'Economic Growth & Higher Education Nexus in India' The ARDL Approach

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Abstract
The research study examines the relationship between economic growth and higher education in India by considering the time series data for the period 1981-21. Autoregressive Distributed Lag (ARDL) Approach given by Toda and Yamamoto (1995) has been applied to study the long run and short run impact of higher education on economic growth of India. Considering Gross Domestic Product as the dependent variable and enrollment, public expenditure, employment level, gross capital formation and economic growth as the independent variables, the log-lin functional form has been fitted. Results show that higher education related variables of enrollment and public expenditure have insignificant long run impact on economic growth while these variables have sort run significant impact on GDP of India. It can be suggested that there is need of a sound education policy in the sphere of higher education so that higher education sector can be developed for having the significant impact on the economic growth of India in the coming years.
KEYWORDS: Higher Education, Economic Growth, Autoregressive Distributive Lag Model, India.

1. Introduction

Education is a very important tool which not only leads to increment in the job opportunities with higher pay scale for an individual but also raises one's entrepreneurship and creative skills. It propagates the spread of social values among the people by the exposure it offers to their minds which is quite innovative for the society and the country. Hanushek and Woessmann (2010) mention that education affects economic growth via leading to increase in labor productivity and innovative capacity of the nation.

Economists have shown interest in the role of human capital in economic growth in recent years. Previous studies usually consider education to be a simple measurement of human capital and attempt to examine the impacts of education on economic growth. While the education–growth linkage is widely discussed, many recent studies pay further attention to higher education levels and attempt to investigate its economic growth impact. This is because higher education is considered one of the main factors driving economic growth and competitiveness for every country. There are many reasons why education is important, this focuses on its contribution to economic growth and outcomes. Education 'can be defined as the stock of skills, competencies, and other productivity-enhancing characteristics' (WEF 2016). In general, education as a main component of a country's human capital increases the efficiency of each individual worker and helps economies to step up the value chain beyond manual tasks or simple production processes (WEF 2016). Human capital has long been considered aa a feature of the economic system and work has proven the impact of

education on its productivity growth. Education is a leading determinant of economic growth, employment, and earnings. Ignoring the economic dimension of education would endanger the prosperity of future generations, with widespread repercussions for poverty, social exclusion, and sustainability of social security systems (Woessman 2015). A knowledge based economy is characterized by dependence on a highly-skilled, well-educated, and technically-minded labor. It makes use of advancements in technology alongside intellectual capital to move away from material consumption and aim towards an economy built on knowledge and data. The higher education sector is a natural partner to the knowledge-based economy. As the source of advanced learning and new information from research, universities help to train the workforce of tomorrow while supporting the innovations of today. The higher education sector is important in passing training to people at all stages of their careers, from students and recent graduates to senior managers. The main role of higher education institutions is to carry innovation, with the moto of finding solutions to global challenges in areas that matter to the society, such as healthcare, environmental protection, resource security, international development, and population trends. As digitization changes the landscape for working professionals, higher education can provide them with the opportunity to enhance their existing knowledge and learn new skills. For employers, this has a positive impact on productivity, output, and staff morale.

India has progressed as a developing nation, it has been able to reach such a high level of education that it is now one of the world's top countries, boosting its economic development every day. In numerous categories, such as nuclear weapons and marine equipment, India ranks third in the world. This success is because of education's contribution to these fields. If it continues to improve at the same rate, our country's economic development will undoubtedly accelerate. Agriculture and Industry give evidence that their productivity has increased significantly as a result of education. Farmers can now use new technologies to produce more than they could previously with old methods. The same with the industrial sector. There is increasing industrialization when new equipment's are introduced. Educated labor and workers are capable of properly applying recent new techniques and equipment's, allowing for increased output and economic progress. This brings great economic development.

The current study examined the impact of higher education on economic growth in India while the specific objective is to analyze the dynamic relationship between education and economic growth using ARDL Model. The rest of the paper is organized as follows: section two is on literature review. This is followed by the research methods and discussion of results in section three and four respectively. Section five concludes the paper.

2. Literature Review

Various researchers and scholars have worked on the ever-expanding literature on the system of education. A brief review of some existing literature is discussed below.

Zivengwa (2006) investigated the cointegration relationship between education and economic growth in Zimbabwe for the period 1980 to 2008 and used a vector auto regression modelling process. The variables used are Economic growth, Education investment and aggregate investment. The methodology of the study is a quantitative one that involves unit root tests before running the

main model of Granger Causality Tests and VAR. The findings confirmed a positive relationship between education and economic growth with physical investment being a channel of transmission of these positive effects.

Khorasgani (2008) examined the relationship between higher education and economic growth in Iran. Multivariable time series data on the variables: annual logarithmic gross domestic product, physical capital (K), human capital, research expenditures (R) and using an autoregressive distributed lag (ARDL) model, the long- and short-run relationship between the growth and higher education variable was investigated. The results indicated that the higher education variable had a positive effect on the economic growth of Iran in both the short and long run.

Beskaya et al. (2010) conducted a study on the impact of education on economic growth in Turkey using the ARDL model applied to data spanning between 1923 and 2007, and the results suggested a significant long-run relationship between school enrolment and economic growth.

Afzal et al. (2010) investigated the short-run and long-run linkage between school education and economic growth in Pakistan and used annual data for the period 1970–71 to 2008–09. The study employed the ARDL bounds testing approach to cointegration and found evidence of cointegration between school education and economic growth and the variables are real GDP, real physical capital, inflation and general school enrollment. The results of the study showed a direct relationship between school education and economic growth in Pakistan, in both the short- and the long-run positive relationship between education and growth.

Afzal M., Malik M.E, Begum I., Sarwar K., and Fatima H. (2012) study utilizes time series data on education, poverty, physical capital and economic growth for the span of 1971-72 to 2009-10 in case of Pakistan. The results of ARDL model confirm that both the short-run and long-run effect of physical capital on economic growth have been found to be positive and significant. Education affects economic growth positively and significantly only in the long-run. In the long-run, poverty and economic growth are inversely and significantly related. The results of Toda-Yamamoto Augmented Granger Causality (TYAGC) Test confirm bi-directional causality between education and economic growth, between economic growth and poverty and between poverty and education. Poverty reduction and education enhancing strategies must be adopted to accelerate the process of economic growth of the country. The study also recommends pro- poor growth and education in Pakistan.

Mercan (2013) the relationship between education expenditures and economic growth is among the practical studies attracting high interest in Economics literature. The analysis was carried out with the bounds testing approach developed by Pesaran et al. (2001) and besides the constant model, constant and trend model was also used unlike the literature. A positive relationship between education expenditures and economic growth was found in the Turkish economy for the quarterly period 1980-2012. Real gross domestic products and total expenditures to the education variables are included to the analysis logarithmic. It appeared that education expenditures in Turkey had a positive effect on economic growth positively. A greater allocation of resources on education expenditures could make the Turkish economy more dynamic. Furthermore, in short term analysis coefficient of error correction terms were negative and statistically significant. So, the deviations occurring between the variables converge to the long-term balance level. In Granger causality

analysis, a two-way relationship was determined between the education expenditures and economic growth.

Obradović and Lojanica (2016) investigated the long and short run relationship between higher education and economic growth in multivariate framework for Sweden, for the period from 1971 to 2013, by using ARDL approach. Toda-Yamamoto procedures of Granger non-causality test were applied to detect the direction of causality in the relationship between economic growth and higher education. The findings showed that unidirectional causality between higher education and real GDP per capita exists. This relationship is positive, but not mutually reinforcing.

Mendy D. and Widodo T. (2018) examined the nexus between different educational levels and Indonesia's economic growth over a reference period 1984-2014. During this period,

education expansion took place at all three levels of education reflecting structural changes tied within the policies under the Millennium Development Goals (MDG's) as the key and powerful factor for sustainable economic development. The augmented Lucas endogenous growth model applied and employed the autoregressive distributed lag model. Variables include Growth Domestic product, Primary Education, Secondary Education, Tertiary Education, Labor Force and Gross Fixed Capital Formation. The empirical analysis reveals a long-run relation between education and economic growth. The estimated long-run and short-run elasticity of different education levels reveal that, overall, human capital structure in Indonesia is still at the stage of promoting economic growth and identifies tertiary education as the main level for development. The findings reveal that education level matters to economic growth. Further, the empirical evidence helps shed light on why empirical studies have failed to find a significant relationship between schooling and economic growth.

NKH Singh, WS Lai and Saukani M. (2018) examined the impact of different levels of education, namely primary, secondary and tertiary, on economic growth in Malaysia. As a step further, the education variables are analyzed by gender to examine whether the impact of education differs according to gender. The study employed the Auto-Regressive Distributed Lag (ARDL) modelling in analyzing the long-term and short-term effects of education levels on economic growth, covering a period of 36 years from 1980-2015. Cointegration between all education variables and economic growth are found in the study. Overall, in the short run, tertiary education is most important to growth, while both primary followed by tertiary education were seen as growth-inducing factors in the long-run. Analysis by gender shows that in the long run, it is the male's education that has a higher contribution to growth compared to the female. Meanwhile, in the short run, it is the female that has a higher contribution to growth than the male. Thus, both male and female should have equal opportunity on acquiring education. The government needs to ensure the equitable access and parity are achieved between both genders at schools. Since the education of the male has a positive and significant contribution in the long-run, special attention needs to be given to the enrolment rates of the males.

Hamdan, Sarea, Khamis and Anasweh (2020) investigated the relationship between expenditure on higher education and economic development in Saudi Arabia which has invested in higher education and knowledge creation since its independence as part of the sustainable development process. Accordingly, study aims at conducting an initial survey of the policies of expenditure on higher

education in Saudi Arabia and then developing a standard model in which the results of this investment will be measured in achieving the economic development in Saudi Arabia for a period of forty years from (1978) until (2017). Variables used as growth in GDP for the year, labor force in the year, capital accumulation in the year, Investment in higher education in the year, Population in the year, number of students' enrollment in universities and Random error. Based on econometric instruments; the study model did not succeed in finding a relationship between investment in higher education and economic development in Saudi Arabia.

Hussaini (2020) examined co-integration between the economic growth and reach of higher education in South and East Asian nations explaining disparity. The research employed an econometric panel co-integration investigation to analyses the long run relationship of higher education and economic growth among South Asian nations. The research confirmed positive long run causality between the economic growth of the South Asian nations and gross enrolment ratio of higher education. So, if the South Asian nations continue with their existing pattern of paying less attention to higher education by allocating low share of investment on it, poor human capital formation would result in growing further economic disparity between developed and South Asian nations where rich nations would remain richer and poor nations would remain poor with the gap remaining unabridged. Gross enrolment in higher education taken as exogenous variable and GDP per capita as dependent variable to measure economic growth of the country. The panel data was collected from 9 countries of South & East Asia for a span of 15 years from 2000 to 2014. This research will serve as an aid to policy makers, educators and financers of South Asian nations to bridge the gap between high- and low-income nations. The focus on the quantum of spending on higher education by the government will help improve the reach of tertiary education and build economic prosperity in these nations.

Maneejuk and Yamaka (2021) analyzed the impact of primary, secondary, and tertiary education on economic growth in ASEAN-5 for the 2000–2018 data range. The influences of education are calculated from public expenditure on tertiary education per student, enrolment rates of primary, secondary, and tertiary levels, educated workforce, and the novelty of unemployment rates with advanced education along with the control variables: trade openness, FDI, research and development, inflation rate, and capital stocks. The findings showed that secondary and tertiary education enrolment rates could boost economic growth in ASEAN-5, but higher education enrolment rates have a greater impact on economic growth than secondary education.

Qi, D., Ali, A., Li, T., Chen, Y. C., & Tan, J. (2022) estimated the asymmetric effects of higher education progress (highly educated employed workforce), higher education utilization (highly educated unemployed workforce), and the separate effects of higher education utilization interactions with high-tech industries on economic growth in China from 1980 to 2020. Using a Nonlinear Autoregressive Distributed Lag (NARDL) model, this study found that the expansion of higher education progress (the employed workforce with higher education) promotes economic growth, while contraction of higher education progress (employed workforce with higher education) reduces economic growth. The country was required to invest more in higher education and the development of high technological industries across all regions, thus may lead to higher economic growth.

3. Data, Variables and Methodology

This section introduces the data used in the analysis and provides a brief description of each variable and the sources of the data. The time-series data has been used of India for the period of 1981 to 2021. The data used in the study has all been sourced from the EPWRF. The dataset consists of the dependent variable which is gross domestic product (GDP) and independent variables are enrolment in higher education (ENR), public expenditure on education (GOV), the gross domestic fixed capital accumulation (GCF), employment (EMP) and economic reforms (ER).

Table 1: Variables – Definition, Specification and Data Source

VARIABLE	DEFINATION	SPECIFICATION	EXPECTED & ALGEBRIC SIGN	DATA SOURCE
GDP	Gross domestic product (GDP) is the total monetary or market value of all the finished goods and services produced within a country's borders in a specific time period.	Dependent variable as a proxy for growth.	-	EPWRF
ENR	The meaning of enrollment is taking admission in an institution.	Independent variable. A variable representing education sector.	Positive	EPWRF
GOV	Public Expenditure on Education refers to the component of education expenditure that comes from national, regional, and local government units to finance and/or produce educational services.	Independent variable.	Positive	EPWRF
GCF	Capital formation is a macroeconomic concept that refers to creating additional tangible assets as a stock of net capital goods, for an economy, in a designated accounting period. It helps in future production. The prime	Independent variable.	Positive	EPWRF

	purpose of capital accumulation is to increase the rate of net income of a nation along with its growth.			
EMP	Employment means the state of having a job or being employed.	Independent variable.	Positive	EPWRF
ER	Economic reforms	Dummy variable 1=economic reforms period 0=otherwise.	Positive	

Research Methodology

Different aspects of research tools applied in the study have been described as below:

Unit Root Test

For testing the stationarity of the series unit root tests have been applied. Augmented Dicky Fuller (ADF) and PP tests have been applied as the unit root tests. GDP, ENR, EMP, GOV and GCF are the variables for which unit root tests have been applied.

Optimum lag length

Time series models consider lagged values of the dependent and independent variables so selection of optimum lg length becomes the essential part of the times series models. Many different criteria are available for deciding the optimum lag length in the analysis. This study uses 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 and decides the optimum lag length.

ARDL Model

The ARDL model of Pesaran et al. (2001) has been employed as the choice of econometric modelling. The ARDL cointegration approach has many advantages in comparison with other cointegration methods. Unlike other cointegration techniques, the ARDL does not impose a restrictive assumption that all the variables under study must be integrated of the same order.

In other words, the ARDL approach can be applied regardless of whether the underlying regressors are integrated of order I (1), order zero I (0) or are fractionally integrated. Secondly, while other cointegration techniques are sensitive to the size of the sample, the ARDL test is suitable even if the sample size is small. Thirdly, the ARDL technique generally provides unbiased estimates of the long-run model and valid *t*-statistics even when some of the regressors are endogenous.

In formulating our ARDL empirical specifications, we firstly specify the model as below:

Model 1: GDP = f (ENR, GOV, ER)

Model 2: GDP = f (EMP, GCF, ENR, GOV, ER)

Above models can be respecified in the log linear form as below:

Model 1: LnGDP = a+bLnENR+cLnGOV+dER+e

Model 2. LnGDP = a+bLnEMP+cLnGCF+dLnENR+eLnGOV+fER+e

On the basis of unit root test and optimum lag length, the ARDL model can now be specified as below:

Model 1: $\Delta GDP_t = \sum_i^n{}_{=1} \phi_1 \Delta GDP_{t-i} + \sum_i^n{}_{=1} \phi_2 \Delta ENR_{t-i} + \sum_i^n{}_{=1} \phi_2 \Delta GOV_{t-i} + \beta_1 GDP_{t-i} + \beta_2 ENR_{t-i} + \beta_3 GOV_{t-i} + \beta_4 ER_{t-i} + \varepsilon_t$

Model 2: $\Delta GDP_t = \Delta GDP_t = \sum_i^n{}_{=1} \phi_1 \Delta GDP_{t-i} + \sum_i^n{}_{=1} \phi_2 \Delta ENR_{t-i} + \sum_i^n{}_{=1} \phi_3 \Delta GOV_{t-i} + \sum_i^n{}_{=1} \phi_4 \Delta GCF_{t-i} + \sum_i^n{}_{=1} \phi_5 \Delta EMP_{t-i} + \beta_1 GDP_{t-i} + \beta_2 ENR_{t-i} + \beta_3 GOV_{t-i} + \beta_4 GCF_{t-i} + \beta_5 EMP_{t-i} + \beta_6 ER_{t-i} + \varepsilon_t$

The long run aspect of the ARDL model is expressed as given below:

Model 1: $GDP_t = \beta_0 + \beta_1 GDP_{t-i} + \beta_2 ENR_{t-i} + \beta_3 GOV_{t-i} + \beta_4 ER_{t-i} + \varepsilon_t$

Model 2: $GDP_t = \beta_0 + \beta_1 GDP_{t-i} + \beta_2 ENR_{t-i} + \beta_3 GOV_{t-i} + \beta_4 GCF_{t-i} + \beta_5 EMP_{t-i} + \beta_6 ER_{t-i} + \varepsilon_t$

The short run aspect of the ARDL model is expressed as given below:

Model 1: $\Delta GDP_t = \phi_0 + \sum_i^n{}_{=1} \phi_1 \Delta GDP_{t-i} + \sum_i^n{}_{=1} \phi_2 \Delta ENR_{t-i} + \sum_i^n{}_{=1} \phi_3 \Delta GOV_{t-i} + \phi_4 ER + \gamma_1 ECT_{t-i} + u_t$

Model 2: $\Delta GDP_t = \phi_0 + \sum_i^n{}_{=1} \phi_1 \Delta GDP_{t-i} + \sum_i^n{}_{=1} \phi_2 \Delta ENR_{t-i} + \sum_i^n{}_{=1} \phi_3 \Delta GOV_{t-i} + \sum_i^n{}_{=1} \phi_4 \Delta GCF_{t-i} + \sum_i^n{}_{=1} \phi_5 \Delta EMP_{t-i} + \phi_6 ER + \gamma_1 ECT_{t-i} + u_t$

Where βi's are the long-run regression coefficients, φ_i's are the short-run coefficients and ECT's are the error correction terms which measure the speed of adjustment back to steady-state equilibrium in the face of external shocks to the economy. The error correction terms are assumed to lie within an interval (0, −1) although there are some exceptional cases where the coefficient can be allowed to be lie between −1 and −2. Incidentally, significant negative error correction terms indicate long-run causality from the regressor to the regress and variable. However, prior to estimating our ARDL models it is imperative that one tests for cointegration effect to his end, the study uses the bounds test for cointegration effects which tests the joint null hypothesis as:

H0: $\beta 1=\beta 2=\ldots=\beta i =0$

And this is tested against the alternative hypothesis of significant ARDL cointegration effects i.e.

H0: $\beta 1\neq\beta 2\neq\ldots\neq\beta i\neq 0$

The test is tested with an F-statistics which is compared to the non-standard critical bound's values reported in Pesaran et al. (2001). If the computed f statistic exceeds the critical upper bounds value, then the null hypothesis of no cointegration is rejected. If the computed φ-statistic falls below the critical lower bounds value, then the null hypothesis of no cointegration is not rejected. And if the computed F-statistic falls between the critical lower and upper bounds values, then the test is considered as being inconclusive.

ARDL Co-integration Approach used to capture the objective of the study. The study employed ARDL Co-integration analysis to explore the contribution of higher education development on economic

growth. This method of estimation would be used to estimate the short-run and the long-run analysis of this study.

Diagnostic Tests

After estimated empirical ARDL models, the final stage of the empirical analysis is to perform diagnostic test on the estimated regressions. In particular, we conduct the Jarque-Bera test for residual normality, the Breusch-Godfrey LM test for serial correlation, the Breusch-Pagan-Godfrey test for heteroscedasticity as well as Ramsey's RESET test for specification error. The CUSUM and CUSUM of squares tests have been applied to study the stability of the models.

Analysis of Results

DESCRIPTIVE STATISTICS

Table 2 displays information about descriptive statistics regarding the variables of the study.

Table 2: Descriptive Statistics

Variable	GDP	GCF	ENR	EMP	GOV
Mean	1.11E+12	3.31E+11	13356952	368.6539	4.43E+10
Median	8.39E+11	1.82E+11	8625882.	391.4000	3.35E+10
Maximum	2.70E+12	8.73E+11	399955886	482.6000	1.23E+11
Minimum	2.87E+11	4.92E+10	2443444.	162.0000	8.41E+09
Std. Dev.	7.68E+11	2.79E+11	11680139	80.00976	3.47E+10
Skewness	0.789534	0.667799	1.011829	-1.100780	1.006774
Kurtosis	2.314170	1.944463	2.659335	3.465660	2.742306
Jarque-Bera	5.063190	4.950717	7.194209	8.650491	7.039669
Probability	0.079532	0.084133	0.027403	0.013230	0.029604
Sum	4.57E+13	1.36E+13	5.48E+08	15114.81	1.81E+12
Sum Sq. Dev.	2.36E+25	3.11E+24	5.46E+15	256062.5	4.83E+22
Observations	41	41	41	41	41

Note: values in parentheses are the probability values.

CORRELATION MATRIX

Correlation coefficients existing between different pairs of the variables are displayed in Table 3 in a matrix form which states the degree of association among variables.

Table 3: Correlation Matrix

	LNGDP	EMP	ENR	GCF	GOV
LNGDP	1.000000	0.863157	0.925759	0.958669	0.934942
EMP	0.863157	1.000000	0.690158	0.709385	0.713774
ENR	0.925759	0.690158	1.000000	0.973321	0.989180
GCF	0.958669	0.709385	0.973321	1.000000	0.976988
GOV	0.934942	0.713774	0.989180	0.976988	1.000000

Table 4: Unit Root Test

Variable	ADF				PP			
	Level		First differences		Level		First differences	
	Intercept	Trend & Intercept	Intercept	Trend & Intercept	Intercept	Trend & Intercept	Intercept	Trend & Intercept
ER	-1.6598 (0.443)	-1.5814 0.7826)	-6.244 (0.0)	-6.2939 (0.0)	-1.657 (0.444)	-1.5814 (0.7826)	-6.245 (0.0)	-6.305 (0.0)
LNGDP	-0.13516 (0.9384)	-2.35168 (0.3978)	-5.8238 (0.0)	-5.7522 (0.0001)	-0.13751 (0.9381)	-2.38321 (0.3823)	-5.8128 (0.0)	-5.73895 (0.0002)
ENR	4.9480 (1.00)	4.2351 (1.00)	1.35957 (0.9983)	-1.20429 (0.8915)	3.7453 (1.00)	-0.10022 (0.9931)	-4.9058 (0.0003)	-6.6920 (0.00)
GOV	3.29268 (1.0)	-0.1068 (0.9930)	-1.7834 (0.3826)	-4.8623 (0.0019)	3.37094 (1.0)	0.0241 (0.9952)	-4.9364 (0.0002)	-6.1510 (0.00)
EMP	-3.04165 (0.0420)	-2.19309 (0.4762)	-4.2534 (0.0019)	-3.1661 (0.1097)	-6.55023 (0.00)	-2.817 (0.1997)	-5.7798 (0.0)	-6.5784 (0.0)
GCF	1.5767 (0.9992)	-1.58712 (0.7804)	-5.8273 (0.0)	-3.1859 (0.1063)	1.9700 (0.9998)	-1.50194 (0.8123)	-5.8233 (0.0)	-6.7142 (0.0)

The study employs two different unit root tests (i.e., Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP)). Determining the cointegration relationship among the proposed model variables is based on the level of stationarity of the variables, which will be explored in the first step by unit root tests. A summary of the unit root test results regarding the order of integration based on the ADF and the PP are provided in Table 4.

Variable EMP has been found to be stationarity at level according to the ADF test. ER, LNGDP and GCF are stationary at first difference except GOV and ENR according to ADF test. All the variables considered in the study are statistically significant at first difference according to the PP test. Clearly, EMP is stationary at level while all other variables are stationary at first difference. So ARDL model can be specified and estimated.

Table 5: Estimates of ARDL Model

Variables	Model 1:(1,0,1,0)			Model 2: (1,0,0,1,1,0)		
	Coefficient	**t statistic**	**Prob.**	**Coefficient**	**t statistic**	**Prob.**
Intercept	-0.115697	-0.227490	0.8214	1.154333	1.352928	0.1859
LNGDP(-1)	1.006362	52.29950	0.0000	0.956628	28.98192	0.0000
ER	0.014477	1.156870	0.2554	0010962	0.946698	0.3511
GOV	5.70E-12	5.790306	0.0000	3.32E-12	3.515529	0.0014
GOV(-1)	-6.83E-12	-7.549424	0.0000	-4.42E-12	-5.007245	0.0000
ENR	1.27E-09	0.731072	0.4697	1.09E-09	0.783055	0.4395
EMP	-	-	-	0.000178	1.651946	0.1086
GCF	-	-	-	4.59E-13	4.612130	0.0001
GCF(-1)	-	-	-	-3.61E-13	-3.877394	0.0005
R- squared = 0.999441			R-squared = 0.999681			
Adjusted R-squared = 0.999358			Adjusted R-squared = 0.999598			
F-statistic = 12151.31			F-statistic = 12136.83			
Prob (F-statistic) = 0.000000			Prob (F-statistic) = 0.000000			
Akaike info criterion =- 5.09850			Akaike info criterion = -5.509444			
Schwarz criterion = - 4.84516			Schwarz criterion = -5.129446			

GDP with lag1 effects economic growth significantly while ER and ENR do not have significant impact on economic growth according to Model 1. ER, ENR and EMP do not have significant impact on economic growth according to Model 2. GDP with lag1, GOV with lag 1, GCF with lag1, GCF and GOV have been found for effecting levels of economic growth significantly. On the basis of the value of coefficient of determination it is cleared that explanatory power of both the estimated models is highly statistically significant.

Table 6: Bounds Test for Cointegration

Model	Value of bound test (F)	Significance level	I (0)	I (1)
Model 1	F= 7.535521 K= 3	10% 5% 2.5% 1%	2.72 3.23 3.69 4.29	3.77 4.35 4.89 5.61
Model 2	F= 6.751905 K= 5	10% 5% 2.5% 1%	2.26 2.62 2.96 3.41	3.35 3.79 4.18 4.68

Table 7: Long-run ARDL estimates

Long run variables Model 1	Coefficient	t value	p value
ER	-2.275401	-0.26719	0.7909
ENR	-1.99E-07	-0.27403	0.7857
GOV	1.78E-10	0.33897	0.7367
Long run variables Model 2	**Coefficient**	**t value**	**p value**
EMP	0.004108	1.994989	0.0549
ENR	2.51E-08	0.710815	0.4825
ER	0.252753	1.042879	0.3051
GCF	2.24E-12	2.269573	0.0303
GOV	-2.53E-11	-1.268310	0.2141

Table 6 presents the results of the cointegration test (Bounds test). Results indicate that the calculated F-statistics is higher than the upper bound critical values at all the levels of significance in cases of both the Models. In Model-1 value of bound test is 7.535 and in Model-2 value of F is 6.751.

Hence, the null hypothesis of no cointegration is rejected, implying the existence of long run relationships amongst the variables. Once the existence of long- run relationships are confirmed, the conditional ARDL long-run model can be estimated. Tables 7 and 8 display the results of estimated long run coefficients using the ARDL model and the results of the error correction model (ECM), respectively. ER, ENR and GOV do not have long-run significant impact on economic growth according to Model -1. Similarly, EMP, ENR, ER and GOV has statistically insignificant at 5% level of significance that means these variables do not have significant impact on economic growth and GCF have been found for effecting levels of economic growth significantly according to Model 2 in long run.

In Model- 1. ENR is negatively related with economic growth in the long run because of lack of sufficient employment opportunities in the economy. Thus, when the enrolled students complete the education and enter into the labor market, they do not get sufficient employment opportunities.

Table 8: Short-run ARDL estimates

Short run variables Model 1	**Coefficient**	**t value**	**p value**
C	-0.115697	-4.13141	0.0002
D(GOV)	5.70E-12	7.51245	0.0000
CointEq(-1)	0.006362	5.72727	0.0000
Short run variables Model 2			
C	1.154333	7.112106	0.000
D(GCF)	4.59E-13	5.908520	0.000
D(GOV)	3.32E-12	4.543451	0.0001
CointEq(-1)	-0.043372	-6.858975	0.000
	Model 1	**Model 2**	
R- squared	0.649430	0.999681	
Adjusted R- squared	0.630480	0.999598	
F-statistic	34.27119	12136.83	
Prob (F-statistic)	0.000000	0.000000	
Akaike info criterion	-5.248500	-5.509444	
Schwarz criterion	-5.121834	-5.129446	

The negative and significant value of the Error Correction Term ensures the restoration of the long run equilibrium with the speed of adjustment being around 43.1%. In short run ARDL estimates in Model1. GOV seem to be quite effective in influencing economic growth which is reflected by the positive and statistically significant coefficient of the variable. Similarly, in Model2. GCF and GOV also have been found for effecting levels of economic growth as the p value is less than 5% which have positive significant impact on Indian economy.

Results for studies for Zimbabwe (2006), Iran (2008), Turkey (2010) (2013), Pakistan (20100 (2012), Sweden (2016), Indonesia (2018), Malaysia (2018) and China (2022) showed that higher education related variables of enrollment and public expenditure played a significant role on economic growth both in long run and short run. In case of India these variables related with higher education do not have any significant role on economic growth in the long run. But in case of short run higher education has played a significant role in effecting the levels of economic growth in India.

Table 9: Diagnostic Tests

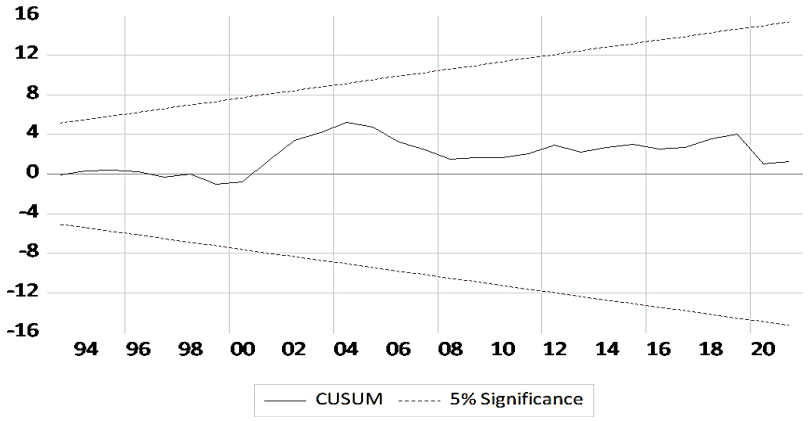
Test	Model 1.		Model 2.	
	T value	**P value**	**T value**	**P value**
Jarque Bera	0.287889	0.865936	0.366459	0.832577
Breusch-Godfrey LM test	0.038811	0.9620	0.640430	0.5344
Breusch Pagan Godfrey (Heteroskedasticity)	2.074597	0.0928	0.732751	0.6620
Ramsey RESET test	0.260957	0.7957	0.845980	0.4043

CUSUM test and CUSUM of Squares test

Table 9: displays the diagnostic tests of the ARDL model. JB Normality test of distribution of residuals states that residuals are normally distributed at 5% level of significance in Model1 and 2. Null hypothesis of presence of serial correlation in the residuals is rejected as the p- value is greater than 0.05 which means there is no autocorrelation in the residuals in both the Models. Also, the residuals are homoscedastic that is there is no presence of heteroskedasticity. The p-value for Ramsey RESET test is also found to be greater than 0.05 confirming that there is no specification bias in the model or that the model is free of specification errors.

So, the results indicate that the model 1. and 2. does not have any problem relating to Jarque Bera, Breusch-Godfrey LM test, Breusch Pagan Godfrey, Ramsey RESET tests. Furthermore, Figures A and B of Cumulative Sum of Recursive Residual (CUSUM) and Cumulative Sum of Squares of Recursive Residuals (CUSUMQ) tests indicate no evidence of misspecification and instability during the period estimated by the models. To check any misspecification in the model RAMSEY RESET test used. Both values of T-statistics and F-statistics need to be insignificant. As is evident from the above results in Table 9 that both these values are insignificant at a 5% level of significance, we can state that this model is correctly specified. Moving onto the second diagnostic measure that is the recursive measure, the graph of CUSUM and CUSUMSQ are reported below: It is considered useful to check for model specifications to get significant results. For this many econometricians like Pesaran (1997),

Brown (1975) has recommended the use of CUSUM and CUSUMSQ. In Figures 1 and 2 CUSUM and CUSUMSQ both report stability at a 5% significance level. Overall, these diagnostics reinforce the validity of our short-run and long-run estimates. CUSUM graph given below supports our results about the functional form about its specification at a 5% level of significance. These figures also demonstrate the consistency of long-run and short-run estimations based on the literature. Graphs are plotted via the sample size, two straight lines (red) show the critical value. As long the CUSUM lies within them, coefficients in the ARDL models are stable.



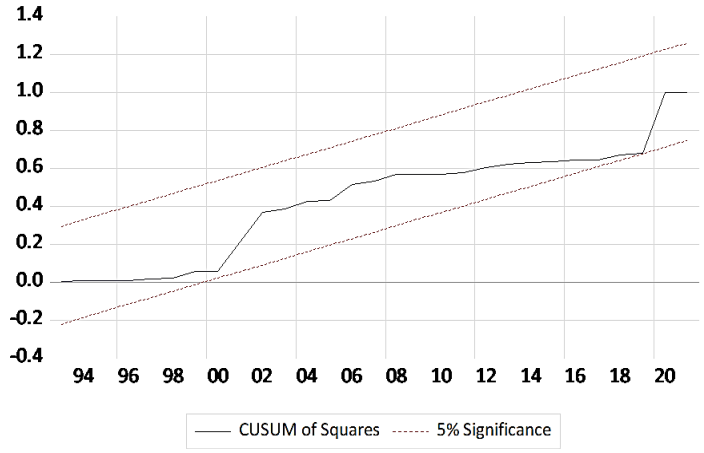
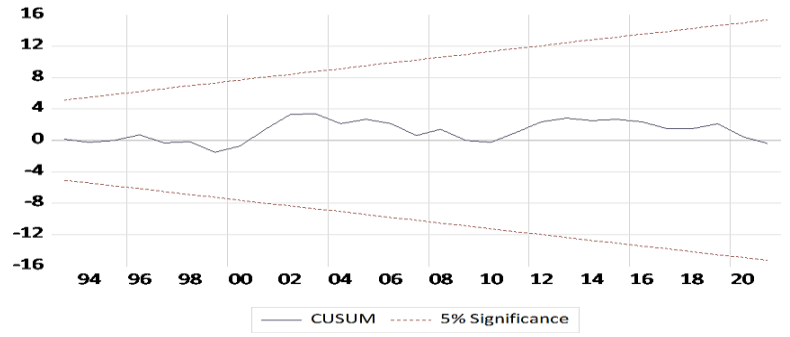
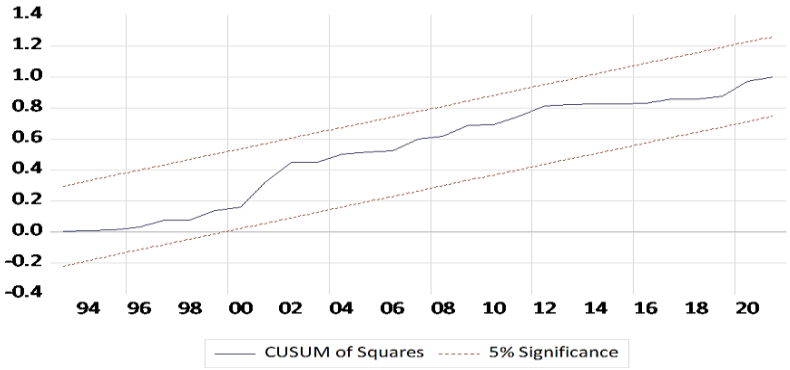


Figure B: CUSUM and CUMSUMSQ plots for Model 2.





Conclusions

The paper examines the long run and short run impacts of higher education on economic growth in India during the period between 1981 and 2021. The empirical analysis is performed by using the bounds testing Autoregressive Distributed Lags (ARDL) approach and estimating the long run and short run impacts of the varying levels of education. The bounds test suggests that the variables included in the model designed in the study are bound together in the long run. The results also indicate that enrollment, employment, government expenditure with a high level of education has a positive impact on GDP, while enrollment, employment, government expenditure with a low level of education have an insignificant positive effect on GDP. Therefore, there is need of a sound education policy in higher education sphere so that higher education sector can be developed for having the significant impact on the economic growth of India in the upcoming years.

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