the productivity of the workforce along with generation of innovative ideas (1, 2). Education enhances the human capital potential of nations which further positively impacts the economic growth (3). Hence it is accurate to state that education level of a nation's labour force has significant impact on the human capital formation process of that nation which further effects the economic development of the nation. Continuous investment in human capital is of great relevance from economic standpoint as depicted by the endogenous growth theory, since human capital not just raises the productivity of the labour but it also enhances the innovation potential of the nations by fostering the generation of new ideas which opens pathway for technological advancement (4). It has been widely accepted that education is one of the most important factors affecting growth potential of nations and hence it can be observed clearly that all the developed nations in the world spend heavily on not just making their citizens educated but also in equipping them with the necessary skills to become valuable economic assets when they enter the labour force. Developing nations too have acknowledged the importance of education but

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due to their financial restrictions, the focus is restricted to raising the quantity of education, with comparatively less emphasis on improving its quality. Human capital is given immense importance in the endogenous growth theory which laid great emphasis on internal factors within economy to be more influential factors in impacting economic growth. Knowledge and technological innovation are considered vital factors influencing the production process wherein knowledge is taken to be an input in the production function (5, 6). The rationale behind undertaking the study is to acknowledge which level of education has comparatively more influence on the economic growth of India, since as per certain studies it is the primary education which impacts economic growth the most specifically in lesser developed economies (7, 8). In complete contrast, some studies suggest that it is the secondary or higher education which is more influential in the context of growth of the economy (9, 10). Investment on school education in emerging economies included in SAARC is expected to work as an efficient stimulus in influencing growth potential of the respective economies (11). Since the financial resources at the disposal of the government are limited, hence the decision regarding which level of education should be accorded more financial resources can be made after analysing the impact each level has on the growth of GDP per capita of the economy. Relevant studies from across the world, focussing on the importance and relevance of education for economic growth of the nations, have been worked upon. Researchers stressed to investigate the dynamics of the relationship between tertiary schooling and economic growth of Nepal considering the time span from 1989 to 2019 using ARDL Approach and confirmed the presence of short-run as well as long-run association between higher education and economic growth (12). In their study based on exploring the causal relationship between education and economic growth in India, the importance of education as a tool to create human capital has been acknowledged and the promotion of vocational training to raise the skills of the labour force is advocated (13). The study examining the causal effect of male and female higher education on economic growth in Greece considering the period 1975-2012 found the existence of unidirectional Granger causality running from male and female who are highly educated towards economic growth is found (14). In India, trade openness leads to rise in demand for the educated and skilled labour force hence giving stress on the importance of investment in education and pointed that due to trade liberalisation, exchange of ideas and advanced technologies is on a high, implying the need for heavy investment on the education sector (15). Research work focused on understanding the importance and impact of cognitive skills for economic growth considering the period from 1991 to 2011 used 'International Assessments of Math and Science' as a measure of cognitive skill. The results suggest that while developing nations have been inching closer to the developed nations when compared based on school attainment but as per cognitive skills, the gap between developed and developing nations is still quite wide (16). Education and health expenditure are said to have a definite long run impact on economic growth of the nation but it has been observed that expenditure on these sectors is quite inadequate when compared to the true requirement of a developing economy like India (17). The relevance of post elementary education for Indian economic growth is highlighted and government is suggested to frame policies with an aim of promotion of secondary and higher education rather than just focussing on investing heavily on primary education alone (9). In context of the study based on African countries for the period 1960–2000, found that the magnitude of human capital induced by higher education on the growth of the economies was almost double when compared with the impact of physical capital on economic growth and suggest the nations to raise public expenditure on higher education to fasten the process of increment in economic growth of their respective nations (18). Results of the study considering process of education as an investment decision and using the growth accounting framework to look at the effects of education on economic growth revealed that the living standard of highly literate societies is quite high in comparison to that of illiterate ones and education plays a critical role in faster adaptation of available technology (19). In the research work examining the impact of education on economic growth separately for quantity and quality of education, conclusion was drawn that the quality of school is

more impactful than its quantity as per their effect on economic growth, also, the female education at the primary level is found to lead to decrease in fertility rate and hence indirectly benefiting economic growth rate (20). As the most populous country in the world, India boasts one of the largest education systems globally. Given its status as a developing economy with relatively limited resources, India faces the challenge of providing educational opportunities that are either free or affordable for its economically disadvantaged populations. While the increase in student enrollment in both school and higher education has placed additional financial pressure on the government, fostering a more educated citizenry is crucial for the nation's future prosperity. As per Union Budget 2023-24, the Ministry of education got around a share of 2.8% of the estimated government budget expenditure which is way short of the target of investing 6% of GDP on the education sector as the recommended by National Education Policy of 1968. Given the evident shortage of resources at the disposal of the government, it is essential to investigate the nature and extent of the relationship between education and economic growth in India. This analysis aims to determine whether education has the potential to influence economic growth and, if so, to what extent, this can further assist in providing recommendations about which educational level should be accorded what portion of the allocated budget designated to the Ministry of Education. India has a large geographical area which is further divided into several states and Union Territories. Given the importance of education for national progress, it is crucial to comprehend India's structural setup. Education policies and expenditures are not managed by a single authority; instead, they are governed by both the Central and individual state governments. Each state has the autonomy to develop its own educational policy framework and allocate its budget according to its priorities. This diversity presents an interesting opportunity to examine the relationship between education and economic growth, offering insights into how different states' educational expenditures and policies influence their GDP and, ultimately, the nation's overall economic growth. The literature review revealed a lack of studies that simultaneously consider all three levels of education in relation to economic growth within the Indian context, especially when compared to global research. The present study in this regard, explores the relationship between economic growth in India and all three levels of education by incorporating both school-level education and university-level education, with the aim to analyze how each educational tier contributes to economic growth, both in the short term and the long term.

Methodology

For the analysis, time-series secondary data has been collected for the period 1980-81 to 2019-20. Data has been taken for Real GDP per capita (in Rupees), gross capital formation (in Rupees), total labour force (in millions) and GER at the three levels of education from various authorized sources.

Table 1: Variables Used in the Study

Variable	Description	Specification	Data Sources
GDPPC	Real Gross Domestic Product Per Capita (in Rupees)	Used as proxy for economic growth of India	World Development Indicators, World Bank
LAB	Total Labour Force (in millions)	Used as a controlled variable and as a proxy for labour	World Development Indicators, World Bank
GCF	Gross Capital Formation (in Rupees)	Used as a controlled variable and a proxy for capital	Handbook of Indian Statistics, RBI
GERPE	Gross Enrollment Ratio at Primary Education	Used as a proxy for primary education	World Development Indicators, World Bank
GERSE	Gross Enrollment Ratio at Secondary Education	Used as a proxy for secondary education	World Development Indicators, World Bank

GERHE	Gross Enrollment Ratio at Higher Education	Used as a proxy for higher education	Ministry of Education Reports

Table 1 gives detailed information of all the variables used for the analysis of the research work. It includes the the description and specification of the study variables along with the sources from which data has been taken. Real GDP per capita has been taken as the dependent variable for the study as it is a relevant indicator of economic growth highlighting the average economic output per person while labour and GCF are taken as the control variables. By isolating these fundamentally strong variables with respect to economic prosperity of a nation, the relationship between core variables of the study can be done with more accuracy. The decision of considering GER at the three levels of education as the proxy variable for education has been made based on strong review of literature. Increasing GER at any level of education reflects improvement in the accessibility of education signifying how effectively a nation can broaden the horizon of education. Hence, GER is a suitable indicator of examining progress of educational access of a nation.The function form for the above tabulated variables is given below:

$$GDPPC = f(LAB, GCF, GERPE, GERSE, GERHE) \quad [1]$$

The above function can be expressed in the Cobb-Douglas form as expressed below:

$$\ln GDPPC_t = \beta_0 + \beta_1 \ln LAB_t + \beta_2 \ln GCF_t + \beta_3 \ln GERPE_t + \beta_4 \ln GERSE_t + \beta_5 \ln GERHE_t + \mu_t \quad [2]$$

where t and μ denote the time in years and error term respectively. β_0, β_1, β_2, β_3, β_4 and β_5 are the parameters to be estimated.

Stationary Test

It is a mandatory to make sure that the time series data being used for the analysis is stationary before attempting to understand the short or long run dynamics of the relationship among variables to avoid the issue of spurious regression which usually arises when data lacks stationary (21). ADF (Augmented Dickey-Fuller) Test and PP (Phillips-Perron) Test have been employed to spot the problem of unit root, i.e., non-stationarity of the data.

Optimal Lag Length

With the help of different criterions that are sequential modified LR test statistic, Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Criterion (SC) and Hannan-Quin (HQ) information criterion, appropriate lag length for the variables will be decided for the estimation of the specified model.

ARDL Model

It is to understand clearly that to estimate any sort of long run relationship between the economic variables under study, it is mandatory to check the order of integration of variables (22, 23). The ARDL Bounds test for Cointegration can be applied for mixed order of integration wherein, the condition requires some variables to be stationary either at I(0) or 1(1), all at 1(0) or I(1) but none at I(2) (24). The F-statistic under ARDL Bounds test ensures for the presence or absence of any long run relationship between variables. A long run association of variables is confirmed only if value of F-statistic surpasses critical bound value. The following conditional error correction regression is applied to analyse long run relationship between Real GDP per capita and the independent variables under consideration:

$$\Delta \ln GDPPC_t = \alpha_0 + \delta_1 \ln GDPPC_{t-1} + \delta_2 \ln LAB_{t-1} + \delta_3 \ln GCF_{t-1} + \delta_4 \ln GERPE_{t-1} + \delta_5 \ln GERSE_{t-1} + \delta_6 \ln GERHE_{t-1} + \sum_{i=1}^{p-1} \theta_i \Delta \ln GDPPC_{t-i} + \sum_{j=0}^{q_1-1} \beta_{1j} \Delta \ln LAB_{t-j} + \sum_{j=0}^{q_2-1} \beta_{2j} \Delta \ln GCF_{t-j} + \sum_{j=0}^{q_3-1} \beta_{3j} \Delta \ln GERPE_{t-j} + \sum_{j=0}^{q_4-1} \beta_{4j} \Delta \ln GERSE_{t-j} + \sum_{j=0}^{q_5-1} \beta_{5j} \Delta \ln GERHE_{t-j} + \varepsilon_t \quad [3]$$

ARDL model of the order (p, q_1, q_2, q_3, q_4, q_5) where p, q_1, q_2, q_3, q_4 and q_5 indicate the number of lags considered for log values of respective variables. The value of δ_i refers to the long run coefficients. The equation for Error Correction Model (ECM) is mentioned below:

$$\Delta \ln GDPPC_t = \alpha_0 + \sum_{i=1}^{p-1} \theta_i \Delta \ln GDPPC_t + \sum_{j=0}^{q_1-1} \beta_{1j} \Delta \ln LAB_{t-j} + \sum_{j=0}^{q_2-1} \beta_{2j} \Delta \ln GCF_{t-j} + \sum_{j=0}^{q_3-1} \beta_{3j} \Delta \ln GERPE_{t-j} + \sum_{j=0}^{q_4-1} \beta_{4j} \Delta \ln GERSE_{t-j} + \sum_{j=0}^{q_5-1} \beta_{5j} \Delta \ln GERHE_{t-j} + \gamma ECT_{t-1} + \varepsilon_t \quad [4]$$

ECM reflects if short run shocks lead to convergence towards long run equilibrium or leads to divergence from it. The coefficient of Error Correction Term (ECT) mentioned in eq. [4], denotes the speed of adjustment at which equilibrium will be restored in the long run. To test

whether the estimated model is perfectly stable and good enough to be used for forecasting, tests for coefficient diagnostic, residual diagnostic and stability diagnostic will be applied.

Results

Graphical Representation of the variables

The time series plots for all the concerned variables are presented showcasing the trend followed by the variables over the period considered for the study.

All the variables in Figure 1 are found to follow upward trend except for graph of log of Gross Enrolment Ratio at primary education, which has undergone noticeable decline. Panel (A) of the Figure 1 indicates a smooth upward trend in GDP per capita which shows that the nation is on the path of continuous economic upliftment. Panel (B) represents that during the period 1980-1995, there has been a considerable growth in the labour force of the nation but this growth rate has slowed down post 1995 for a while, a noticeable increase in the rate is found during 2010-2014. Panel (C) reflects that GCF has grown over the considerable time-period with small breaks in between. Panel (D) shows GER at primary education has witness a lot of fluctuations over the time span specifically, from a steady growth period during 1990-2000, followed by sharp rise, but post 2009-2010, there has been sharp decline. Panel (E) indicates that GER at secondary education has followed an overall upward trend with occasional dips in between. Panel (F) represents the trend followed by GER at higher education which is found to have an overall steady growth path during the time-span considered in the study.

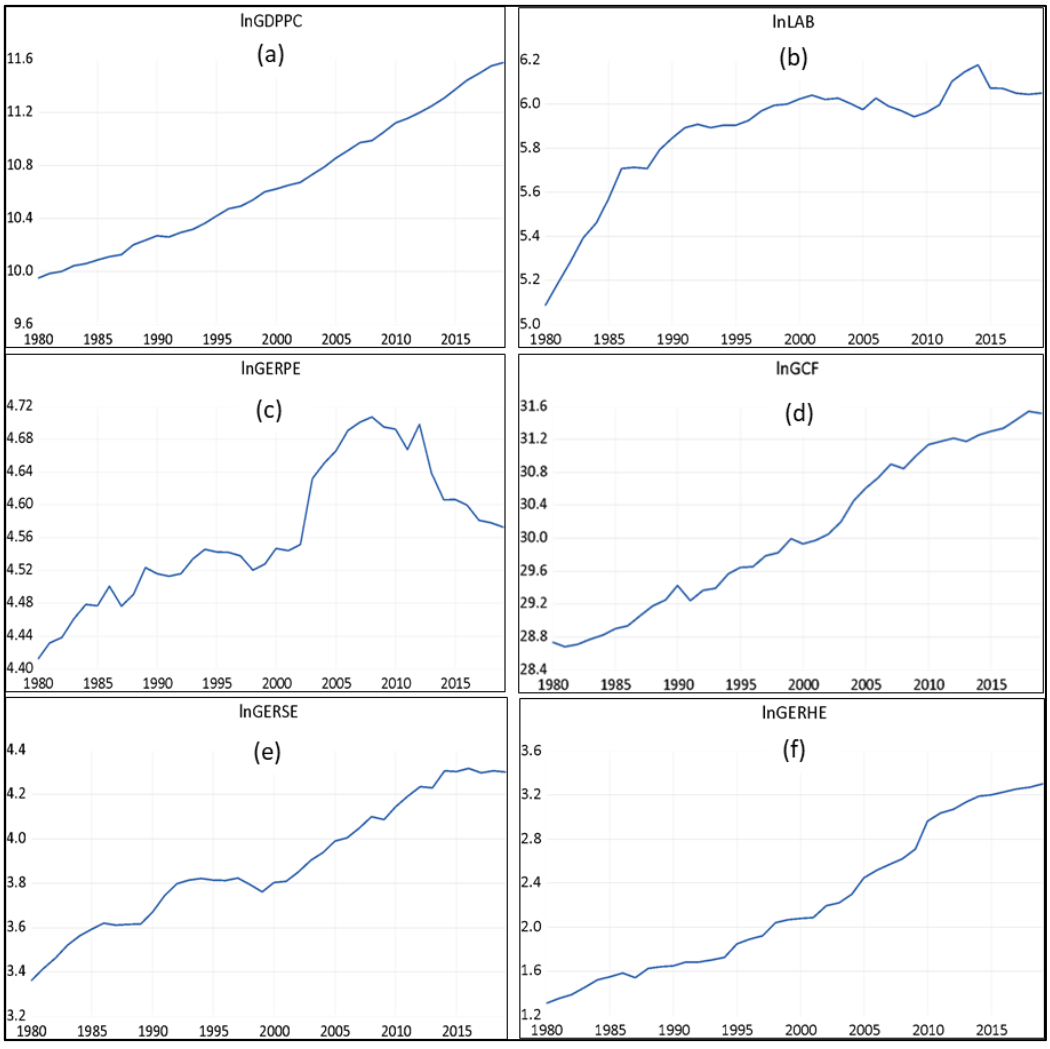


Figure 1: Graphical Representation of the Variables (X-Axis of All the Six Figures Indicates the Time-Period in Form of Years, the Y-Axis Represents the Magnitude of Respective Variables in the Log Form)

Table 2: Descriptive Statistics

Variable	lnGDPPC	lnLAB	lnGCF	lnGERPE	lnGERSE	lnGERHE
Mean	10.662	5.871	30.068	4.565	3.885	2.214
Median	10.610	5.969	29.954	4.545	3.818	2.075
Maximum	11.573	6.179	31.542	4.707	4.319	3.299
Minimum	9.949	5.088	28.679	4.412	3.363	1.311
Std. Dev.	0.498	0.261	0.953	0.083	0.279	0.658
Skewness	0.305	-1.598	0.104	0.226	0.088	0.396
Kurtosis	1.855	4.741	1.591	2.079	1.968	1.724
Jarque-Bara	2.806	22.078	3.379	1.753	1.825	3.762
Probability	0.246	0.000	0.185	0.416	0.402	0.152
Observations	40	40	40	40	40	40

Descriptive Statistics

Table 2 displays the information about descriptive statistics related to all the variables which presents a summary of the important characteristics of the variables providing a simplified interpretation of the data. It can be noticed that except labour, all the rest variables are positively skewed and normally distributed. The coefficient of kurtosis is positive for all the variables, with labour having the magnitude higher than 3 (4.741) which reflects that it corresponds to a leptokurtic curve while the other variables present the case of platykurtic curve.

Correlation Matrix

The level of correlation existing between the variables is represented by the correlation coefficient. Table 3 lays out the coefficients of correlation in a matrix form giving a rough idea about the extent to which the variables are correlated. It can be clearly noticed that not only all the variables are found to have positive correlation coefficients but also the value of the coefficients lies between 0.7 to 0.9 ensuring strong correlation existing between them.

Table 3: Correlation Matrix

	lnGDPPC	lnLAB	lnGCF	lnGERPE	lnGERSE	lnGERHE
lnGDPPC	1					
lnLAB	0.761	1				
lnGCF	0.991	0.778	1			
lnGERPE	0.765	0.729	0.835	1		
lnGERSE	0.978	0.815	0.977	0.798	1	
lnGERHE	0.992	0.729	0.986	0.768	0.976	1

Table 4: ADF Test and PP Test Results for Stationary Check

Variable	Augmented Dickey-Fuller Test				Phillips-Perron Test			
	With Intercept		With Intercept and Trend		With Intercept		With Intercept and Trend	
	Level	First Difference	Level	First Difference	Level	First Difference	Level	First Difference
lnGDPPC	2.978	-4.836*	-1.338	-6.013*	6.345	-4.836*	-1.292	-10.414*
lnLAB	-5.871*	-3.719*	-3.209	-4.499*	-8.098*	-3.652*	-4.370*	-4.445*
lnGCF	0.079	-7.034*	-2.648	-6.894*	0.127	-7.041*	-2.725	-6.898*
lnGERPE	-1.930	-5.350*	-0.596	-5.698*	-1.902	-5.501*	-1.040	-5.746*
lnGERSE	-1.386	-4.603*	-1.839	-4.609*	-1.246	-4.557*	-2.271	-4.570*
lnGERHE	0.682	-5.182*	-1.570	-5.228*	0.604	-5.171*	-1.631	-5.231*

Note: * indicates the rejection of null hypothesis of unit root at 5% level of significance

Unit Root Test

Table 4 carries the outcomes of the ADF and PP tests employed to check the stationarity of the variables. It is mandatory to make sure that all the variables are stationary at level or first difference or mix of both before using ARDL methodology. Except labour, all the rest of the variables are found to be stationary at first difference according to the results of ADF and PP test which means that their order of integration is 1. For labour, the order of integration is 0 as it is having stationary at level. Since the variables are having mix order of integration that is I(0) and I(1) and none of the considered variables is I(2), hence it is suitable to specify and estimate the model using ARDL technique.

Optimal Lag Length

Outcomes based on which decision about the appropriate number of lags to be consider is made is showcased in the Table 5. As major criteria (AIC, FPE and HQ) point out 4 to be the suitable lag to be taken, hence the optimal lag length of 4 is chosen for the current analysis.

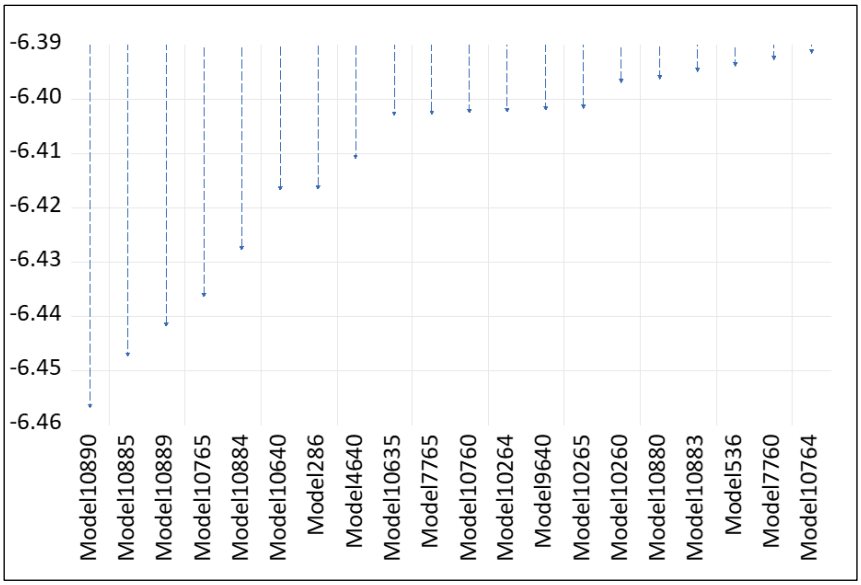
Model Selection

On the basis of Akaike Information Criteria, the order of the ARDL model is confirmed based on the model having the least AIC. The criteria graph shown in the Figure 2, presents the top 20 models out of which the ARDL model of the order (1, 2, 2, 4, 2, 0) is chosen as it corresponds to having the least AIC.

Table 5: Lag Length Selection Criterion

Lag	LogL	LR	FPE	AIC	SC	HQ
0	226.077	NA	1.97e-13	-12.227	-11.963	-12.134
1	486.755	419.981*	7.72e-19	-24.709	-22.861*	-24.064
2	523.031	46.352	9.05e-19	-24.724	-21.293	-23.526
3	574.953	49.0378	6.20e-19	-25.609	-20.594	-23.858
4	644.835	42.706	3.24e-19*	-27.491*	-20.893	-25.188*

Note: * indicates lag order selected by the respective criterions



Model10890: ARDL (1, 2, 2, 4, 2, 0)
Model10885: ARDL (1, 2, 2, 4, 3, 0)
Model10889: ARDL (1, 2, 2, 4, 2, 1)
Model10765: ARDL (1, 2, 3, 4, 2, 0)
Model10884: ARDL (1, 2, 2, 4, 3, 1)
Model10640: ARDL (1, 2, 4, 4, 2, 0)
Model286: ARDL (4, 4, 2, 3, 2, 4)
Model4640: ARDL (3, 2, 2, 4, 2, 0)
Model10635: ARDL (1, 2, 4, 4, 3, 0)
Model7765: ARDL (2, 2, 2, 4, 2, 0)
Model10760: ARDL (1, 2, 3, 4, 3, 0)
Model10264: ARDL (1, 3, 2, 4, 2, 1)
Model9640: ARDL (1, 4, 2, 4, 2, 0)
Model10265: ARDL (1, 3, 2, 4, 2, 0)
Model10260: ARDL (1, 3, 2, 4, 3, 0)
Model10880: ARDL (1, 2, 2, 4, 4, 0)
Model10883: ARDL (1, 2, 2, 4, 3, 2)
Model536: ARDL (4, 4, 0, 3, 2, 4)
Model7760: ARDL (2, 2, 2, 4, 3, 0)
Model10764: ARDL (1, 2, 3, 4, 2, 1)

Figure 2: Model Selection Criteria

ARDL Bounds Test

ARDL Bounds test has been used to check, if there is any sort of long-run relationship prevailing between GDPPC and the independent variables. The results of the test are shown in Table 6. Since the magnitude of F-statistic surpasses all the upper bound values of the critical value bound across all levels of significance (1%, 2.5%, 5% and 10%), hence it can be inferred that a long-run relationship is found to prevail among the variables under study and we now move forward to understand what relationship the concerned independent variables share with the Real GDP per capita of India in long and short run.

Table 6: Results of Bounds Test

Test Statistics	Value	K
F-Statistic	8.868246	5
	Critical Value Bound	
Significance	I(0)	I(1)
10%	2.26	3.35
5%	3.62	3.79
2.5%	3.96	4.18
1%	3.41	4.68

Since the magnitude of F-statistic surpasses all the upper bound values of the critical value bound across all levels of significance (1%, 2.5%, 5% and 10%), hence it can be inferred that a long-run relationship is found to prevail among the variables under study and we now move forward to understand what relationship the concerned independent variables share with the Real GDP per capita of India in long and short run.

ARDL Long Run Form Estimation

After being assured about the presence of a long run relationship, the next step taken is to estimate the long run coefficients of the variables to check the direction and the extent to which they are impact GDP per capita and hence the economic growth in long run.

Table 7 reflects the long run coefficients of the estimated ARDL model obtained from the Conditional Error Correction Regression. As can be depicted from the results, except primary education, all the rest four independent variables are found to be positively impacting GDP per capita of India. Labour is having positive but insignificant impact on economic growth while gross capital formation, secondary and higher education are found to be positive and statistically significant relationship with GDPPC at 5% level of significance which reveals how vital these factors are in bringing a long run positive impact on economic growth of India. The equation showcasing long run relationship existing among the variables is given below:

$$lnRGDPPC_t = 0.017lnLAB + 0.335lnGCF - 1.076lnGERPE + 0.216lnGERSE + 0.312lnGERHE \quad [5]$$

Error Correction Model Estimation

Table 8 presents the dynamics of the short run association of the independent variables with GDP per capita. The magnitude of Error Correction Term is found to be negative and significant which ensures that in the long run, equilibrium is expected to be restored with speed of adjustment being around 61% which is quite effective. In the short run, the coefficient of labour and secondary education is negative while primary education and gross capital formation are having positive and significant impact on GDP per capita. Since procurement of education at post-elementary level requires longer time span of years, hence its true impact on education can only be examined in long run.

Table 7: Long Run Coefficient

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnLAB	0.017	0.038	0.445	0.661
lnGCF	0.335	0.059	5.677	0.000
lnGERPE	-1.076	0.134	-8.052	0.000
lnGERSE	0.216	0.066	3.285	0.004
lnGERHE	0.312	0.071	4.415	0.000

Table 8: Results of ECM

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.414	0.291	8.297	0.000
D(lnLAB)	-0.150	0.038	-3.970	0.001
D(lnLAB(-1))	-0.095	0.033	-2.876	0.009
D(lnGCF)	0.107	0.021	5.051	0.000
D(lnGCF(-1))	-1.108	0.029	-3.679	0.002
D(lnGERPE)	0.198	0.083	2.394	0.027
D(lnGERPE(-1))	0.667	0.137	4.862	0.000
D(lnGERPE(-2))	0.389	0.089	4.384	0.000
D(lnGERPE(-3))	0.195	0.071	2.747	0.013
D(lnGERSE)	-0.127	0.052	-2.441	0.025
D(lnGERSE(-1))	-0.255	0.069	-3.662	0.002
CointEq(-1)*	-0.614	0.075	-8.198	0.000
R-squared	0.907	Mean dependent var		0.043
Adjusted R-squared	0.864	S.D. dependent var		0.019
		Akaike info criterion		-6.735
S.E. of regression	0.007	Schwarz criterion		-6.207
Sum squared resid	0.001	Hannan-Quinn criter.		-6.550
		Durbin-Watson stat		2.446
Log likelihood	133.222			
F-statistic	21.195			
Prob (F-statistic)	0.000			

Note: *p-value incompatible with t-Bounds distribution

Diagnostic Tests

To test the strength and consistency of the model estimated and to check if it is specified correctly and possess econometric properties, diagnostic tests have been conducted, the result of these tests are given in Table 9. The results of the diagnostic tests ensure that the residuals of the distribution are normally distribution and have no presence of serial correlation and heteroskedasticity. Ramsey RESET Test confirms that model estimated is free from any specification bias and parameters of the model have stable nature. The application of CUSUM and CUSUMSQ test has been employed to test the stability of the estimated model.

Table 9: Results of Diagnostic Tests

Test	Test Statistic Value	Probability	Results
Jarque- Bera test (normality test)	JB = 2.662	0.264	Residuals are normally distributed
Breusch-Godfrey Serial Correlation LM test	F = 1.139	0.363	No serial correlation exists
Breusch-Pagan-Godfrey (Heteroskedasticity)	F = 0.402	0.964	No presence of Heteroskedasticity
Ramsey RESET Test	F = 1.657	0.214	No specification error

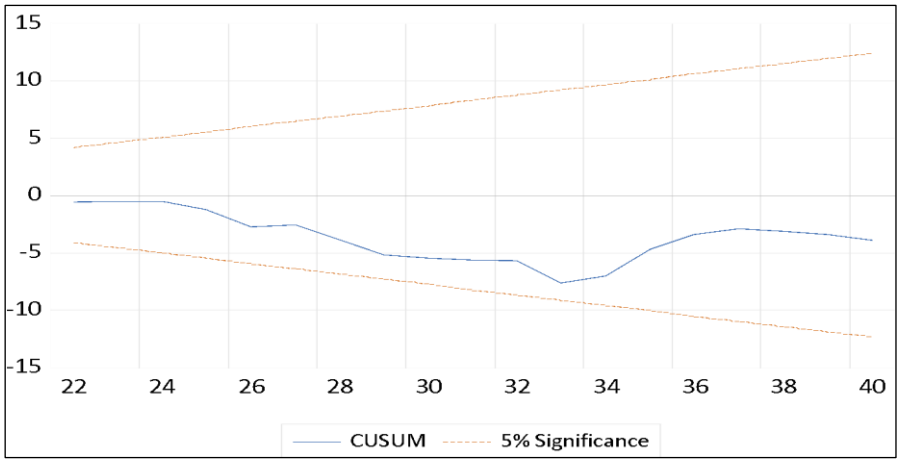


Figure 3: CUSUM Test (X-Axis of the Graph Represents the Time of Sequence of Observations and the Y-Axis Indicates the Cumulative Sum of the Deviations of the Observed Values from Their Expected Values)

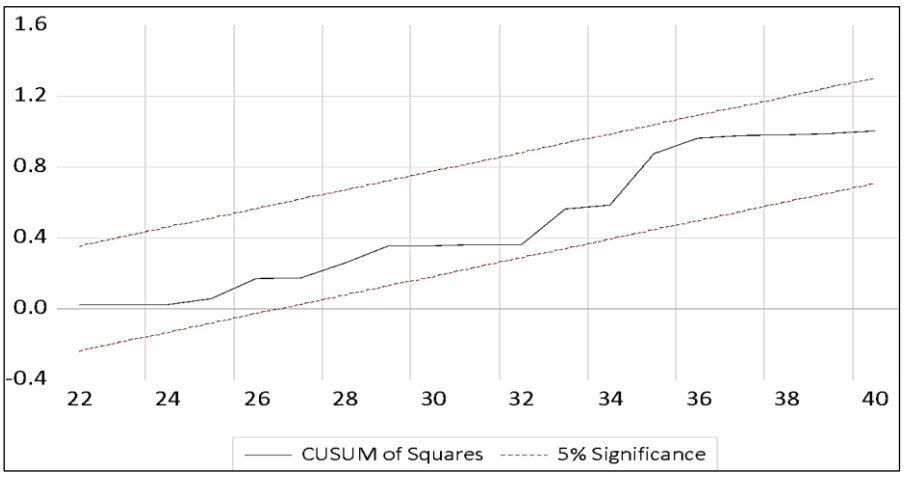


Figure 4: CUSUMSQ Test (X-Axis Signifies Time or the Sequence of Observations of the Dataset and Y-Axis Represents the Magnitude of the Cumulative Sum of Squared Recursive Residuals)

The graph displaying CUSUM test (Figure 3) result helps to confirm stability of a model. For a model to be considered as stable, the curves under the test are expected to fall within the critical bound of 5%. It can be observed from the graph that the curve does lie within the limits which indicate that the ARDL model estimated is statistically stable. CUSUMSQ test (Figure 4) is a widely used econometric tool aimed at testing the stability of the variance in time series data via checking if the residuals of the estimated model are stable or not. Since the curve under CUSUMSQ test does not cross the critical lines, hence confirming that the ARDL model estimated is reliable and can be used for forecasting and further analytical purposes.

Discussion

The results of long run form of the ARDL model indicate that while, secondary and higher education are possessing statistically significant influence on the Indian economic growth but the primary education is found to have negative and statistically insignificant impact on the same. The results are in accordance with the findings of various studies stating that post-elementary education has considerable influence on the growth of the economy in the long run and that primary enrollment rates do not bring significant benefits to per capita growth but attracts investment in physical capital while secondary enrollment rates promote economic growth (25, 26). Secondary and higher education is found to yield greater financial progress due to upliftment of skills and knowledge (27). Higher education enrollment impacts the economic growth the most when compared with the primary education enrollment which is consistent with results of the present analysis (11). The outcomes of the current study are in partial agreement with the results of the work as per which while physical capital has no effect on GNP but human capital has considerable

long-run effect on GNP per capita but in the current study, gross capital formation is found to be an extremely important factor impacting the economic growth significantly in both long and short run (17). Primary education alone is not impactful enough to bring people above of the poverty line but it is the post-elementary education which has the potential in providing labour with high-quality skill and knowledge hereby increasing the productivity level of the labour which opens door for better job opportunities hence preventing people from falling in the poverty trap (9). Post-elementary education is found to have no impact on the growth of GDP per capita in the short-run. One possible reason behind it is the fact that attainment of secondary or higher education takes considerable number of years, hence the true influence of these levels of education on growth of the economy can better be realised in the long run. The strong positive correlation between secondary and higher education and economic growth in India underscores the necessity for the government to allocate more resources to these educational levels. However, this should not come at the expense of primary education, even if its long-term impact on growth appears limited. Primary education is essential as it lays the groundwork for a child's overall development. The reason being that primary education forms the bedrock of overall personality development of a child. It is at this level of education that students learn basic foundational skills which are required by them throughout their lives and the focus is on enhancing the creativity level of the young minds which cannot be compromised. The focus of policymakers should be on increasing the quality standard of education imparted at all the levels of education for which efficient teacher training programmes should be carried out to enhance teaching quality and upgrade their skills. Promotion of vocational training at the school level should be advocated and schemes should be launched in this regard as it helps bridge the gap between education and employment. E-learning should be introduced as part of educational curriculum so that students get to know of the technological upgradation taking place and reach to remote areas can be increased.

Conclusion

The study has been devoted to examine and evaluate the impact of primary, secondary and higher levels of education on the Real per capita income of India and hence on the Indian economic growth for which time-series data for the period 1980-81 to 2019-20 has been used. Existence of a long-run relationship between education and economic growth is assured by the ARDL Bounds test. In the short run, primary education is found to have positive and significant impact on economic growth while secondary education is found to have a negative impact on the same. The coefficient of Error Correction Term is negative and significant which provides assurance of the restoration of equilibrium in the long-run. All the variables except primary education, are found to have positive impact on economic growth in the long run. The results of the diagnostic tests ensure the stability of the model. India must realize that it needs to modify its focus from just making its people literate but rather focus on educating and making them skilled in such a manner that they can be economic assets for the nation. The government and the policymakers should aim at promoting students to continue education at post elementary level which can be done by making quality education available to them at affordable cost as well as create relevant job opportunities which works as an incentive for students to invest their time in acquiring higher education to develop enough skills to be eligible for jobs at the competitive marketplace.

Abbreviation

Nil.

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Author Contributions

The authors have made equal contributions.

Conflict of Interest

Neither of the two authors declare any kind of conflict of interest.

Ethics Approval

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