Working Paper 557

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Published and Printed by: Institute for Social and Economic Change
Dr V K R V Rao Road, Nagarabhavi Post,
Bangalore - 560072, Karnataka, India.

ISEC Working Paper No. 557 April 2023

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ISBN 978-93-93879-26-4

Working Paper Series Editor: **M Balasubramanian**

HUMAN CAPITAL AND ECONOMIC GROWTH IN INDIA: A TIME SERIES ANALYSIS USING EDUCATIONAL VARIABLES FROM 1982-2017

Surendra Kumar Naik and Indrajit Bairagya*

Abstract

Although a plethora of literature studies the relationship between human capital and economic growth in the Indian context, the empirical relationship between human capital and economic growth is observed as ambiguous in the existing studies. The present study attempts to combine both input and output measures of human capital across all levels of education from the Indian context during 1982-2017. Subsequently, it also examines the consistency of the results across all the educational measures of the human capital variable separately and compares them with various measures of human capital. The theoretical framework of the study is anchored in the Lucas growth model, which is empirically analysed using Johansen cointegration for examining the long-run relationship. Based on the Vector Error Correction Model (VECM), we investigate the short-run association between human capital and economic growth. From the analysis, we found that human capital variables like Gross Enrolment Ratios (GER), Average Years of Schooling (AYS) and public education expenditure influence economic growth in the country. Interestingly, an analysis of public spending across different levels of education indicates that the tertiary level influences economic growth in a positive and significant manner in both periods. However, secondary public education expenditure results found it positively influences economic growth in both periods. Therefore, a specific focus on those levels of education is desirable to give further impetus to economic growth for a developing country like India.

Keywords: Human Capital, Economic Growth, AYS, GER, Public Expenditure on Education, Johansen Cointegration Test, VECM

Introduction

The economic growth of a country is driven by factors like natural and human resources, physical and social capital, development of technology, political stability, etc. While pondering the key factors influencing economic growth, the Classical school of thought considered trade an important channel, whereas the Neoclassicals underscored the role of physical capital and savings (Smith, 1776; Harrod, 1939; Domar, 1946; Solow, 1956). Endogenous growth theory by Lucas and Romer (1988) popularised the inevitable role of human capital in economic growth. It testified to the long-run growth pattern experienced by the countries through the consistent augmentation of human capital stock, reiterating the reason behind the advancement of certain countries. Since then, human capital has been acknowledged for explaining growth differences among world nations. However, even as the role of human capital in economic growth is widely accepted in extant studies, a set of empirical studies at a global level yielded ambiguous results (Judson, 2002).

It implies that in many cases, the relationship between human capital and economic growth turned statistically insignificant, paving the way for analysing this relationship specifically from the Indian context using varied measures of human capital, specifically education variables. Besides, a plethora of literature studied the relationship between human capital and economic growth in the Indian context using either total public education expenditure or across all levels of education. For instance, Pradhan (2009) investigated using an error correction model from 1951 to 2001 to find out the

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relationship between public expenditure on education and economic growth in India. He noticed that there is a uni-directional causal relationship between education and economic growth in the Indian economy. The relationship between economic growth and education spending is causal, but not vice-versa. Therefore, Siddiqui and Rehma (2016) suggested that there is no consensus on what constitutes education as human capital; hence, the present study has delved into various measures of education in order to provide cross-comparison opportunities and robustness checks using AYS, GER as output indicators and also input indicators as total government education investment and investment on education across all the levels of education. The study also considered from 1982 to 2017 independent regression for each level of education in order to aim at the policy decision and also to avoid collinear issues between input and output measures of human capital. Subsequently, it also examines the consistency of the results using various educational measures of human capital and compares them with various measures of human capital. This measure gives a holistic view of the human capital stock of a nation.

An array of studies have acknowledged the statistically significant relationship between human capital and economic growth, reiterating a significant difference in regional income distribution based on the mean education level. Investments in people through channelised financing may enhance economic growth, which has a positive spillover on individuals and society as a whole (Sweetland, 1996). De la Fuente and Domenech (2000, 2006) examined both the level and rate effect using first-order differences between human capital and production, finding a statistically significant correlation. Using an Organisation for Economic Co-operation and Development (OECD) data set spanning between 1971 and 1988, Bassanini and Scarpetta (2001) found that an additional year of schooling led to a six per cent increase in per capita Gross Domestic Product (GDP). It further testified that the higher economic growth trajectory is mainly driven by the rise in a highly qualified workforce. The increased demand for an educated and professionally trained workforce can be ascribed to the faster growth witnessed by certain countries through technological advancement aided by those educated bunch of professionals (Mincer, 1995).

According to Bundell *et al* (1999), the rate of accumulation of human capital through attaining higher levels of education accentuates innovation which may positively impact labour productivity, thereby enhancing the output growth rate. For instance, half a century's dedicated investments in education expansion resulted in a 33 per cent improvement of labour productivity in the United States (Griliches, 1997). Similarly, in the United Kingdom, a unit increase in the level of education of the highly skilled workforce led to an increase of 0.42 to 0.63 per cent in annual output between 1971 and 1992 (Jenkins, 1995). For attaining a higher trajectory of economic growth, attaining higher levels of education is deemed essential, backed by the aforementioned empirical and theoretical studies. Considering education's role in economic growth, the Millennium Development Goals gave prime focus on access to education. Universalisation of primary education, especially in developing countries, was identified as a panacea to improve access to education.

The empirical literature, however, has conflicting findings regarding the link between economic growth and human capital. For instance, Levine and Renelt (1992) found that human capital has no statistically significant impact on economic growth. The association between economic growth and

education is found to be insignificant between 1960 to 1987 for 91 nations (Pritchett, 2001). The genuine growth benefit of schooling is not consistent among 57 countries in the meta-analysis (Benos & Zotous, 2014). Moreover, some studies pointed out that empirical investigation of the above relationship may sometimes have been influenced by specification bias, and thus, a weak correlation between the two is shown (Temple, 1999; Dessus & Temple, 1999; Bills & Klenow, 2000). The long and short-run influence of human capital on economic growth is another key area which needs vigorous attention. The clarity in the pattern of influence may have powerful policy implications in shaping the country's education policies. In an empirical study, Maksymenko & Rabbani (2011) identified a long-run positive and significant relationship between both the variables.

From the Indian context per se, Ghatak & Jha (2012) found that human capital formation is vital for high earnings at the individual level, generating ripple effects or positive externalities in the economy. India, the second largest populated country, has a favourable demographic dividend and witnessed varied business cycles with troughs and booms. India commands 17.14 per cent of the world's population while the share of GDP is a mere 2.76 per cent, which underscores the relevance of the study regarding human capital and economic growth trajectory (World Bank, 2020). Education is one of the factors that is thought to be effective in raising human capital, particularly formal education that has been assessed and standardised by the government, which has the power to do so. In order to improve the number of educated individuals in the nation, the Indian government has implemented a variety of policies and programmes. The AYS and the GDP growth rate per annum in the period 1981–1990 were 2.95 and 5.40 per cent respectively. Moreover, from 2011 to 2016, the AYS and GDP growth rates increased to 6.74 and 7.02 per cent annum respectively. As a result, the various policies and programmes have been effective in generating educational attainment, and over the past two decades, the average number of years spent by children in school has increased dramatically. Consequently, India had become one of the world's economies with the fastest growth rates at the end of the 20th century, especially after the 1990s (Ahmed & Varshney, 2012). As the percentage of educated workers rises, a nation's economy becomes more productive because educated workers are better able to complete activities that call for literacy and critical thought.

In this context, it is essential to note that measuring human capital is crucial while finding out its nexus with economic growth. The study has used education indicators as proxies for the human capital measure. There is no agreement on what constitutes education human capital; hence the study uses various indicators of education to provide possibilities for cross-comparison and robustness assessment (Siddiqui & Rehma, 2016). For instance, for calculating the stock of human capital, AYS has been used across all countries and regions (Mincer, 1974). UNESCO and national statistical organisations frequently use the GER as a standard flow measure of educational investment in society and for cross-sectional comparison for many official publications. From the quality of education perspective, Programme for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS) tests are used as indicators to understand the capability of human capital in the OECD nations (Hanushek and Kimbo, 2000). On the other hand, World Economic Forum's human capital index includes these major factors: education, wealth and wellness; workforce

and employment; and enabling environment. Enabling environment refers to the legal and other amenities ensuring the value of human capital.

Given this background, the present study delves into exploring the relationship between human capital and economic growth from the Indian scenario between 1981-82 to 2016-17 and also to examining the consistency of the results using the aforementioned measures of the human capital variable. Three crucial aspects influence the study period. First, extensive trade and investment reforms have been in operation since the 1980s. From the supply side, trade is essential for enabling inputs, globally accessible technology, and capital goods. As a result, the beginning of the 1980s was observed as a turning point in India's economic growth rate. The real GDP per capita increased by almost one per cent a year between 1950 and 1980. On the other hand, from 1980 to 2000, GDP per capita increased at a rate of about four per cent annually. Second, the time period taken into account for the study shows that India experienced a period of economic reforms, with the initial liberalisation beginning in the early 1980s and the wide-ranging reforms beginning in the early 1990s. Third, by guaranteeing the availability of comprehensive and comparable data for the collection of recent variables, the choice of time period also minimises the proportions of management tasks.

The paper is organized as follows: Section 2 briefly describes the conceptual framework and empirical methodology used for the study. Sections 3 and 4 include a description of data sources and descriptive analysis respectively. Section 5 unveils an empirical analysis and subsequent discussion. Section 5 ends with a conclusion and policy recommendations.

Conceptual Framework and Empirical Methodology

The study attempts to empirically examine the relationship between human capital and economic growth based on Lucas' (1988) aggregate production model as given below;

$$y = A.k^{\alpha}(uh)^{1-\alpha}(h_a)^{\gamma} \quad \text{..... (1)}$$

Where, γ represents per capita output, k is per capita physical capital stock, u shows the proportion of time spent on production, (1-u) represents the fraction of remaining time devoted to human capital accumulation, h captures the agents' human capital, α represents the elasticity of substitution of physical capital, A indicates the level of technology and h_a shows the average human capital measure in an economy.

Hence, the study first checks the order of integration and once all the variables are identified I (1), or integrated into order one, a cointegration relation exists and is confirmed. Error Correction Model (ECM) can then be derived. Take into account the subsequent bivariate relationship.

$$Y_t = \mu + \beta_1 X_t + \epsilon_t \quad \text{.....(2)}$$

Based on the above equation (1) and following the econometric specification suggested by Shrestha and Bhatta (2018), we have established the link between cointegration and Error Correction Model (ECM). The cointegration model for both the Y_t and X_t is as follows;

$$\epsilon_t = Y_t - \mu - \beta_t X_t \quad \text{.....(3)}$$

The estimation for the cointegration and error correction equation of the log of real GDP, log of Gross Fixed Capital Formation (GFCF), log of Trade Openness (TO), log of Labour Force Participation Rate (LFPR), and log of Human Capital (HC) is given below. The Vector Error Correction Model (VECM) approach estimates the short run relationships for each of the variables after estimating the long run relationships. Based on the literature, the cointegration equation of the study as follows;

$$\epsilon_t = lnGDP - \phi - \beta_1 lnGFCF - \beta_2 lnTO_t - \beta_3 lnLFPR - \beta_4 lnHC \ldots\ldots\ldots\ldots (4)$$

Here, HC indicates human capital for both the cointegration equation and error correction model. Thus, in specification-1, HC => log of real total education expenditure. In specification-2, HC => log of real education expenditure at elementary, secondary, and higher education levels. In specification-3, HC => log of average years of schooling. In specification-4, HC => log of gross enrolment ratio at elementary, secondary, and higher educational levels.

Error Correction Model (ECM) is as follows;

$$\Delta \ln GDP = \mu \ln GDP + \alpha \ln GDP \varepsilon_{t-1} + \sum_{h=1}^{2} a_{1h} \Delta \ln GDP_{t-h} + \sum_{h=1}^{2} b_{1h} \Delta \ln GFCF_{t-h} + \sum_{h=1}^{2} c_{1h} \Delta \ln TO_{t-h} + \sum_{h=1}^{2} d_{1h} \Delta \ln LFPR_{t-h} + \sum_{h=1}^{2} e_{1h} \Delta \ln TEE_{t-h} + U_{lnGDP_t} \ldots (5)$$

Model Specification, from the econometric specification (1), investigates the relationship between public expenditure on education and economic growth, whereas specification (2) examines the association of public expenditure at different levels of education, namely primary, secondary and tertiary and GDP growth. specification (3) delves into the linkage between the average years of schooling and economic growth. Finally, specification (4) throws light into the association between GER across the aforesaid three levels of education and economic growth of the country. Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests have been carried out to test the stationarity of the time series data used here. Based on the restricted Vector Auto Regressions (VAR) model and Akaike Information Criterion (AIC) the optimal lag length is selected for the cointegration tests. To form a long-run relationship between human capital and economic growth, the Johansen cointegration technique has been used. Stock and Watson (1988) and Enders (2018) found that an actually useful way that is easy to unveil cointegration variables shares common stochastic trend relationships. Thus, the estimation of VECM utilised for adjusting toward the long-run equilibrium.

Deploying a Johansen cointegration technique may be appropriate in this study as cointegrating variables have a common stochastic trend, highlighting the cointegration relationship with better clarity (Stock and Watson, 1988). In addition, VECM identified the adjustment toward the long-run equilibrium.

Data Sources

In the macro assessment between human capital and economic growth deploying educational indicators, the study used annual time series data spanning from 1981-82 to 2016-17 to explore the dynamic relationship between educational indicators and to measure economic growth both in the short and long-run. The study also used shock responses among educational indicators and economic growth

in India. To prevent the problem of omitted variable bias in the estimated results, the variable selection is based mainly on past empirical research, the country's development experience and economic growth stages, and data availability in the country.

Apart from AYS and total public spending on education, it is also crucial to note that the educational indicators across levels of education are decomposed into three levels of GER and government expenditure such as elementary, secondary and higher education. The basic aim is to determine which educational level statistically more consistently influences the country's economic growth and to derive more policy implications for that education level. To avoid the problem of heteroscedasticity, autocorrelation, and unreliable policies, all the variables are transferred in a logarithm. Despite using educational indicators as a proxy of human capital measures, other important control variables have been used in the estimation to mitigate the biasedness in the results, such as GFCF, TO, and LFPR. Trade openness has been noted in the various literature that more economy openness means higher the employment opportunities it generates through investment and trade. Increased investment may lead to more skills and technology, cash flow in the economy, and unemployment reduction (Gozgor, 2014). The sources of the variables and descriptions are presented in

Table 1: Description of variables that are used for subsequent analysis

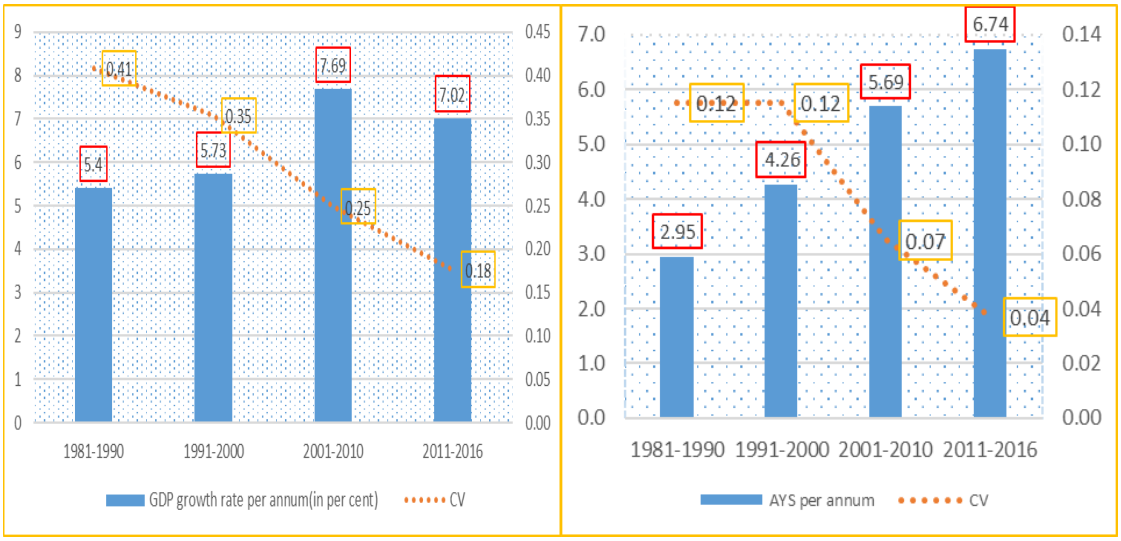
Variables	Definitions	Sources
GDP (Outcome Variable)	Real Gross Domestic Product in 2011-12 constant Indian rupees as a proxy for economic growth	National Account Statistics (NAS)
GFCF	GFCF as a proxy for physical capital in 2011-12 constant Indian rupees	Annual Survey of Industries (ASI), Ministry of Statistics Programme Implementation (MOSPI), Government of India (GoI)
TO	TO=(Export+Import)/GDP) *100	Reserve Bank of India
AYS	Highest level of education attained at each age group of population and official duration of each educational level. Barro and LEE (1993, 2010)	India Human Development Survey (IHDS) and United Nations Development Programme (UNDP).
GERELM GERSEC GERHE	$GER_h^t = \frac{E_h^t}{P_{h.a}^t} \times 100$	Economic and Political Weekly Research Foundation (EPWRF), U-DISE and All India Survey on Higher Education (AISHE)
PE TEE PE ELM PE SEC PE HE	Government expenditure on education across different levels in Indian rupees adjusted with inflation	Analysis of Budgeted Expenditure on education (various years) and Bas van Leeuwen in 2008
LFPR	(No. of employed+ unemployed persons)/ Total population)*100	National Sample Survey Office (NSSO) (various employment and unemployment round)

Source: Authors' computations

Descriptive Analysis

The section on descriptive analysis presents a comparative analysis of the decade-wise Compound Annual Growth Rate (CAGR) of GDP as well as the human capital variables that are used in this paper. It starts by presenting the CAGR of the GDP and Average Years of Schooling (AYS) in figure 1.

Figure 1: Decadal Growth Rate (in per cent) of GDP and AYS per annum (in per cent)

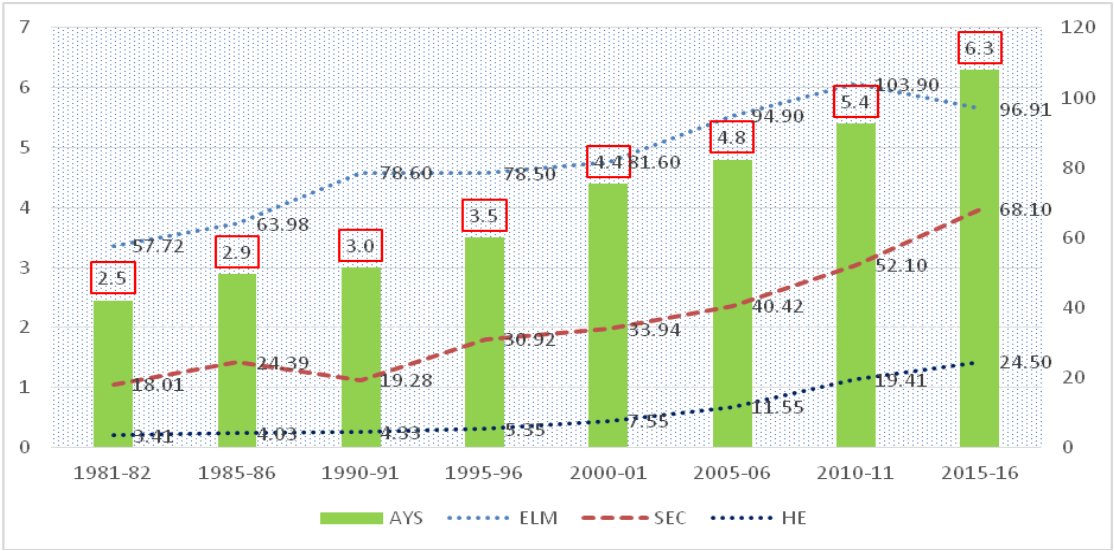


Source: Authors' computations using secondary data (NAS; UNDP and IHDS)

Figure 1 indicates that the AYS accounts for about 2.95 per cent between 1981-90, whereas it has increased to about 6.74 per cent between 2011-16. The AYS shows an increase, perhaps due to the implementation of various government policies and programmes like the national education policy in 1986 and 1992. Similarly, the government also introduced District Primary Education Programme (DPEP) in 1993-94 and Sarva Shiksha Abhiyan (SSA) for the uiversalisation of primary education in 2001. The most interesting point one can note is that after the introduction of Right to Education (RTE) Act in 2009 for universalisation of both primary and upper primary education and Rashtriya Uchchatar Shiksha Abhiyan (RUSA) in 2013 for secondary education, there has been a significant increase in AYS. Subsequently, the GDP growth rate per annum has also shown an increase from 1981-90 to 2001 to 2010. The most interesting point is that both AYS and economic growth moved in a positive direction during this period. However, a possible reason for the decline of GDP growth from 2001-10 to 2011-16 could be the financial crisis in 2008.

Before enactment of the time series analysis, the pattern of movement of AYS and GER at elementary, secondary, and tertiary levels are analysed. Any investment or efforts towards education will take a certain time to yield results.

Figure 2: Trends of Average Years of Schooling (AYS) and Gross Enrolment Ratio (GER)



Source: Authors' computation from secondary data (EPWRF, MHRD, AISHE, U-DISE)

The growth of the enrolment ratio is related to multiple interrelated factors such as institutions and teachers, public investment in education etc. The thrust of Universalisation of Elementary Education (UEE) combined primary with upper primary to achieve elementary education. The development of any nation's education has a key role to play, and that will be planned by public policies. Therefore, in higher secondary education, uniform patterns of the education system have been introduced with the approval of the National Education on Education (NEP) in 1986 across the Indian states in the country. The approval of the NEP has taken more than a decade across the major Indian states to implement. Despite a decade, longer time access and continuity of the schooling pattern have improved. The main aim of the DPEP in 1993-94 was only to universalise primary education. However, in 2001, SSA covered both educational levels for UEE, such as primary and upper primary education in India. The progress of elementary education seems to be a little slow up to the DPEP introduced. However, the GER of elementary education has improved after implementing SSA.

The SSA and RTE's aims were to reduce drop-outs and to identify all out-of-school children to bring universalisation of primary and elementary education. Although Census 2011 identified the age group of 5 to 17 years, 84 million children were out of school, a few states have not followed up rigorously to identify out-of-school-going-age children (Mehta, 2017). When compared with figures in the 2011 Census, the Ministry of Human Resource Development (MHRD) commissioned a survey in 2014 and found that 61 million children between the ages of 6 and 13 were not enrolled in school. This figure may be considered a gross underestimation. Thus, it could be one of the possible reasons for the declining GER in elementary education in India after 2011.

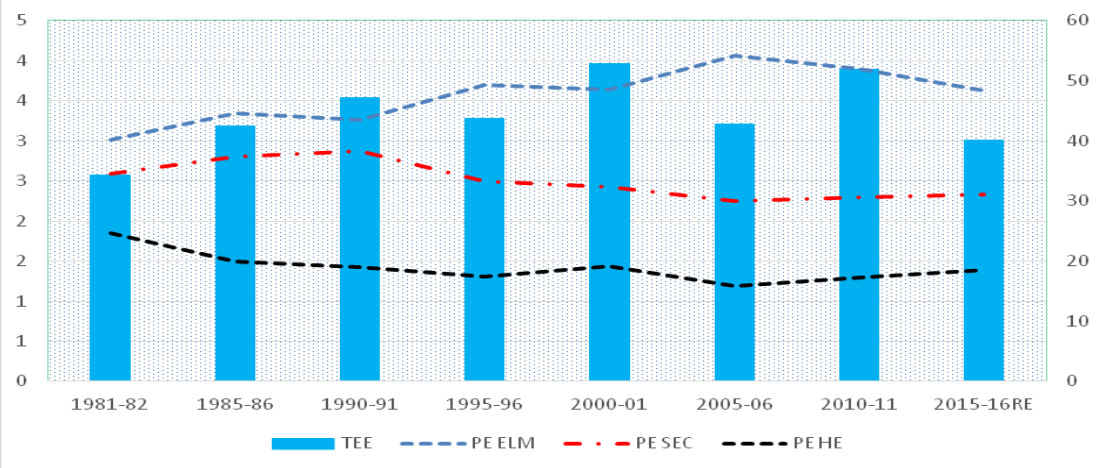
The 1986 education policy played an essential role in providing educational opportunities to disadvantaged groups, particularly to the scheduled castes, scheduled tribes, other backward classes, and women. This put pressure for developing new schools, colleges and teacher recruitment from oppressed groups. It further emphasised opening open universities in Delhi, i.e., Indira Gandhi National Open University, and following the Gandhian philosophy to educate rural people (Government of India,

1986). The Right to Education Act emphasised free and compulsory education for children between the ages of 6 to 14 years. Similarly, in 2009, the Rashtriya Madhyamik Shiksha Abhiyan (RMSA) introduced secondary education to enhance the access and quality of secondary schools. It also set up educational institutions within a reasonable distance of any habitat and increased the total enrolment rates (Social and Rural Research Institute, 2014).

After the introduction of the RMSA, more secondary education schools were opened, and while in the year 2012-13 only 34.64 million students were enrolled, in the year 2016-17, it achieved 38.82 million enrolments, a sudden spike of 4.18 million. Subsequently, the higher secondary enrolment increased from 19.92 million to 24.40 million in the same years and here also, an increase of 4.48 million enrolments were found. One can also see the combined increment of both secondary and higher secondary education at the same time from 2012 -13 to 2015-16 when it rose from 54.56 to 63. 88 million respectively. Hence, one can find that government policy plays a vital role in increasing GER in secondary education.

Similarly, introducing RUSA helped in the fastest growth of GER for higher education compared to the earlier policy and programme. Hence, one can conclude that government policy and programmes play a vital role in increasing a country's human capital stock. Moreover, the relationship between AYS and GER across educational levels postulates a positive trend over a period of time.

Figure 3: Trends of Total Education Expenditure and Public Expenditure across different levels of Education



Source: Authors' computations from secondary data (Analysis of Budgeted Expenditure on education for various years)

The study period considered shows that India experienced a period of economic reforms, with the initial liberalisation beginning in the early 1980s and the wide-ranging reforms starting in the early 1990s. Extensive investment reforms have been in operation since the 1980s. The total public expenditure on education from 1981-82 to 1990-91 shows an upward trend. It may be due to the implementation of the 42nd amendment Act of 1976 that moved education from the state list to the concurrent list, increasing the central government's responsibility for education (Patel, 2019). Similarly, the introduction of a NEP in the years 1986 and 1991 by the Ramamurthy Committee may have

influenced the increased public spending on education. However, from 1990-91 and 2000-01, the total spending on education has come down to around 3.5 per cent of the total GDP. India's rapid economic growth was made possible by the liberalisation, privatisation, and globalisation of economic reforms of the 1990s. The study finds that total public expenditure has come down during that period. Human capital investments are a significant factor in determining India's productivity growth, in addition to having an immediate impact on capital accumulation in India. Even though the percentage share of GDP on total education expenditure has come down, the noteworthy fact is that the public expenditure on elementary education is increasing.

During the past few decades, public expenditure on elementary education by the central government has found a rise in the central budget. In 1995-96 and 2003-04, the public expenditure on elementary education increased from 40 to 50 per cent, respectively. Whereas, in 1990–91, spending on secondary education was only 13.7 per cent. Thus, secondary schools have largely suffered as the share of elementary education has increased. Furthermore, in 2001, there was a sharp decline in higher education spending, although this was the primary responsibility of the central government. Nonetheless, spending on technical education has been observed to be relatively unaffected. As a result, it is clear that in an intra-budget allocation, more policies and programmes have been focused on elementary education spending rather than higher education (Tilak, 2006a).

The most critical possible reason could be the implementation of the DPEP in 1993-94. At the same time, there was a decline in public expenditure on secondary education. It may be due to the lack of attention to public spending on secondary education. However, in the year 2000-01, there is a spike in public expenditure in total. The possible reason could be the implementation of UEE through SSA in the years 2000-01. Moreover, it may be due to the general analysis of the trajectory in education spending for the entire period showing that the post-reform period, which spanned 2000 to 2008-09, experienced a lower trend. The speed of economic reforms accelerated during this time, which had a negative impact on public spending generally, the social sector specifically, and spending on education. It is commonly recognised that this phase was characterised by privatisation, state shrinkage, and a reduction in the fiscal deficits of the federal and state governments.

In 2010-11, the total public expenditure found an increasing trend, perhaps due to the implementation of the RTE Act in 2009. Hence, we see that the share of public expenditure on elementary education has increased consistently. It receives approximately half of the total resources for elementary education only while secondary education received around a third. Therefore, it's clear that more emphasis has been given to elementary education and the resources spent on secondary and higher education are negligible at aggregate levels of public expenditure. However, one can conclude from the public expenditure on tertiary education, which is less than one per cent of GDP, what is the spending on higher education in India. Hence, it is clear that the quality of higher education has a severe problem. Public expenditure on elementary education is steeper than on secondary and higher education. Therefore, investment in education should be consistent, which will help the accumulation of human capital, which in turn is beneficial to the country's overall growth. Education-related factors are typically used as proxies for investments in human capital. In fact, it is generally recognised that the formal educational system serves as the main governmental mechanism for developing human abilities

and knowledge. Most emerging nations have been persuaded that the key to their economic and societal progress lies in the quick expansion of educational possibilities.

Empirical Analysis and Discussions

Stationarity Test

The results of stationarity tests for the variables understudy as carried out based on Augmented Dickey-Fuller (ADF) (1981) and Phillip-Perron (PP) (1988) are presented in **Table 2.** They confirm the integration order of the variables, meaning whether those variables are integrated at the level and first differences. The time span of these variables is 1982-2017.

Table 2: Stationarity Test Based on Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP)

Variables	**Level (0)**		**Level (0)**		**First Difference I(1)**		**First Difference I(1)**	
	I	**I & T**	**I**	**I & T**	**I**	**I & T**	**I**	**I & T**
LnGDP	3.03	-1.28	4.16	-1.20	-4.55***	-5.34***	-4.60***	-5.56***
LnGFCF	0.54	-1.86	0.52	-1.91	-5.72***	-5.73***	-5.73***	-5.74***
LnTO	-0.74	-1.17	-0.82	-1.86	-4.38***	-4.34***	-4.46***	-4.39***
LnLFPR	-0.74	-1.91	-0.14	-1.24	-3.63***	-3.73**	-3.63***	-3.70**
LnGER ELM	-1.77	-1.85	-1.91	-1.88	-5.56***	-5.70***	-5.59***	-6.42***
LnGER SEC	1.11	-3.24	-0.17	-3.19	-5.64***	-5.55***	-7.55***	-8.34***
LnGER HE	0.67	-1.88	1.02	-1.88	-6.74***	-6.96***	-6.76***	-7.20***
LnAYS	-0.65	-3.22	-0.65	-2.57	-5.44***	-5.36***	-5.44***	-5.36***
LnPEELM	3.54	-3.36	-0.32	-2.48	-4.35***	-4.27***	-5.53***	-5.50***
LnPESEC	3.38	0.51	-0.09	-1.76	-5.18***	-4.61***	-5.17***	-5.14***
LnPEHE	3.13	-2.40	1.62	-1.81	-5.65***	-4.59***	-6.19***	-7.36***
LnTEE	1.67	-3.47	-0.90	-2.85	-4.46***	-4.95***	-6.05***	-5.67***

Source: Authors' estimation using Eviews 10.

Note: I means intercept and I &T means intercept and trend

Note: ***, ** and * implies level of significance at 1%, 5% and 10% respectively.

As per the results, the series are integrated in the order I (1) and its corroborate (Shrestha and Bhatta, 2018). Since all the variables are stationary at the first difference and integrated in order one, Johansen cointegration is the appropriate empirical technique to proceed with the cointegration.

Cointegration Test

From the AIC, the optimum lag length for all the equations turned out to be two. The following empirical exercise using Johansen cointegration throws light on the long-run association between human capital and economic growth in India. To investigate the long-run relationship between variables, the cointegration technique is deemed appropriate, applying the reduced rank procedure developed by Johansen (1988) and Johansen and Juselius (1990). To proceed with cointegration, the Johansen approach based on two statistics, Trace and Maximum Eigenvalue tests, is carried out as a prior step, and the results are exhibited in **Table 3.**

Table 3: Trace and Max-Eigen Statistics confirming the long-run association between economic growth and human capital in India

	Trace		Max-Eigen	
	Statistics	**Critical Value**	**Statistics**	**Critical Value**
Specification 1: Total Education Expenditure				
r=0*	87.07	69.81	36.72	33.87
r≤1*	50.34	47.85	27.47	27.58
r≤2	22.87	29.79	14.72	21.13
r≤3	8.14	15.49	7.83	14.26
r≤4	0.31	3.84	0.31	3.84
Specification 2: Public Expenditure Across Different Levels of Education				
r=0*	226.96	125.61	99.30	46.23
r≤1*	127.65	95.75	46.48	40.07
r≤2*	81.17	69.81	36.35	33.87
r≤3	44.82	47.85	25.27	27.58
r≤4	19.54	29.79	12.20	21.13
r ≤5	7.34	15.49	7.30	14.26
r ≤6	0.03	3.84	0.03	3.84
Specification 3: Average Years of Schooling				
r=0*	105.55	69.81	43.64	33.87
r ≤1*	61.90	47.85	33.76	27.58
r ≤2	28.14	29.79	13.54	21.13
r ≤3	14.59	15.49	9.23	14.26
r ≤4	5.36	3.84	5.36	3.84
Specification 4: GER Across Different Levels of Education				
r=0*	290.84	125.61	99.70	46.23
r ≤1*	191.13	95.75	87.22	40.07
r ≤2*	103.90	69.81	38.69	33.87
r ≤3*	65.21	47.85	29.12	27.58
r ≤4*	36.08	29.79	23.62	21.13
r ≤5	12.46	15.49	10.96	14.26
r ≤6	1.49	3.84	1.49	3.84

Source: Authors' estimation

Note: ***, **, * implies level of significance at 10%, 5% and 1% respectively

From **Table 4** given below, it is evident that human capital variables like AYS and education expenditure exhibit a long-run association with economic growth captured by the GDP in India. The result highlights that keeping all other variables constant, GER across various levels of education influences economic growth and moves together in the long run. Given the presence of cointegrating vectors, we rejected the null hypothesis, stating there is no cointegration.

It is intriguing that from the estimated coefficients of specification (1), a long-run relationship exists between physical capital and labour force participation, which is statistically significant at one per cent. It implies that the elasticity of GDP with respect to physical capital and labour force participation rate has positive effects on economic growth. On the contrary, the relationship between public

expenditure on education and trade openness turned negative and significant. In India, the rise in public expenditure on education enhanced the infrastructural amenities like establishing new schools, compound walls, toilets etc., while giving less focus on providing quality education through improvement in Pupil Teacher Ratio (PTR), adequate training programmes, etc. (Goel, 1974). The relationship with different levels of education is insightful. Specification (2) testifies that public education expenditure at elementary and secondary levels has a negative and significant influence on the economic growth of the country. At the same time, it is positive and significant for one per cent expenditure at the tertiary level. From specification (3), there is a long-run association between AYS and GDP of the country. However, the variable elasticity of GDP to physical capital and trade openness in this equation which is negative and significant on economic growth, is noteworthy. It implies that in this equation, although the country's physical capital base is significant, it influences economic growth negatively, even as human capital influences growth positively. Finally, from specification (4), GER across various levels of education turns positive and statistically significant, along with trade openness and labour force participation. Therefore, GER across all three levels of education are crucial for economic growth in the long run.

Table 4: Results of Johansen cointegration affirming the long-run relationship between economic growth and human capital in India

Variables	Specification 1	Specification 2	Specification 3	Specification 4
Ln GFCF	0.17(4.82)***	0.008(0.43)	-0.25(-6.47)***	-26(-12.03)***
Ln TRADE	-0.12(-3.68)***	0.05(3.95)***	-0.01(-0.47)	0.10(10.80)***
Ln LFPR	0.74(5.47)***	0.46(5.18)***	4.23(5.66)***	0.77(14.44)***
Ln TEE	-0.09(5.70)***			
Ln PE Elm		-0.16(-8.11)***		
Ln PE SEC		-0.03(-1.87)*		
Ln PE HE		0.18(14.89)***		
Ln AYS			1.86(1.39)	
Ln GER ELM				0.11(3.25)***
Ln GER SEC				0.013(1.31)
Ln GER HE				0.26(14.34)***
Constant	-3.88**	-1.95*	-24.21***	-0.95.

Source: Authors' estimation by using Eviews 10.

Note: ***, **, * implies level of significance at 1%, 5% and 10%, respectively.

(t- Values are presented in parentheses)

Estimation of VECM in the short-run

After establishing the long-run association between human capital variables and economic growth, a VECM is deployed to determine the relationship between the short-run and long-run equilibrium.

Table 5: Estimates of Vector Error Correction Model

Variables	Specification 1	Specification 2	Specification 3	Specification 4
ΔlnGDP t-1	0.17 (0.91)	-0.02 (-0.08)	-0.00 (-0.04)	0.23 (1.34)
ΔlnGDP t-2	-0.01 (-0.06)	0.55 (2.47)**	-0.18 (-0.90)	-0.06 (-0.34)
ΔlnGFCF t-1	0.11 (2.02)**	0.03 (0.69)	0.06 (0.87)	-0.06 (-0.81)
ΔlnGFCF t-2	0.04 (0.91)	0.11 (2.65)***	0.12 (1.75)*	0.13 (2.17)**
ΔlnTRADE t-1	-0.02 (-058)	-0.00 (-0.21)	0.04 (1.05)	0.02 (0.60)
ΔlnTRADE t-2	-0.00 (-0.13)	-0.03 (-1.25)	-0.00 (-0.17)	0.02 (0.53)
ΔlnLFPRt-1	-0.49 (-1.78)*	0.05 (0.18)	-0.64 (-1.09)	-0.43 (-2.42)**
ΔlnLFPRt-2	0.62 (2.40)**	0.21 (0.48)	0.61 (2.97)***	0.79 (2.00)**
ΔlnTEE t-1	0.11 (2.70)***			
ΔlnTEE t-2	-0.08 (-2.06)**			
ΔlnPEELM t-1		0.06 (1.20)		
ΔlnPEELM t-2		-0.23 (-3.77)***		
ΔlnPESEC t-1		0.07 (2.00)*		
ΔlnPESEC t-2		0.02 (0.72)		
ΔlnPEHE t-1		0.04 (2.11)**		
ΔlnPEHE t-2		0.07 (3.32)***		
ΔlnAYSt-1			0.16 (0.76)	
ΔlnAYSt-2			0.60 (2.63)***	
ΔlnGERELM t-1				0.33 (2.44)**
ΔlnGERELM t-2				0.04 (0.42)
ΔlnGERSEC t-1				0.06 (1.49)
ΔlnGERSEC t-2				0.09 (2.13)**
ΔlnGERHE t-1				0.21 (2.71)***
ΔlnGERHE t-2				0.10 (1.33)
ECM $_{t-1}$	-0.44 (-1.96)*	-0.63 (-2.48)**	-0.060 (-3.08)***	-0.95 (-3.28)***
Constant	-0.01 (-1.60)	-0.01 (-1.40)	0.06 (3.98)***	-0.03 (-3.08)***
R-Square	0.63	0.76	0.53	0.67
F- Statistics	3.34	3.67	2.22	2.31

Source: Authors' estimation

Note: ***, ** and * implies level of significance at 1%, 5% and 10%, respectively.

The Trace and Max-Eigen test statistics in table 3 confirmed that the cointegration exists among variables at 1 and 5 per cent significance levels, respectively. Therefore, deployment of VECM is possible, and the estimated error correction coefficient term is expected to be negative as well as less than unity. From the table above, we find that it ranges between zero and one with a one per cent level of significance, implying the presence of cointegration and the existence of a steady-state equilibrium in the long run. Thus, economic growth and human capital variables are moving together in the long run. The statistical significance of the error correction term implies that an error of past equilibrium plays an essential role in determining the current outcome. ECM is defined as the speed of adjustment of the system toward equilibrium in the long run.

The above results are insightful from the policy-making perspective, as education variables also influence economic growth in the short run. The public expenditure on education positively

influences the GDP in the short run with a one-period time lag while leaving a negative impact in a two-period time lag. The results corroborate the findings of Holdar (2009). Furthermore, the adjustment coefficient in the short run (ECM_{t-1}) postulates that a negative and significant result is a necessary condition for the ECM model to converge toward the long-run equilibrium. In equation (5), the error correction term is significant at the 10 per cent level. Hence, it can be inferred that with one-time lag, the convergence speed of the coefficient towards the long-run equilibrium is about 44 per cent. Similarly, physical capital and public expenditure on education at secondary and tertiary levels positively influence the changes in GDP in the short run (two-time lag), meaning a unit change in physical capital and the aforesaid expenditures alter the GDP by 11 and 7 per cent, respectively. In this case, the speed of adjustment turns out to be 63 per cent. Notably, public expenditure in elementary education is statistically insignificant, implying expenditure at this level does not necessarily influence economic growth either in the long run or short run. It may serve only as a pre-requisite for attaining higher education levels. Besides, the AYS also leaves a positive and significant impact on economic growth in the short run at a two-period time lag. It implies that a unit change in AYS leads to a 6 per cent GDP increase. Similar is the case with GER across three levels of education, with the speed of adjustment being 95 per cent.

Diagnostic Test

The diagnostic tests are vital for validating the above-explained models of connecting human capital and economic growth both in the short and long run. From the diagnostic tests **(Table 6)**, we understand that in the short run, the error term is distributed normally with zero mean and constant variance. The model also confirms that it is free from the problem of autoregressive conditional heteroskedasticity and white heteroskedasticity. Similarly, the diagnostic test for serial correlation testifies that the short-run error terms are normally distributed with zero mean and constant variance. Therefore, it ensures that the model is free from serial correlation in the short run.

Table 6: Results of the Diagnostic Tests

Test	LM Version				F Version			
	Eq. 1	**Eq. 2**	**Eq. 3**	**Eq. 4**	**Eq. 1**	**Eq. 2**	**Eq. 3**	**Eq. 4**
Serial Correlation	0.80 (2.59)	0.10 (0.46)	1.87 (5.44)	0.41 (1.74)	0.45 (0.27)	0.89 (0.79)	0.18 (0.06)	0.66 (0.41)
Normality	0.90 (0.63)	0.10 (0.94)	1.88 (0.38)	2.30 (0.31)	Not Applicable			
Heteroskedasticity	0.67 (12.32)	0.39 (14.20)	0.60 (11.43)	0.25 (10.85)	0.77 (0.65)	0.96 (0.86)	0.83 (0.72)	0.99 (0.96)

Source: Authors' estimation

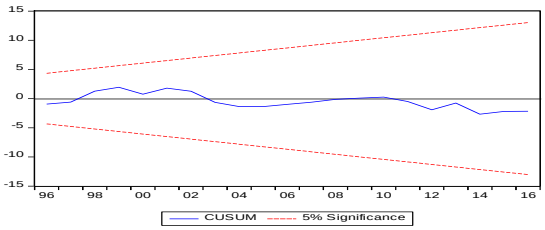
Note: P values in parentheses

Robustness Check

The cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMsq) test check the parameters' stability in the short and long run. These tests are frequently used in graphic form to represent the stability of parameters. The stability tests in a time series analysis are also called tests of

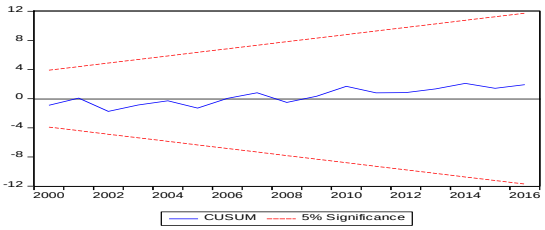
structural change. It also examines the estimated coefficients stability of the equation and determines whether any structural changes are present in the correlation. Therefore, the test of CUSUM is used for the robustness check of the long-run relationship between GDP and particular to human capital variables. As per the tests, the models are found robust. The significance of the statistics is represented by the straight lines at 1 and 5 per cent levels, respectively **(Figures 4 to 7 provide the robustness check under CUSUM tests, and Figures 8 to 11 represent CUSUM square tests).**

Fig. 4



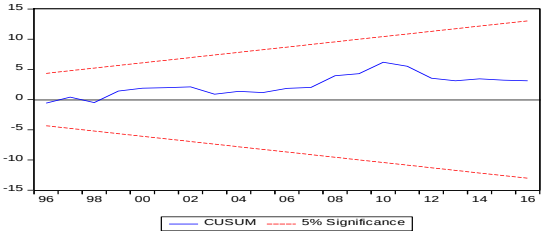
Total education expenditure and GDP

Fig. 5



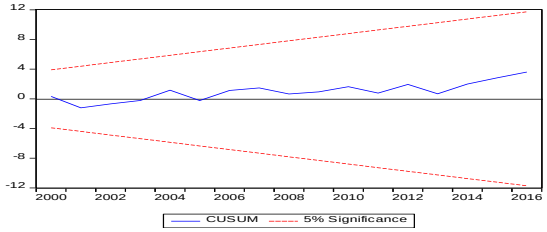
Expenditure by levels of education and GDP

Fig.6



AYS and GDP

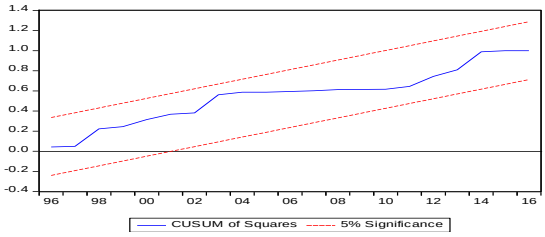
Fig. 7



GER across levels of education and GDP

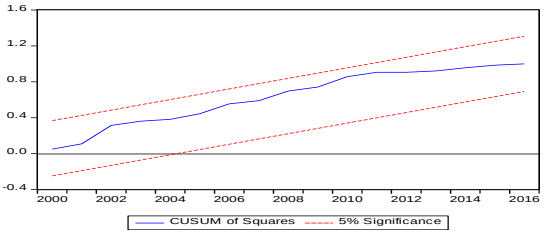
Following figures are from the CUSUM Square tests

Fig. 8



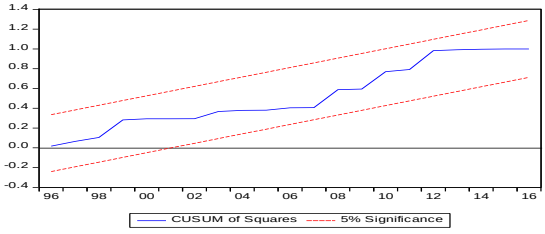
Education expenditure and GDP

Fig. 9



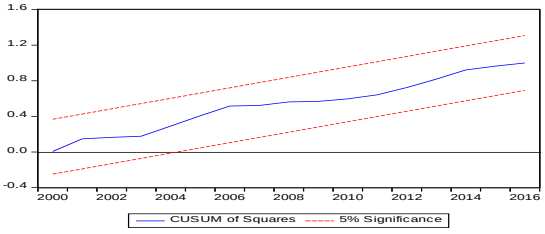
Expenditure by levels of education and GDP

Fig.10



AYS and GDP

Fig.11



GER across levels of education and GDP

Source: Authors' estimation by using Eviews 10.

Note: Significance of critical value at five per cent level is postulated by the straight lines

Impulse Response Function

The Impulse Response functions (IRFs) are produced when the long-term relationships between the trimmed variables have been established. As IRFs examine the impact of a shock, it provides the plot of variables' dynamic response to those shocks with one standard deviation and the simulations of the impulse response are shown in graph form **(Refer Appendix fig. 1.A to 4.A)**. From the GER figures, it is evident that shocks to physical capital, labour force participation rate and GER of secondary and higher education are influencing economic growth significantly in the short and medium run but not in the long run. Similarly, from the AYS graphs, it is evident that shock to trade openness, labour force participation rate, and AYS positively affect economic growth in the short and medium runs. However, to determine which educational levels offer the best returns, public investment in human capital is also measured in total and across all educational levels. Therefore, one can find out from the total spending on education and across all the levels of education aftershocks to labour force participation and total education expenditure has influence significantly on economic growth. Consequently, across educational levels, graphs show that shocks to trade openness and secondary and tertiary education affect economic growth in the short run. On the other hand, although insignificant, shocks to elementary education public expenditure have negative and negligible effects on economic growth. The solid blue line indicates the IRF value.

Conclusion and Policy Recommendations

The present study attempts to investigate the empirical relationship between human capital and economic growth in India during 1982-2017. Since after the first difference, all the variables were found to be stationary, the study deployed the Johansen cointegration test techniques to confirm a long run association among the variables under study. VECM was used to discern both the short and long-run dynamic process of adjustment simultaneously. The human capital variables like AYS and GER across levels of education have both short and long-run associations with economic growth in the country, confirming the observations (Tallman & Wang, 1994). Using various definitions of human capital used by empirical researchers, our objective in this study was to discern a systematic assessment of the relationship between human capital stock and economic growth in India. Hence, an analysis of public expenditure across different educational levels and GER across levels of education and its influence on economic growth is insightful from a policy-making perspective. Most importantly, this study simultaneously examined input (total public expenditure on education and public expenditure across different levels of education) and output (AYS and GER at each educational level) variables as a proxy for human capital accumulation in different regression equations and examined whether its impact on economic growth changes with the use of different measures of the human capital variable or not.

The analysis shows that the empirical relationship between human capital and economic growth is mostly consistent with different measures of the human capital variable but varies in a few cases. Therefore, studies should provide sufficient justification for choosing a particular measure of human capital while examining its impact on economic growth.

Moreover, the patterns of stock of human capital variables and economic growth delineate that India has improved AYS and GER in elementary education due to the operationalisation of various

education schemes and programmes of universalisation of primary and upper primary education. Subsequently, the spending patterns for elementary education increased faster than for secondary and higher education. Hence, it is clear that in an intra-budget allocation, more policies and programmes have been focused on elementary education spending rather than higher education (Tilak, 2006a). Although public expenditure on secondary and tertiary education has a long-run influence on India's economic growth, the impact of expenditure on elementary education turns statistically insignificant. Giving utmost focus on elementary education through policy interventions may not suffice to provide the necessary impetus to economic growth. There is a need to further focus on secondary and tertiary education, continuing its focus on elementary education regarding the allocation of educational resources by the government. Nevertheless, the total public expenditure on education impacts economic growth with a one-time lag, whereas the relationship is negative and significant for two-time lags. As mentioned earlier, the expenditure by the government mainly focuses on extending infrastructural amenities rather than ensuring the quality of education.

India, as a developing country with varied social divisions, and marginalised and economically backward communities, may find it difficult to afford private education, especially at higher education levels (Patel, 2009). Given the magnitude and direction of government spending at the higher education level and the country's economic growth, necessary policy initiatives should be in place to step up the role of government through their budgets. In India, human capital scores over physical capital while impacting economic growth. Achieving a higher economic growth trajectory is possible only through consistent efforts to augment human capital. Enrolment rates across all levels of education and educational attainment measured by AYS are found vital for higher economic growth. Therefore, considering the importance of education capital along with physical capital, enhancing the education level through a specified focus on higher education is desirable for a country like India to reap the benefits of existing demographic dividend.

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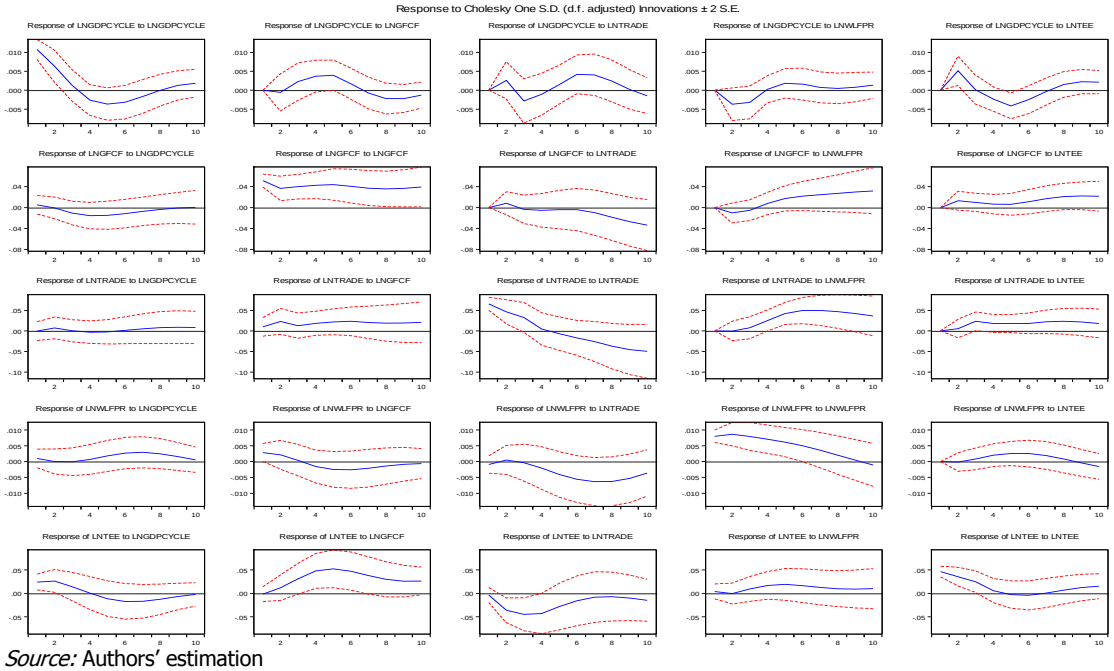
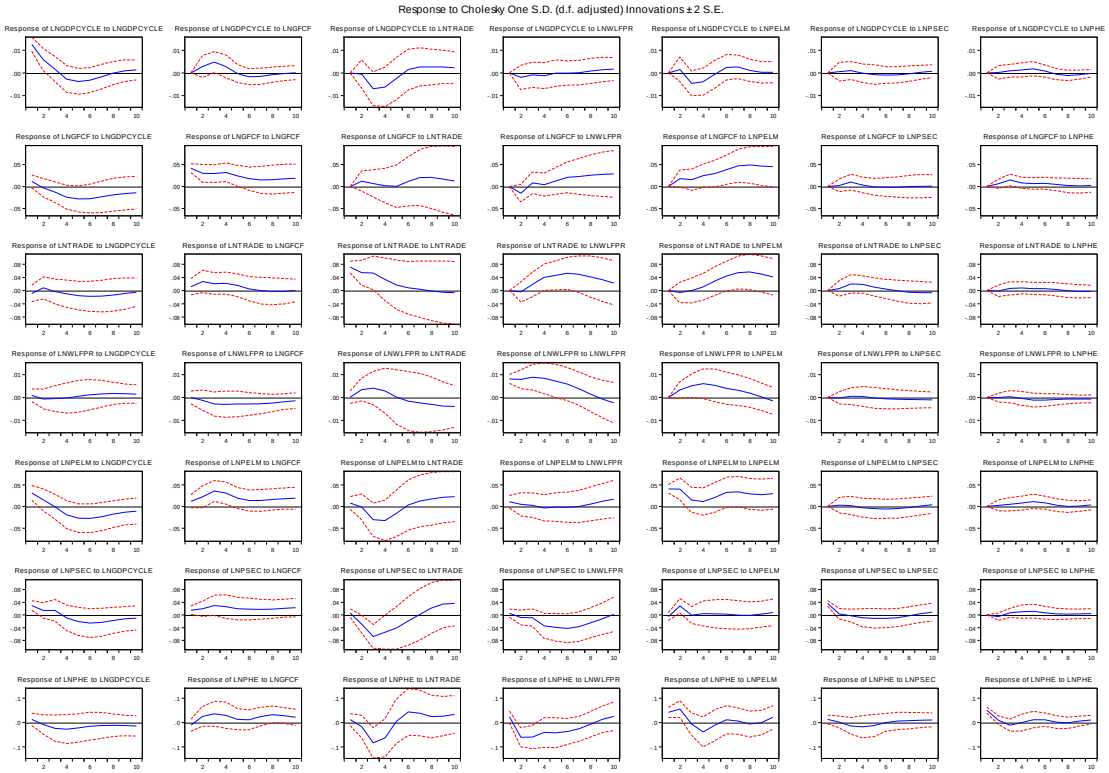
Appendix

Figure 1.A: Impulse Response Function of Total Education expenditure



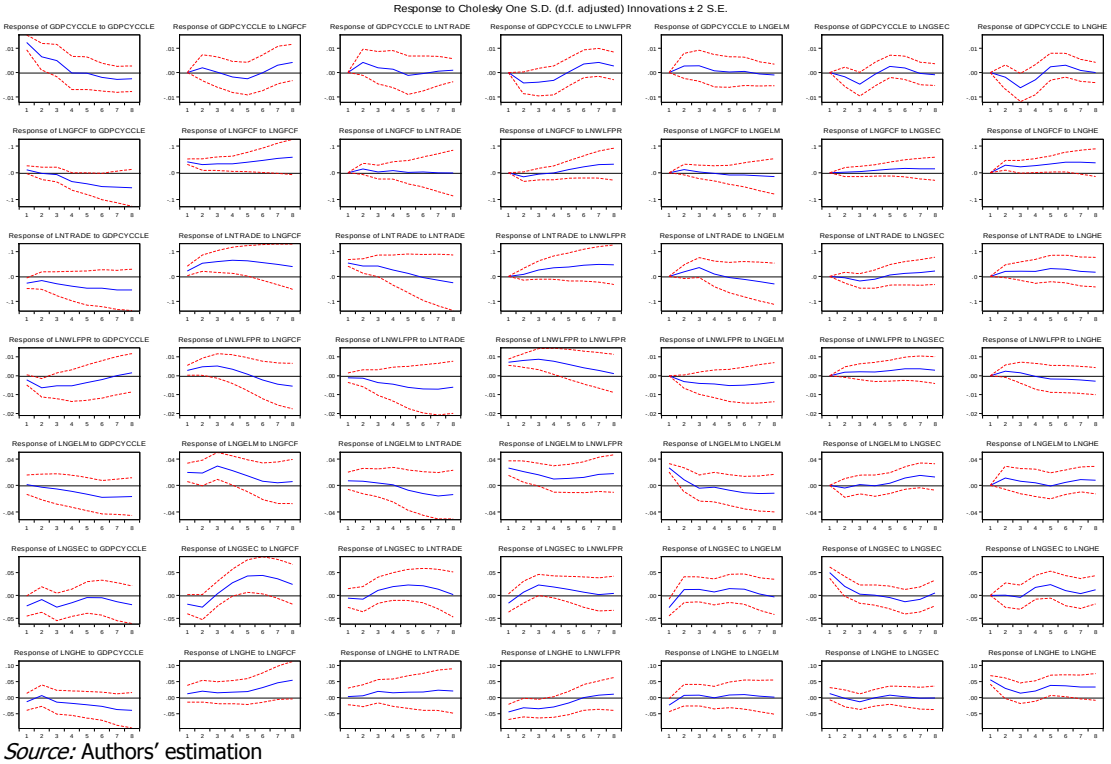
Source: Authors' estimation

Figure 2.A: Impulse Response Function of Public Expenditure across educational Levels



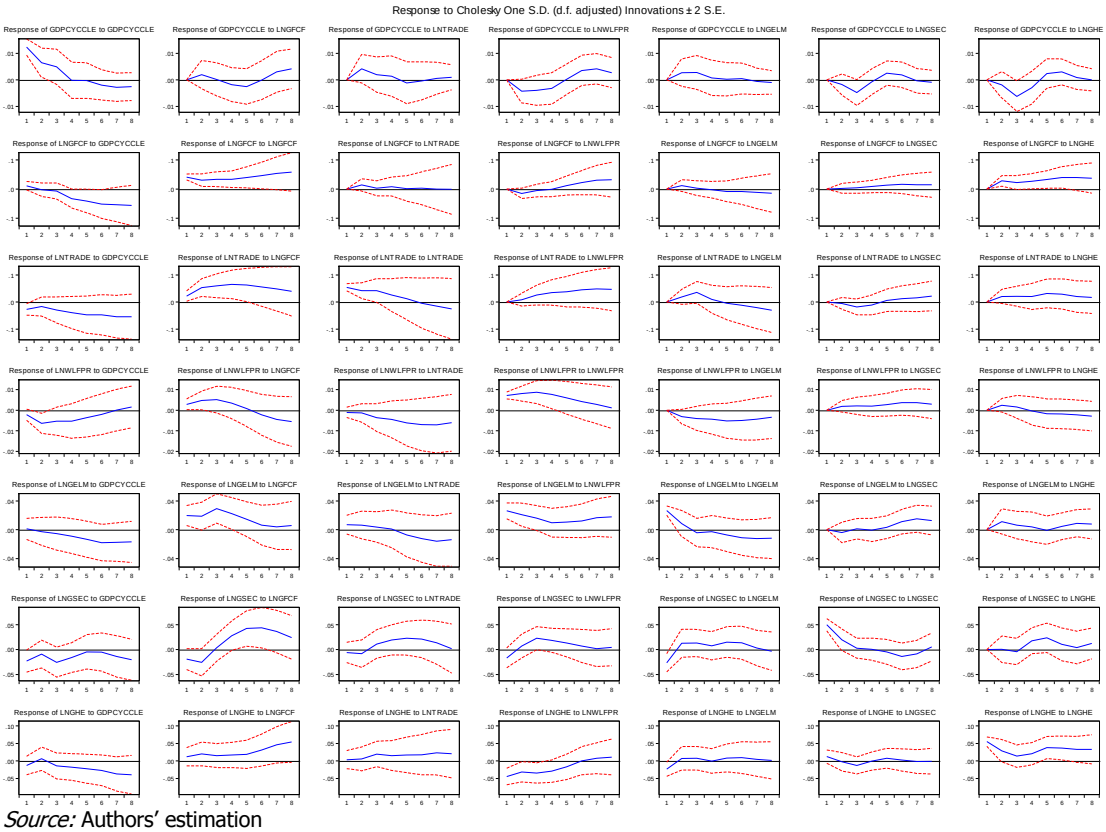
Source: Authors' estimation

Figure 3.A: Impulse Response Function of Average Years of Schooling



Source: Authors' estimation

Figure 4.A: Impulse Response Function of GER across different education levels



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ISBN 978-93-93879-26-4

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