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Interlinkages Between Economic Growth and Human Development in India

A State-Level Analysis

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Abbreviations

ASR	Adult Survival Rates
ARDL	Auto-Regressive Distributed Lag Model
BWI	Basic Welfare Index
DFE	Dynamic Fixed Effects
ECM	Error Correction Model
ECT	Error Correction Term
EG	Economic Growth
EYS	Expected Years of Schooling
GCF	Gross Capital Formation
GDP	Gross Domestic Product
GMM	Generalised Method of Moments
GSDP	Gross State Domestic Product
GSVA	Gross State Value Added
HC	Health Centres
HD	Human Development
HDI	Human Development Index
IMR	Infant Mortality Rate
IPS	Im, Pesaran, and Shin Test
LE	Life Expectancy
MDG	Millennium Development Goals
MG	Mean Group
MYS	Mean Years of Schooling
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
OOPE	Out of Pocket Expenditure
PMG	Pooled Mean Group
PQLI	Physical Quality of Life Index
PTR	Pupil-Teacher Ratio
SDG	Sustainable Development Goals
UNDP	United Nations Development Programme

Abstract

This study explores the relationship between economic growth and non-income components (health and education) of the Human Development Index (HDI) for 26 Indian states during the period from 1990 to 2019. By applying the auto-regressive distributed lag (ARDL) model and Dumitrescu and Hurlin panel causality technique, the study identified a strong two-way relationship between economic growth and non-income components in the long run. Public expenditure on health and education did not impact human development outcomes, whereas total expenditure (public and private) did. However, public expenditure on health is crucial in ameliorating households' financial burden and preventing impoverishment due to catastrophic health expenditure. Furthermore, the analysis of the relationship between different educational levels (primary, secondary, and tertiary education) and the gross state sectoral value added revealed that while education limited to the primary level had no discernible influence on economic activity, secondary and higher education played a pivotal role in determining sectoral economic activity. Secondary education positively influenced agriculture and manufacturing, while higher education significantly shaped the services sector. The impact of higher education on services was four times greater than that of secondary education on manufacturing.

Executive Summary

Traditionally, economic growth or income alone was considered the primary measure of human development. However, health and education have gradually emerged as crucial components of human development, besides income. A significant impetus for the inclusion of health and education in human development came in 1990 when the United Nations Development Programme (UNDP) introduced the Human Development Index (HDI). This index comprises income, health, and education as the three fundamental elements of human development. All three elements are interconnected and influence one another. For example, a higher income level provides individuals, households, or nations with greater resources that can be allocated to health and education. Likewise, health and education have multifaceted impact on economic activity by boosting individual productivity, enhancing capabilities, and facilitating technology diffusion.

This study explores the relationship between the non-income aspects of human development, i.e., health and education, and economic growth at the state level. In this context, the study seeks to answer the following questions: (i) Whether there exists a long-run relationship between human development (health and education) and economic growth in India? (ii) Whether economic growth causes human development and *vice-versa?* (iii) Does public expenditure on health and education impact human development outcomes? (iv) Is there a relationship between different levels of education and economic activity?

While India's overall HDI has steadily improved over the years, significant disparities exist among states. For example, during 1990–2019, Bihar, Uttar Pradesh, Odisha, and Madhya Pradesh consistently registered the lowest HDI values, while Delhi, Kerala, and Goa showed the highest values. Analysing data from 1990 to 2019 for 26 Indian states, a bi-directional relationship between economic growth (EG) and human development (HD) was identified. Both HD and EG significantly influence each other in the long run, with a causal relationship observed in both directions, indicating the need for balanced development. Notably, education was found to contribute more to EG than health.

To better understand the impact of education on EG, the study examined the relationship between various education levels (primary, secondary, and tertiary education) and the sectoral value added to the economy. It revealed that higher levels of education beyond primary schooling positively influenced different economic sectors. While secondary education positively affected the agriculture and manufacturing sectors, tertiary education notably impacted the service sector. The influence of tertiary education on services was four times greater than that of secondary education on manufacturing. The effects of secondary and tertiary education on economic activity were noticeable after a lag of three years. It is noteworthy that tertiary education enrolment rates surged after 1997. When seen this in conjunction with the role of tertiary education in driving the value added of the service sector, it is not surprising that the share of the service sector in India's GDP increased sharply from 39.1% in 1997 to 50.1% in 2019.

Regarding the role of public expenditure in human development, the study found that public expenditure alone did not impact human development outcomes, but total expenditure (public and private) did. This might be due to low public sector efficiency and also because public expenditure accounts for only 40–50% of the total expenditure on health and education, with the remaining coming from households or the private sector. Expenditure on health and education is non-discretionary, making households to allocate funds to these critical items by either borrowing or reducing expenditure on other items. An inverse relationship exists between public and private expenditure, suggesting that low public spending on human development is compensated for by high private expenditure. Thus, while public expenditure may not directly impact human development outcomes, it remains critical in reducing households' financial burden and preventing the impoverishment of poor households due to catastrophic health expenses.

1. Introduction

Traditionally, a country's development was believed to be determined solely by its economic growth. While economic growth provides material comfort to human beings, human development encompasses much more than just economic development. It involves enhancing the overall quality and experience of human life, focusing on individuals, their possibilities, and their freedom to make choices, rather than merely emphasising a nation's economic prosperity (UNDP, 2002). Health has now become a crucial component of "pro-poor" economic growth strategies aimed at boosting economic growth and addressing economic inequality (Government of India, 2005). Similarly, education has emerged as a crucial determinant of an individual's productivity as well as that of a nation (Ozturk, 2001). Among the earliest attempts to recognise the importance of non-monetary measures unrelated to income as indicators of improving physical quality of life were the studies by Morris (1978) and Morris and McAlpin (1982). These authors conceptualised an outcome-oriented composite index, the Physical Quality of Life Index (PQLI), which utilised data on literacy rates, infant mortality rates (IMR), and life expectancy (LE) at the age of one to calculate the quality of life. Acknowledging the importance of overall human development, the United Nations Development Programme (UNDP) began monitoring human development outcomes beginning 1990.

Human development may encompass several elements, including health, education, political freedom, governance, and income equality, among others. The human development approach emphasises income growth as a means to development rather than an end in itself (Sen, 1985; UNDP, 2002). Recognising the importance of non-income aspects of welfare, the UNDP developed a composite Human Development Index (HDI) as a summary measure of a nation's average achievement in three key dimensions of human development: (i) health (assessed by LE at birth); (ii) education (measured by Mean Years of Schooling (MYS) for adults aged 25 years and above and Expected Years of Schooling (EYS) for school-age children); and (iii) decent income/standard of living (measured by per capita gross national income) (UNDP, 2010). The HDI has been computed country-wise and disseminated by the UNDP regularly since 1990.

The explicit recognition of non-income aspects of welfare, such as health and education, along with the income aspect, in enhancing human well-being does not suggest that they are mutually exclusive of each other; on the contrary, they are interrelated and influence each other. Economic growth offers access to resources, enabling a country or an individual to invest in health and education. Children with good health are more likely to develop better cognitive abilities and become healthier adults, and employees with better health tend to demonstrate higher levels of productivity. Education makes individuals more health-conscious and promotes health-appropriate behaviour (UNDP, 1996).

This doesn't imply that economic growth will always and automatically result in human development and *vice versa*. There have been instances worldwide where economically prosperous countries have performed poorly in health and education. Nonetheless, despite the possibility of initial economic growth occurring without sufficient attention to health and education, numerous studies suggest that a country might face limitations in achieving its full long-term growth potential unless it prioritises the health and education of its population. Similarly, there are instances where a society has performed reasonably well in health and education compared to countries with similar or higher levels of economic growth. Thus, the relationship between the income and non-income components is neither automatic nor linear; rather, it is complex and depends on several other factors (UNDP, 1996).

India has progressed from the low HDI category in 1990 to the medium HDI category in 2007 and it is rapidly approaching the high HDI category. The progress is reflected in various health and education indicators. For instance, LE at birth improved from 57.9 years in 1990 to 69.9 years in 2020. Likewise, the infant mortality rate significantly declined from 88.6 (per 1000 live births) to 27 (per 1000 live births) during the same period. Expected years of schooling improved from 7.6 years in 1990 to 12.2 years in 2019. India's economic growth also accelerated from approximately 4% in the 1980s to 6.2% in the following three decades. Despite these recent improvements, India's HDI still lags behind that of many of its peers and advanced economies. One area of particular concern has been low public sector spending, especially on health. As a result, out-of-pocket expenditure (OOPE) on health in India has been one of the highest in the world (Mundle, 2018). Against this background, this study takes an integrated view of social sector spending, health and education indicators, and EG in India to clearly understand the relationships between them.

This study builds on the existing literature on the interlinkages between human development and EG by filling key empirical gaps in the literature. Using the latest dataset spanning from 1990 to 2019 at the state level, we examine in detail the dynamic nature of the relationship between human development (HD) and economic growth (EG). Unlike other studies, we use the error correction model (ECM) to study the relationship between HD and EG. We also employ the Dumitrescu and Hurlin panel causality test (Dumitrescu & Hurlin, 2012) to assess the existence and direction of causality between EG and HD. The test extends the Granger (1969) time series framework of causality to heterogenous panel data, considering potential cross-sectional dependency. To the best of our knowledge, no other study has employed the Dumitrescu and Hurlin panel causality framework to evaluate the causality between gross state domestic product (GSDP) and HD in India. To better understand the role of education in influencing EG, we assessed one particular link between education and EG - the impact of different levels of education (i.e., primary, secondary, and higher education) on the sectoral value added of the agriculture, manufacturing, and service sectors.

Some of the key questions we seek to address in this study are the following: (i) Is there a long-run relationship between HD (health and education) and EG in India? (ii) Does EG cause HD and *vice versa?* (iii) Does public expenditure on health and education impact human development outcomes? (iv) Is there a relationship between different levels of education and economic activity? These questions, wherever relevant, were examined against the backdrop of the endogenous growth theory developed in the 1980s, according to which economic growth is driven not only by physical capital but also by human capital. Unlike neoclassical growth models, proponents of the endogenous growth model argue that investment in human capital drives economic convergence and long-term growth in different countries (Romer, 1990).

Several important findings emerged from our analysis: (i) There exists a strong two-way relationship between HD and EG in the long run. (ii) There is also evidence of bi-directional causality between EG and HD. (iii) While public spending on health and education (as a percentage of GDP) does not significantly impact health and education indicators, total spending (public and private) does. (iv) Secondary-level education has a positive impact on the agriculture and manufacturing sectors, while higher education positively impacts the service sector, with primary education playing no discernible role in shaping economic activity.

The paper is organised into 7 sections. Section 2 reviews the literature on the relationship between EG and HD. Section 3 outlines the theoretical underpinnings of the likely patterns of the relationship between EG and HD and the pathways through which they influence each other. Section 4 analyses the trends in HDI in India at the national and state levels. Sections 5 and 6 provide descriptive statistics and econometrically test the relationship (including causality) between HD and EG. Section 7 summarises the key findings and spells out the policy implications.

2. Review of the Literature

The relationship between EG and HD has been a widely debated issue in academic literature, even prior to the 21st century (Preston, 1975; Romer, 1986, 1990; Floud *et al.*, 1990; Fogel, 1994; Arora, 2001). Early literature attempting to gauge the influence of human capital on EG modified the neoclassical growth theory, which initially assumed technology as exogenous and, therefore, implied diminishing returns to capital. Incorporating the growth and level effects of human capital on income led to the formulation of endogenous growth theories (Romer, 1986, 1990, 1994; Barro, 1991; King & Rebelo, 1993). These theories regarded human capital as an important factor in enhancing labour productivity and/or accumulating physical capital, thereby contributing to economic growth. Several studies by authors such as Uzawa (1965), Romer (1986), Lucas (1988), Barro (1991), and Schultz (1971, 1981) incorporated human capital as an important determinant of economic growth.

Numerous studies have identified a positive impact of HD on EG. Barro (1991) and Ranis *et al.* (2000) found a positive impact of HD on EG using country-level panel datasets. Higher levels of HD imply more productive human capital, resulting in higher EG. Ranis *et al.* (2000) identified specific factors linking HD to EG in 35–76 developing countries (based on the availability of data) for the period 1970–1992. They found a positive and significant impact of HD (levels as well as changes) on GDP per capita growth. They also determined that a higher gross domestic investment in capital and a more equal income distribution strengthen the impact of HD on EG. Barro (1991) studied the impact of human capital on GDP per capita growth for 98 countries between 1960 and 1985. After controlling for the investment ratio, fertility rate, and political stability, he found that the initial human capital (1960 school enrolment rates) had a significant positive impact on per capita income growth. Benhabib and Spiegel (1994) estimated the impact of human capital on GDP per capita growth using a Cobb-Douglas production function for 78 countries over the period 1965–1985 and obtained similar results after accounting for the role of human capital in influencing the growth of total productivity as well as its capability to attract other factors of production, such as physical capital. Similiarly, among the Organisation for Economic Co-operation and Development (OECD) countries, Bassanini and Scarpetta (2002) found a long-run relationship between human capital and EG using the Pooled Mean Group (PMG) estimator. Analysing a large panel of 104 countries for the period 1970–1990, Bloom *et al.* (2004) established that a one-year improvement in the life expectancy of a nation contributed to an increase of 4% in GDP growth. In a study based on dynamic panel data for 21 OECD countries over 1960–2011, Teixeira and Queirós (2016) proxied human capital with average years of schooling and observed a positive impact on GDP per capita. In yet another study, Gyimah-Brempong and Wilson (2005) established a significantly positive impact of all levels of educational attainment on per capita income in 34 African countries for the period 1960–2000. The study applied the dynamic panel data estimation and utilised the Barro and Lee database for educational attainment (Barro and Lee, 2000). Pelinescu (2015) established a negative and statistically significant impact of education expenditure (as % of GDP) on GDP per capita for a sample of European countries over the period 2000–2012. However, the role of secondary education of employees and the innovative capacity of the countries, measured by the number of patents, was found to be positive and statistically significant in driving GDP per capita.

While there is ample evidence supporting the positive impact of HD on EG, accurately measuring HD to capture the true relationship between the two has remained a challenge. Average years of schooling and enrolment rates, widely utilised as indicators of HD, have been contested on many grounds. Not only do they make international comparisons difficult and disregard an individual's the cognitive skills, but they also overlook the health aspects of human development. Hanushek (2013) argued that a rise in school enrolment rates in developing countries compared to the developed world has not corresponded to a simultaneous improvement in quality of schooling and cognitive skills of students in developing countries. By integrating cognitive skills, based on mathematics and science tests as an explanatory variable, and controlling for years of schooling, Hanushek and Woessmann (2012) found a positive and statistically significant impact of cognitive skills on GDP per capita growth for the period 1960–2000 in a study of 50 countries. The study recommended prioritising quality education over mass education to foster growth.

A section of the literature also employs social sector expenditure on health and education as indicators of human development. In a study conducted by Baldacci *et al.* (2004), a comprehensive analysis of 120 developing countries spanning from 1975–2000 revealed a positive long-run effect of public spending (health and education) on real GDP per capita growth. Specifically, public educational spending was correlated with increased school enrolment rates, while public health expenditures were associated with reduced under-five child mortality rates. Similarly, Mercan and Sezer (2014) investigated the impact of educational expenditure on EG in Turkey for the period 1970–2012, utilising the auto-regressive distributed lag (ARDL) model. Their findings demonstrated a positive and statistically significant relationship between educational expenditure and EG.

Some studies have also examined the relationship between HD and EG within an asymmetric framework. For instance, Yang (2020) examined the impact of health expenditure on EG in China. His findings suggested the existence of threshold effects in the relationship between health expenditure and GDP growth for various levels of human capital. Notably, when the level of human capital falls below the first threshold (first regime), health expenditure shows a negative correlation with EG. The relationship between health expenditure and EG turns positive in the second and third regimes, specifically when the level of human capital exceeds the first threshold. By considering adult survival rates (ASR) as an indicator of a country's health outcomes, Bhargava *et al*. (2001) explored the dynamics between ASR and GDP growth, allowing for the relationship to be contingent on GDP levels. Their estimates revealed that ASR positively and significantly influenced GDP growth rates solely in low-income countries, such as India, Nigeria, Central African Republic, and Ivory Coast. ASR played an insignificant or negative role as a determinant of economic growth in middle- and high-income countries.

The relationship between HD and EG is not solely unidirectional. It is hypothesised that EG also drives HD. A higher EG leads to increased per capita income, which subsequently enables more expenditure on HD. Anand and Ravallion (1993) examined the pathways through which EG could influence HD indicators. They discovered that EG leads to the following: (i) direct enhancement of capabilities; (ii) a decrease in poverty; and (iii) an increase in the public provision of services. Empirical testing of the latter two pathways in a cross-section of 22 developing countries revealed that although EG positively impacted HD, this impact vanished after accounting for poverty and public expenditure. This suggested that an equitable distribution of economic output among the population was imperative for widespread HD. A study by Ranis *et al*. (2000) illustrated that a higher GDP per capita growth rate and social expenditure (as a ratio of GDP) were linked to improvements in HD indicators, specifically in reducing the shortfall in life expectancy during the period 1970–1992. In another study, Biswas (2002) compared the relative importance of EG and public provisioning in enhancing the HDI using the dataset from 29 countries over the period 1990–2000. His findings indicated that the public provision of health services played a more crucial role than the increase in real income in expanding the fundamental capabilities necessary for HD.

A few studies have attempted to examine the causal relationship between HD and EG. Cheng and Hsu (1997) utilised the Granger causality methodology and reported a bi-directional causality between economic growth and stock of human capital per worker in Japan for the period 1952–1993. Similarly, Asteriou and Agiomirgianakis (2001) utilised the Johansen cointegration and established a long-run relationship between educational attainment (enrolment rate) and EG in Greece. Their study also applied Granger causality tests, revealing a unidirectional causation from education to GDP growth. However, the causal relationship was observed to be weaker for higher education.

Several studies have analysed the relationship between HD and EG in the Indian context. Dholakia (2003) identified a two-way relationship between HDI and per capita income for Indian states. Additionally, he noted that an improvement in HDI led to a rise in the average per capita income of the states with an approximate lag of eight years, whereas, economic growth resulted in an enhancement of HDI with a much shorter lag of two years. Ghosh (2006), using data from 15 major Indian states for the years 1981, 1991, and 2001, demonstrated a two-way causality between the average per capita income of the states and HDI, particularly in terms of life expectancy at birth and literacy rate indicators. Viswanath *et al.* (2009) established the crucial role of human capital investment in propelling economic growth by studying a sample of 25 Indian states during 1995–1996 and 1998–1999. Employing the Johansen's cointegration for the period 1960–2005, Haldar and Malik (2010) concluded that investments in health and education expenditures had a positive and statistically significant impact on long-run per capita economic growth in India.

Utilising data from 28 Indian states, Mukherjee and Chakraborty (2010) observed that an increase in gross state domestic product per capita initially correlated with a rise in HDI. However, the significance of this relationship diminished over the study period. Both Mukherjee and Chakraborty (2010) and Mukherjee *et al.* (2014) identified a reverse causality, indicating a positive and statistically significant impact of HDI on economic growth. Confirming this, Mehrotra and Parida (2021) also reported a positive and statistically significant influence of HDI on states' gross state domestic product. Notably, they revealed a unidirectional Granger causality from HDI to economic growth, emphasising the crucial role of elevated human development in driving higher economic growth rates within the states.

Expenditure on human capital acts as a vital bridge between economic growth and human development, prompting numerous studies to explore its correlation with human capital expenditure and EG as well as human capital expenditure and HDI. Dholakia (2002), using data from 14 Indian states for two periods (1971–1981 and 1981–1991), discovered that government spending on human capital reduced the disparity in the Basic Welfare Index (BWI), an alternative and more comprehensive measure of human development based on nine socio-economic indicators. In the initial years 1981, 1991, 2001, and 2005, Gopalakrishna and Rao (2012) found that the impact of public expenditure on HD was higher than that of economic growth. Mor (2022) noted that total health expenditures (in %) could explain approximately half the variation in disability-adjusted life years lost, an indicator of health outcomes. However, Patel and Annapoorna (2019) found that educational expenditure, as a ratio of GDP, did not Granger-cause HDI. Meanwhile, Pradhan and Abraham (2002) observed a significant impact of social sector expenditure on HD and EG, using a dataset of 17 Indian states between 1980 and 1997. Examining the link between social sector expenditure (comprising health and education expenditure as a percentage of GDP) and economic growth, Narayan et al. (2010) employed the panel cointegration test and dynamic Ordinary Least Squares (OLS) on a sample of five Asian economies (including India) from 1974 to 2007. They reported that while the impact of health expenditure on economic growth was positive, though relatively modest, the expenditure on education did not significantly affect the economic growth of these economies. Ray and Sarangi (2021) investigated causality between social sector expenditure and economic growth and found bi-directional causality between educational expenditure and economic growth, while they discovered only unidirectional causality from health expenditure to economic growth.

In conclusion, a comprehensive literature review confirms a strong two-way relationship between HD and EG. Nonetheless, the intensity of this relationship and the causal direction remains subjects of empirical evaluation. Findings may vary across different countries and timeframes. Moreover, elements such as the quality of human development, variable selection, levels of public expenditure, income distribution, and other factors contribute to the complexity of the relationship between EG and HD.

3. Economic Growth and Human Development—A Theoretical Perspective

How do health and education influence economic growth? Is the impact of an individual's health and education on economic growth temporary or permanent? These questions can be evaluated with the help of growth theories discussed in Box 3.1. The literature identifies three specific pathways through which human capital impacts EG. These include: (i) the impact of education in boosting the ability of the labour force to efficiently carry out tasks; (ii) the diffusion of new knowledge, technologies, products, and information created by others; and (iii) the improvement in creativity (World Economic Forum, 2015). More educated people are more likely to secure employment and enhance their skill sets, resulting in higher earnings over their working lives compared to less educated people. Ideas and technology exhibit non-rivalry, leading to increasing returns to scale.

Box 3.1: Impact of Human Capital on Economic Growth—Is it Transitory or Permanent?

The impact of HD on EG relies on whether HD directly enhances labour productivity or indirectly prompts investment in human and physical capital (Arora, 2001; Benhabib & Spiegel, 1994). If HD influences productivity, it will permanently boost the long-term growth of an economy. However, if HD encourages investment in physical capital, the impact on economic growth will vary based on the returns to scale. Under constant or increasing returns to physical capital, the increase in the growth rate would be permanent. Conversely, as suggested by the neoclassical growth model, under diminishing returns to capital, growth rates would rise only temporarily, eventually causing per capita income to revert to its prior steady-state growth rate. In such a scenario, investment in physical capital does not permanently alter the rate of growth; it only increases the level of output.

Nonetheless, even without growth-rate effects, reproducible factors significantly contribute to economic development by raising the level of income.

Based on this, Romer (1986, 1990) established that the accumulation of ideas will ensure sustained per capita economic growth.

When analysing the dynamics between health and economic growth, it is evident that countries with healthier people typically exhibit higher income levels compared to those with less healthy populations. A healthy population not only reduces labour loss due to illness and premature death but also increases productivity, fostering increased savings and investments in human and physical capital. The correlation between health and economic growth is complex and contingent upon several factors (Box 3.2).

Box 3.2: Health and Economic Growth—A Complex Relationship

The empirical literature regarding the correlation between health and EG indicates a complex relationship between the two. Assessing the economic impact of health improvements is complicated by at least four factors, regardless of the method used to measure them.

First, the nature of the relationship between health and EG is unclear. This is not only due to the bi-directional causality between the two but also due to confounding factors, such as complementarity between health and education.

Second, the impact of health on EG varies depending on the specific health dimension considered, whether it's morbidity (illness) or mortality (death). While reduction in morbidity increases labour supply and productivity, reduction in mortality not only boosts labour supply but also encourages savings, investment in physical capital, and enhances the returns on educational investments (Bloom *et al.*, 2018).

Third, the empirical evidence on the relationship between LE and EG is not unequivocal. Several studies suggest that a higher LE positively stimulates EG (Barro, 1996; Barro & Sala-i-Martin, 2004; Bloom *et al.*, 2010). However, a few other empirical studies demonstrate a non-linear pattern or an inverted U-shaped relationship, where LE stimulates growth up to a certain threshold level, beyond which its impact becomes negative. For example, An and Jeon (2006) found that the growth rates initially increased with favourable demography and then decreased as the population aged, using data from 25 OECD countries for the period 1960–2000. Kunze (2014) found that an increase in LE unambiguously decreased growth if bequests were operative; if bequests were inoperative, the relationship showed an inverted U-shaped pattern. The demographic transition is one of the main reasons for the non-linear relationship between LE and EG, which involves three stages. The first stage exhibits high birth and mortality rates, the second stage has a high birth rate but low mortality rate, and the third stage presents low rates for both birth and mortality rates. Different countries have undergone various stages of demographic transition. As LE changes with various stages, its effect on economic growth is expected to change.

Fourth, there is a notable difference in the economic effects of health interventions between developed and developing countries. In developing countries with low initial health status, even minor health interventions can yield significant and positive outcome for working-age population's health. In advanced economies, even major interventions may not have a significant impact given the high initial health status of the population.

The third and fourth factors, in particular, explain why the relationship between health and economic growth may vary in emerging market economies and developed economies.

In conclusion, there is a strong case for a positive effect of health on economic growth in developing economies compared to developed countries. Health improvements in developing countries can stimulate greater investment in human capital, increase female participation in the labour force, and lower fertility (Bloom *et al.*, 2018). Together, these factors can lead to a demographic dividend and propel long-term economic growth in a country.

Economic growth contributes to HD by augmenting resources available for investment in health and education (Ranis, 2004). Higher income levels incentivise households to adopt activities that promote positive health outcomes, such as using clean cooking fuel, safe housing, drinking clean water and practicing proper sanitation (Ali and Khan, 2022).

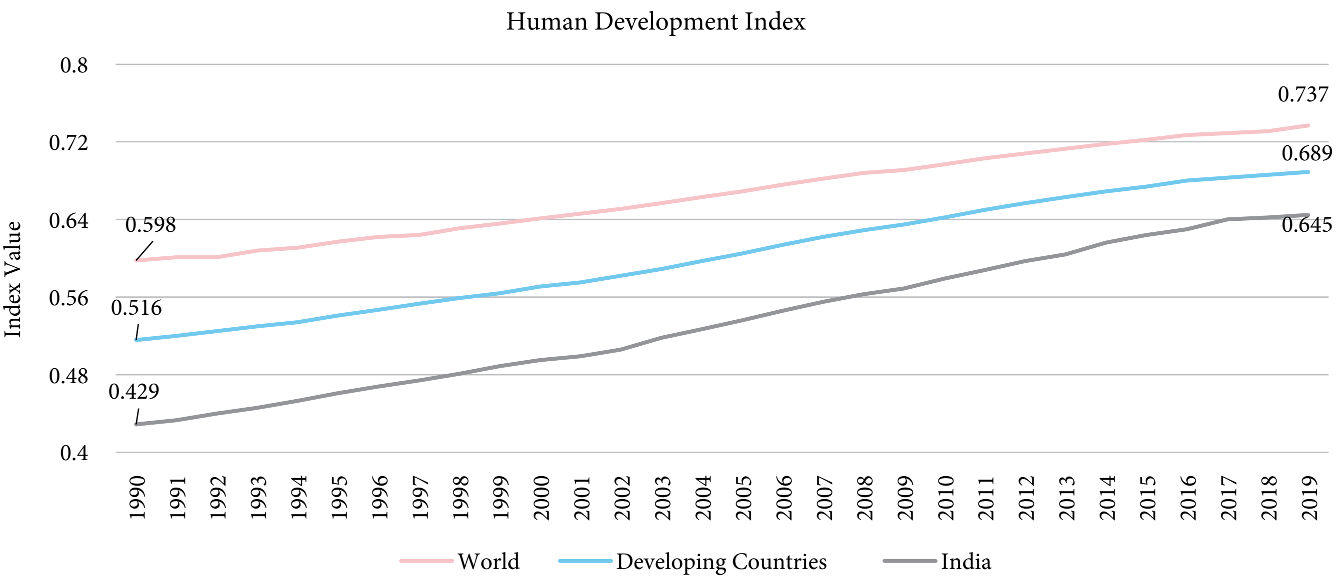
Similarly, health and education are also closely interlinked. Theoretically, people's decision to invest in human capital relies on the anticipated lifetime returns from such investments. Longevity tends to encourage schooling. After controlling for parents' incomes, education, and social status, Case *et al*. (2005) discovered that children who faced poor health exhibited significantly lower educational achievements, poor health, and lower earnings as adults. This highlights the importance of child nutrition and health as a focal point for the intergenerational transmission of wealth. Furthermore, Ranis (2004) established the importance of parents' income level, health, and educational attainments as decisive factors of their children's capabilities and their future health and earnings as adults. Schooling imparts knowledge of health-appropriate behaviour, creates awareness of the increased opportunity cost of poor health, and encourages people to protect their health. Moreover, education also facilitates women's empowerment, leading to improved health and education outcomes for women and their children. While health and education enhance productivity, it is significant to note that the purpose of investing in these areas aren't solely aimed at improving productivity; the development of human capabilities is an end in itself (UNDP, 1996).

In summary, health and education play vital roles in shaping economic growth and *vice versa*. Human capital contributes to growth by enhancing labour force efficiency through education, diffusion of knowledge, and fostering creativity. Higher education levels lead to better employment opportunities and lifelong earnings. Moreover, healthier populations tend to have higher income levels due to reduced labour loss from illness, increased productivity, and greater investments in human and physical capital. Economic growth, on the other hand, increases individual and state capacity to invest in human development. Health and education are interconnected, with childhood health influencing educational attainment and lifelong earnings. Education imparts health knowledge and empowers women, resulting in better health and education outcomes. Ultimately, health and education enhance productivity and contribute to human development beyond economic gains.

4. Trends in HDI

A comparison of the composite HDI, encompassing income, education, and health, for India and the rest of the world from 1990 to 2019 indicates that India's HDI score lagged behind the world average as well as the developing countries' average. However, the gap has gradually narrowed down over the years (Figure 4.1).

Figure 4.1: Human Development Index—India's Performance



Source: UNDP Human Development Report, 2019

Figure 4.2: Non-Income HDI—India's Performance

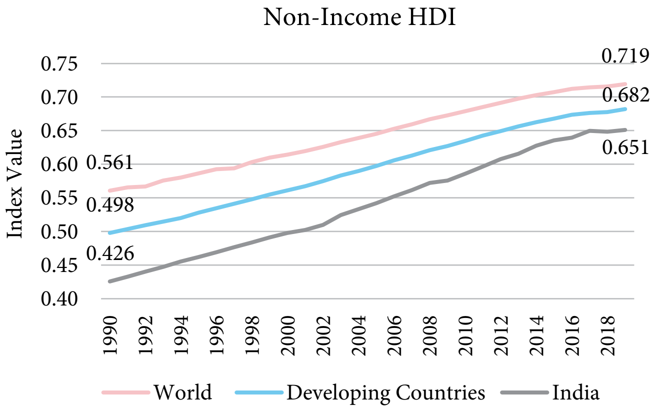
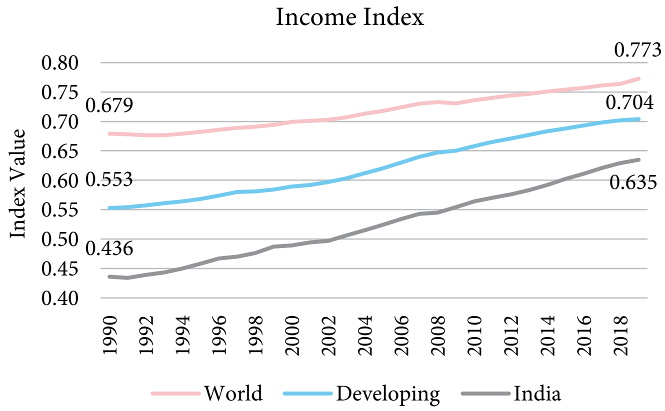


Figure 4.3: Income Index—India's Performance



Source: UNDP Human Development Report, 2019

The disaggregation of HDI into its income and non-income (health and education) components demonstrates that the narrowing of the gap between India and other economies primarily resulted from an increase in the non-income component rather than in the income component (Figures 4.2 and 4.3). The world average includes many advanced economies where significant improvements in health and education have already been achieved. Since health and education indicators in most of the advanced economies are very close to the highest possible level, the pace of improvement in these indicators is slow. In contrast, developing economies still have considerable ground to cover in reaching health and education levels comparable to those of advanced economies. Viewed in this context, the gradual convergence of the gap between India's non-income HDI and that of the developing economies is particularly noteworthy.

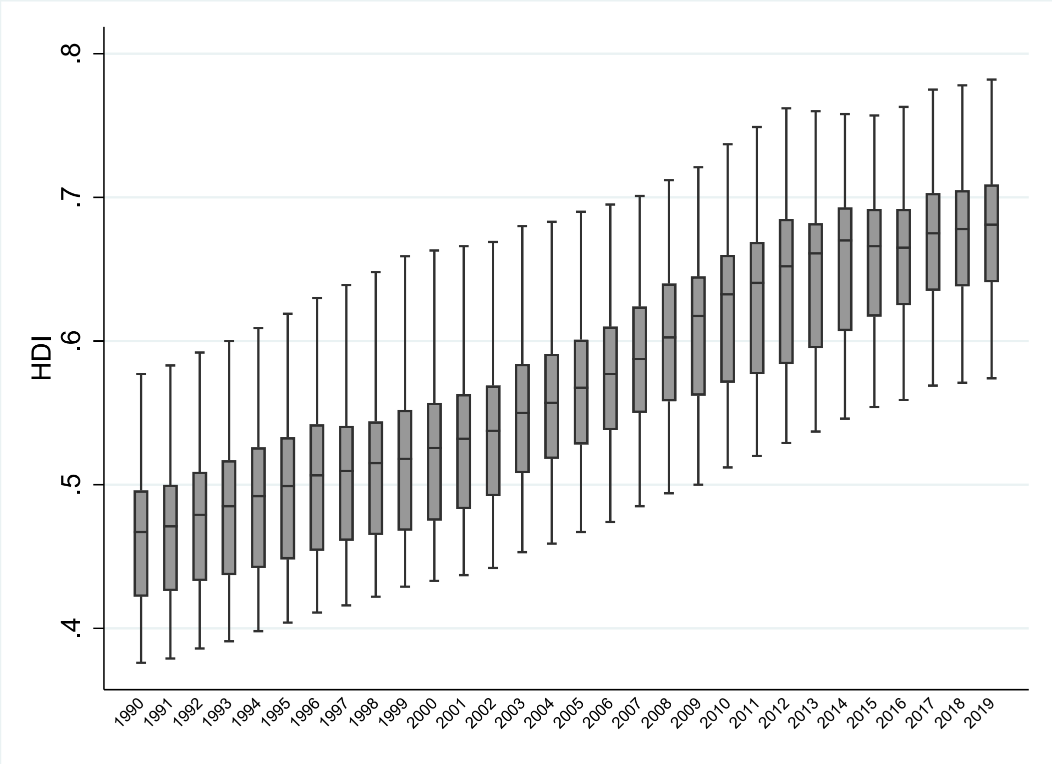
The HDI for all the Indian states combined exhibited consistent improvement between 1990-2019, as reflected in the gradual upward trend in the (i) lowest HDI (lower edge of the box); (ii) highest HDI (upper edge of the box); and (iii) median HDI (middle of the box) in Figure 4.4. Most of the box plots are normally distributed, suggesting a symmetrical distribution of states below and above the median. The size of the box plot has remained relatively consistent across the years, indicating a steady variance over time (Figure 4.4).

An analysis of the HDI at the state level for the period 1990–2019 indicates that while the minimum, maximum, and median levels of HDI improved across all the states, significant inter-state variations were observed (Figure 4.5). Bihar, Uttar Pradesh, Odisha, and Madhya Pradesh recorded the lowest HDI values among all the states, while Delhi, Kerala, and Goa displayed the highest HDI values during 1990–2019 (Figure 4.5). Although not visually apparent from the graph, data illustrate that the median HDI value for most states was reached in 2005. Moreover, most of the box plots demonstrate symmetrical distribution around their medians, suggesting consistent improvements in HDI both before and after 2005. Six states notably differ from this pattern.

Among these six states, Nagaland, Arunachal Pradesh, Meghalaya, and Manipur, showed substantial improvements in HDI values post-2005, as evidenced by the right skew of their box plots. The other two states, Kerala and Himachal Pradesh, however, witnessed faster improvements before 2005 and only mild improvements thereafter. This can be inferred from the left skew of their box plots[1].

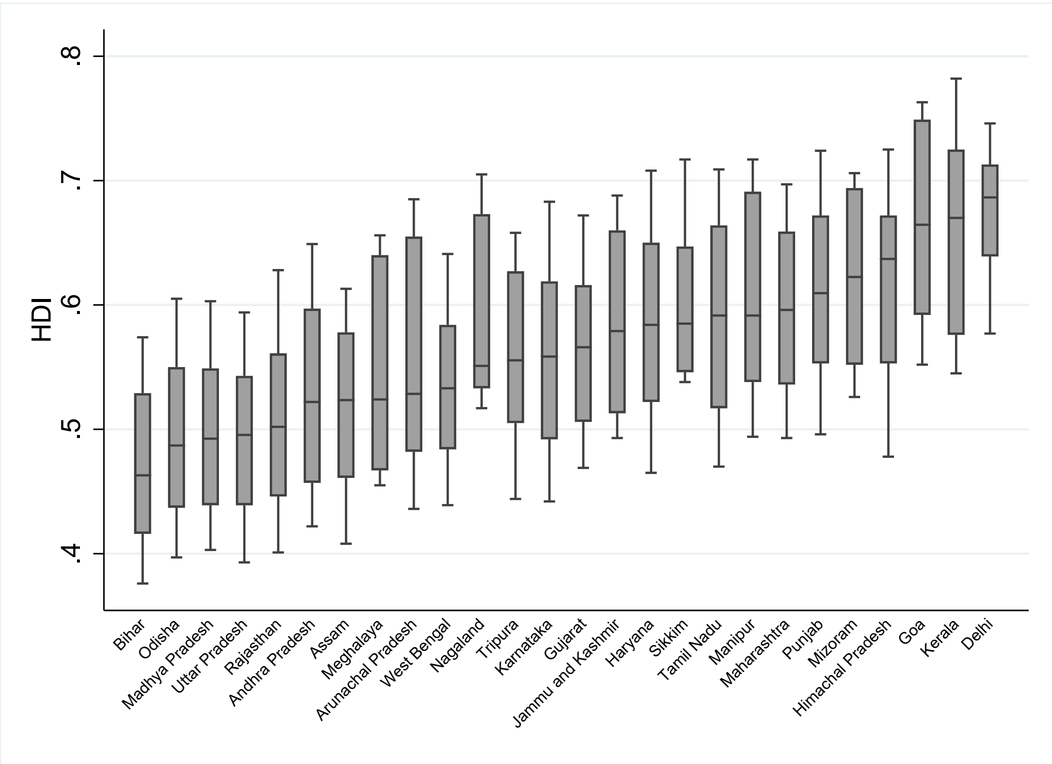
[1] The pattern of the relationship between human development and economic growth amongst states has been discussed in detail in a recent study by Raj *et al.*, 2023.

Figure 4.4: Movement in HDI–All States (1990–2019)



Source: Global Data Lab of the Institute of Management Research of the Radboud University, the Netherlands

Figure 4.5: State-Wise Progress in HDI (1990–2019)



Source: Global Data Lab of the Institute of Management Research of the Radboud University, Netherlands.

5. Econometric Exercises—Data and Methodology

5.1. Data

We used panel data from 1990 to 2019 for 26 Indian states[2] for this study. The selection of the period and the set of states was influenced by the availability of data. Our main variables were HD and EG. Various indicators were utilised to represent different components of HD. Life expectancy (*LE*) at birth was utilised as a measure of health and expected years of schooling (*EYS*) for education. A non-income HD index (geometric average of education and health indices) was utilised to capture the combined effects of health and education. Economic growth was assessed by per capita state GSDP in nominal terms.[3] Ranis (2004) and Suri *et al.* (2011) underscored the significance of expenditure on health and education as an critical inter-linking factor between EG and HD. Consequently, in line with existing literature, we added public expenditure on health (*Health Exp*) and education (*Educ Exp*) as a share of GSDP as additional explanatory variables in the equation estimating the impact of EG on HD. Building upon Barro (1991) and Benhabib and Spiegel (1994), gross capital formation (GCF), as a percentage of GSDP, was used as a control variable in the equation estimating the impact of HD on EG. The variables, their definitions, and the data sources utilised are set out in Appendix 1.

The descriptive statistics (mean, standard deviation, minimum, maximum, and median values) of the variables in this study indicate that the mean expected years of schooling (*EYS*) during 1990–2019 was 10.51 years and life expectancy (*LE*) at birth was 66.81 years; the former exhibited lower variability across time and states compared to the latter. On average, expenditure on education (as % of GSDP) (*Educ Exp*) was at 4.3%, almost 3.5 times higher than average health expenditure (*Health Exp*) (1.3%). However, variability in health expenditure across time and states was lower than education expenditure (Table 5.1).

5.2. Methodology

Panel Unit Root Tests

Since we utilised panel data with a long-time dimension, we began by testing the stationarity of the variables, which is important to avoid spurious regression. If the variables are stationary in level form, they are said to be integrated of order I (0). If they are stationary in first differences, then they are said to be integrated of order I (1). To check for stationarity, two panel unit root tests were carried out—the Im, Pesaran, and Shin (IPS) (2003) test and the Breitung (2000) test. The null hypothesis of both tests is that the panels contain a unit root, meaning they are non-stationary. Rejection of the null hypothesis indicates that the panels do not have a unit root and are,

Table 5.1: Descriptive Statistics (1990–2019)

Variable	Mean	Standard Deviation	Minimum	Maximum	Median
EYS	10.51	1.80	5.8	15.04	10.42
LE	66.81	4.49	54.16	76.95	67.29
HDI	0.58	0.08	0.37	0.79	0.58
lnPCGSDP	10.39	1.11	8.07	13.07	10.32
Educ Exp	4.34	2.41	1.36	13.60	3.50
Health Exp	1.29	0.83	0.36	4.97	0.95
GCF	30.01	5.29	22.32	38.23	32.26

Source: Authors' Calculations

[2] Four states—Jharkhand, Uttarakhand, Chhattisgarh, and Telangana were formed after 2000 and have been removed from the analysis due to insufficient observations. Delhi has been considered as a state for this study.

[3] Nominal GDP is preferred over real GDP because expenditure data on health and education have been utilised in nominal terms. However, for robustness, regressions using real GDP were also carried out. Additional controls were added while performing robustness checks (see Appendix 2). Qualitatively, the results remained broadly the same.

hence, stationary. While the Breitung test assumes a common autoregressive parameter for all the panels under study, the IPS test relaxes this assumption and allows for heterogeneity across panels. Both tests are first-generation panel unit root tests, implying that all the panels are considered homogeneous, and as a result, the cross-sectional units are assumed to be independent.

Panel Auto-Regressive Distributed Lag Model

Most studies have used ordinary least squares (OLS) to assess the relationship between HD and EG. However, we found it unsuitable for our purpose. OLS, being a static model, fails to capture dynamic aspects and is susceptible to issues like endogeneity, reverse causality, and non-stationarity. Baldacci *et al.* (2004) employed the Generalised Method of Moments (GMM) to address measurement error and endogeneity in dynamic modelling for robustness.[4] However, GMM is more suitable for models with large N (cross sections) and small T (time horizons), where N>T. Since our dataset did not meet this condition, we adopted the auto-regressive distributed lag (ARDL) model. This model resolves issues of reverse causality and endogeneity by regressing the dependent variable on its own past lagged values and current and past values of other explanatory variables. It holds two main advantages over other models. First, it can be used even if variables are I(1) or I(0) or a mixture of both (Pesaran and Pesaran, 1997). Second, it can be re-parametrised to form an error correction model (ECM) allowing for testing long-run and short-run relationships. We estimated two relationships—the impact of EG on HD and *vice versa,* as detailed below.

Impact of Economic Growth on Human Development

The long-run impact of EG on HD can be formulated into a panel ARDL (p, q_1, q_2) equation where p and q represent the lags of the dependent and independent variables, respectively. The equation can be written as:

$$HD_{it} = u_i + \sum_{j=1}^{p} \gamma_{1,i} HD_{i,t-j} + \sum_{j=0}^{q_1} \gamma_{2,i} lnPCGSDP_{i,t-j} + \sum_{j=0}^{q_2} \gamma_{3,i} Expenditure_{i,t-j} + \varepsilon_{it} \quad (1)$$

Where $i = 1,2,3\ldots.\ N$ and $t = 1,2,3,\ldots..T$ represent the states and time, respectively; u_i is the state's fixed effects; *PCGSDP* is the per capita state gross domestic product; HD represents human development; and *Expenditure* represents public expenditure on human development (health and education) as a share of GSDP. Three separate equations were run using three different indicators of HD: (i) expected years of schooling (education); (ii) life expectancy (health); and (iii) non-income HDI (geometric average of education and health indices). Correspondingly, in each equation, expenditure represents public expenditure (as a percentage of GSDP) on: (i) education *(Educ Exp);* (ii) health *(Health Exp)*; and (iii) both education and health *(Total Exp).*

Equation (1) can be re-parametrised in ECM form as:

$$\Delta HD_{it} = u_i + \sum_{j=1}^{p-1} \delta_{1,i} \Delta HD_{i,t-j} + \sum_{j=0}^{q_1-1} \delta_{2,i} \Delta lnPCGSDP_{i,t-j} + \sum_{j=0}^{q_2-1} \delta_{3,i} \Delta Expenditure_{i,t-j} + \varphi_i \left(HD_{i,t-1} - \beta_2 lnPCGSDP_{i,t-1} - \beta_3 Expenditure_{i,t-1} \right) + \varepsilon_{it} \quad (2)$$

Where δ_1, δ_2, δ_3 capture the short-run relationship of lagged dependent and independent variables with the dependent variable, and β_2 and β_3 capture the long-run relationship of economic growth and public expenditure with human development, respectively.

[4] The GMM estimation framework utilises instrumental variables (IVs) framework (moment conditions) to estimate the unknown parameters of a dynamic model. Under certain assumptions, the GMM estimators can be shown to be consistent and asymptotically normal (Hansen, 1982; Cochrane, 2001).

φ_i is the speed of adjustment. A negative and significant φ_i indicates a return to the long-run equilibrium, whereas $\varphi_i = 0$ indicates no long-run relationship. ε_{it} is the error term.

Impact of Human Development on Economic Growth

The long-run impact of human development on economic growth can be formulated into a panel ARDL (p, q_1, q_2) equation where p and q represent the lags of the dependent and independent variables, respectively. The equation can be written as:

$$lnPCGSDP_{it} = u_i + \sum_{j=1}^{p} \gamma_{1,i} lnPCGSDP_{i,t-j} + \sum_{j=0}^{q_1} \gamma_{2,i} HD_{i,t-j} + \sum_{j=0}^{q_2} \gamma_{3,i} GCF_{i,t-j} + \varepsilon_{it} \quad (3)$$

Where *GCF* represents the gross capital formation of a state as a percentage share of its GSDP, and the other variables are defined as before.

Equation (3) can be re-parametrised in ECM form as:

$$\Delta lnPCGSDP_{it} = u_i + \sum_{j=1}^{p-1} \delta_{1,i} \Delta lnPCGSDP_{i,t-j} + \sum_{j=0}^{q_1-1} \delta_{2,i} \Delta HD_{i,t-j} + \sum_{j=0}^{q_2-1} \delta_{3,i} \Delta GCF_{i,t-j} + \varphi_i (lnPCGSDP_{i,t-1} - \beta_2 HD_{i,t-1} - \beta_3 GCF_{i,t-1}) + \varepsilon_{it} \quad (4)$$

The ECM equations (2) and (4) can be estimated using three different methods: the mean group (MG) estimator (Pesaran and Smith, 1995), which accommodates state-specific heterogeneity in both short and long-run dynamics; the pooled mean group (PMG) estimator (Pesaran *et al.*, 1999), which assumes homogeneity in long-run coefficients across states but allows for short-run heterogeneity; and the dynamic fixed effects (DFE) estimator which further restricts the short-run coefficients to also be equal across states.

According to Pesaran *et al.* (1999), homogeneity in long-run parameters across countries can be expected on account of arbitrage conditions or common technologies. Given that our sample consisted of states within the same country with high integration, we expected the homogeneity conditions to be even stronger in our sample. Consequently, we had choice of using either PMG or DFE estimators. The final choice was made based on the Hausman test.

The lag selection followed the methodology suggested by Loayza and Ranciere (2006). If the research focus is on long-run estimates, the optimal lag length for each country can be decided using a consistent information criterion. However, if the research interest lies in analysing both the short and long-run estimates, a common lag structure can be utilised across countries. Since we aimed at capturing both the long and the short-run dynamics, we adopted the latter method and utilised a common lag structure. Owing to the limited time horizon of our study (30 years), we imposed a lag order of one across states to avoid over-specification of the model (Kim & Lin, 2010; Njindan Iyke & Ho, 2019).

In our regressions, we utilised nominal income levels to maintain comparability with expenditure figures that were available from the budget documents in nominal terms. To ensure that the results are not distorted by the usage of nominal income in place of real income, we re-ran all the regressions with log of real GSDP per capita. Similarly, it is possible that our results may be sensitive to our choice of human development indicators, particularly EYS for education and LE for health. To address this, we ran additional regressions using alternative indicators for education and health; mean years of schooling (MYS) was utilised for education and infant mortality rates (IMR) for health. In addition to these checks, a few control variables were added to account for quality. These were physical infrastructure and pupil-teacher ratio (PTR) for education and the number of health centres (HC) per one million population for health. The gross fiscal deficit as a percentage of GSDP was also utilised as a control variable (see Appendix 2 and 3 for details).

Causality

Although regression analysis can test the relationship between human development and economic growth, it is unable to establish cause and effect. The two variables may be related, but it does not necessarily imply that one causes the other. Therefore, we tested for causality using the Dumitrescu and Hurlin (2012) causality test that extends the Granger (1969) time series framework of causality to panel data while considering possible cross-sectional dependence between different units (states). We tested the null hypothesis of absence of causality for all states against the alternative hypothesis of the presence of causality for at least one state. To investigate causality, the following test was carried out:

$$HD_{it} = u_i + \sum_{k=1}^{K} \alpha_{i,k} HD_{i,t-k} + \sum_{k=1}^{K} \beta_{i,k} lnPCGSDP_{i,t-k} + \varepsilon_{it} \quad (5)$$

$$lnPCGSDP_{it} = u_i + \sum_{k=1}^{K} \alpha_{i,k} lnPCGSDP_{i,t-k} + \sum_{k=1}^{K} \beta_{i,k} HD_{i,t-k} + \varepsilon_{it} \quad (6)$$

Where i, t, and k represent states, time, and lags, respectively. Since the test requires stationarity of variables, the variables were considered in the first-differenced form.

6. Results and Discussion

6.1. Panel Unit Root Tests

Table 6.1 displays the panel unit root results. It is evident that variables displayed varying orders of integration, but none of them was found to be integrated of the second order (i.e., I(2)). The human development indicators (EYS, LE, and HDI) and per capita GSDP were integrated of order one, i.e., I (1), while the shares of health and education expenditure (in total expenditure) and gross capital formation were I (0). As the variables were either I (0) or I (1), the ARDL model was preferred over traditional regression techniques like OLS and GMM.

6.2. Impact of Economic Growth on Human Development

Table 6.2 sets out the empirical findings regarding the impact of EG on HD. As indicated in column 2 of Table 6.2, EG exhibited a positive and statistically significant impact on non-income HDI, both in the short- and long-run. However, health and education budgets (health and education expenditure as a percentage of GDP) had no impact on human development outcomes either in the short- or long-run. Though this result looks counter-intuitive, the empirical evidence on this aspect is mixed (Box 6.1).

We also estimated the impact of economic growth on education and health separately (Columns 3 and 4, table 6.2). A 10% increase in per capita GSDP of states increased expected years of schooling (EYS) by 0.17 years and life expectancy by 0.24 years, respectively, in the long run. The adjustment term (error correction term) was negative and significant, implying a long-run relationship between the variables. It also provided the speed of adjustment to restore the long-run equilibrium following a disturbance, which for education (EYS) was 8.7%. In other words, about 9% disequilibrium between short-run and long-run is corrected every year. Thus, the process of adjustment is slow, and it takes about 7.7 years for a 50% deviation to be corrected. The results remained robust even after factoring in additional controls (Appendix 2).

Table 6.1:Panel Unit Root Tests (Levels and First Difference)

Variable	Levels		First-difference	
	Breitung test	IPS test	Breitung test	IPS test
(1)	(2)	(3)	(4)	(5)
EYS	5.76	7.28	-9.80***	-6.91***
LE	1.57	-0.81	-3.29***	-1.39*
HDI	5.15	3.30	-5.97***	-2.54***
lnPCGSDP	-1.52*	-0.87	-1.91**	-3.21***
Educ Exp	-1.27	-4.77***	-4.46***	-9.65***
Health Exp	-3.08***	-5.84***	-4.14***	-7.17***
Total Exp	-1.68**	-5.10***	-3.87***	-9.66***
GCF	-3.28***	-1.09	-7.49***	-6.47***

Source: Authors' analysis.

*Note: Variables have been tested at lag (1). ***, **, * denote statistical significance at 1%, 5%, and 10%, respectively.*

Table 6.2: Impact of Economic Growth on Human Development[5]

Variable	Non-income HDI	EYS	LE
(1)	(2)	(3)	(4)
Long-run estimation			
lnPCGSDP	0.060***	1.737***	2.395***
	(0.01)	(0.12)	(0.23)
Expenditure	-0.008	-0.057	0.143
	(0.01)	(0.13)	(0.61)
Short-run estimation			
D. *lnPCGSDP*	0.018***	1.044***	0.305
	(0.01)	(0.20)	(0.26)
D. *Expenditure*	-0.001	-0.095***	-0.041
	(0.00)	(0.03)	(0.10)
Constant	0.005	-0.643***	2.719***
	(0.00)	(0.16)	(0.29)
Adjustment term	-0.053***	-0.087***	-0.058***
	(0.01)	(0.01)	(0.01)
Fixed effects	Yes	Yes	Yes

Source: Authors' analysis.

*Note: ***, **, and * denote statistical significance at 1%, 5%, and 10%, respectively. Figures in brackets denote standard errors.*

[5] The negative coefficient of education expenditure in the short-run (Table 6.2, column 2) can be due to low year on year variations in expenditure shares. Insignificant coefficient on public expenditure could also be because government expenditures at current prices are flows and cannot represent a stock of government efforts, the latter being more effective in influencing HD. While our results do not capture this effect, we have controlled for state-level fixed effects that will likely account for the stock of efforts taken over the years and prevent it from introducing bias in our results.

Box 6.1:Public Expenditure—Does it Impact Human Development Outcomes?

Numerous studies have highlighted public expenditure on health and education as an important link between economic growth and human development (Ranis, 2004). However, empirical findings in this area present a mixed picture. While Anand and Ravallion (1993), Biswas (2002), Gupta *et al.* (2002), and Baldacci *et al*. (2004) reported a positive impact of public expenditure on human development outcomes, Filmer (1999) and Pelinescu (2015) found the impact on HD outcomes to be insignificant.

In the Indian context, the literature also exhibits a similar divide. Ghosh (2006), Farahani *et al.* (2009), and Pradhan and Abraham (2002) discovered a positive and statistically significant impact of public expenditure, whereas Patel and Annapoorna (2019), Dubey (2019), Goswami and Bezbaruah (2011), among others, argued that public expenditure did not impact health and education outcomes. Some papers even point towards diminishing returns to public expenditure on education (Kaur and Mishra, 2003).

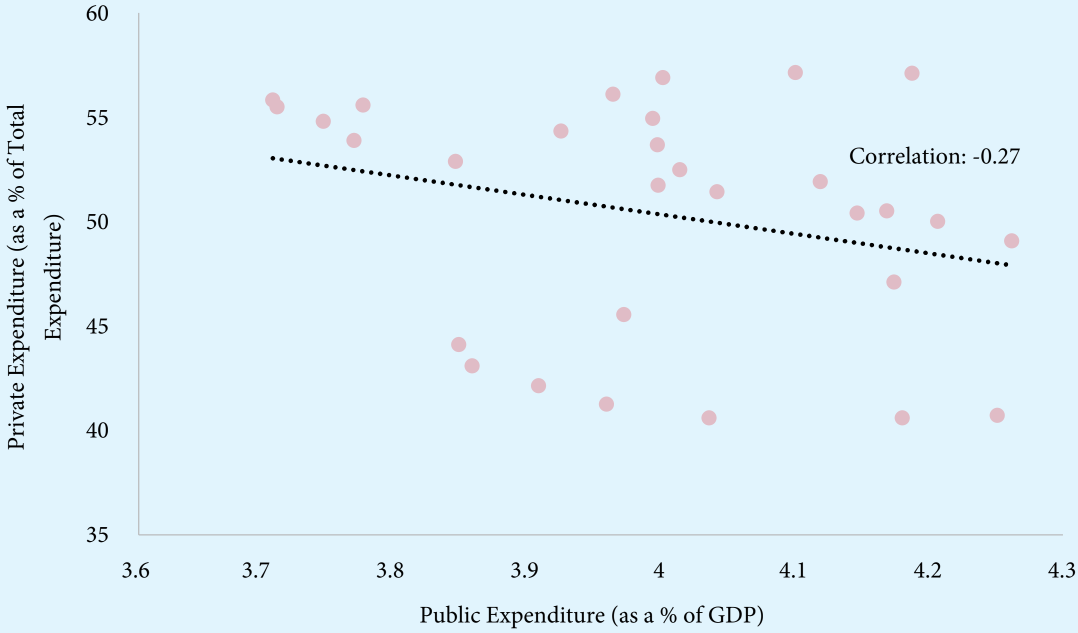
Understanding why public expenditure has not had a strong effect on improving HD indicators is crucial for shaping public policy in developing countries. Filmer (1999) proposed three potential explanations: (i) cost-effectiveness of public spending; (ii) crowding out of private expenditure; and (iii) public sector efficiency. The insignificant impact may also be attributed to low levels of expenditure (Goswami and Bezbaruah, 2011). As per the 2021–2022 Economic Survey, India's public expenditure on education was around 4% of its GDP and on health, about 1.3% (Government of India, 2022). In OECD countries, the corresponding figures were approximately 5% and 7.5%, respectively. On the efficiency of expenditure, Mohanty and Bhanumurthy (2021) noted that states that were more efficient in spending their social sector budget also had higher HDI levels.

Since public expenditure is low, out-of-pocket expenditure (OOPE) plays an important role in India (Garg and Karan, 2009). Over 60% of total health expenditure and about 50% of total education expenditure are incurred by the private sector. Therefore, public expenditure alone may not be able to influence HD outcomes. Its effect on outcomes will be further muted if public expenditure crowds out private expenditure. Expenditure on health and education is non-discretionary, compelling individuals to allocate funds to these areas, either through borrowing or by cutting down expenditure on discretionary items. This implies that if the government does not spend adequately on health and education, the public would be forced to spend on such activities out of their own pockets. Thus, there is an inverse relationship between public and private expenditure (on health and education) in India (see Figure A).

Even though public spending might not directly correlate with human development results, it plays a critical role in reducing the households' financial burden. It aids in preventing families from falling into poverty because of overwhelming healthcare costs or from having to make tough decisions like reducing their food, education or other essential expenses.

On further examination we found that that while public expenditure alone may not impact human development outcomes, the combined total expenditure (including both public and private spending) on health and education did influence HD outcomes. Using the ARDL model and substituting public expenditure with total expenditure at an all-India level, we found that an increase in total expenditure resulted in an increase in both education (EYS) and health (LE) outcomes, *albeit* with lags: a one-year lag in the case of education and two years in the case of health. Other variables exhibited the expected signs (Tables 1A and 1B).

Figure A: Relationship between Public and Private Expenditures on Health and Education



Source: National Account Statistics, MOSPI.

Table 1A: Impact of Total Expenditure on Education (Dependant Variable: Expected Years of Schooling)

Variable	Coefficient
L. *EYS*	0.603*** (0.10)
lnPCGSDP	5.813*** (1.67)
L. *lnPCGSDP*	-5.046*** (1.61)
Educ Exp	-0.763** (0.28)
L. *Educ Exp*	0.883*** (0.28)
Constant	-5.132*** (1.29)
Observations	28
Durbin-Watson statistic	2.600

Table 1B: Impact of Total Expenditure on Health (Dependant Variable: Life Expectancy)

Variable	Coefficient
L. *LE*	2.051*** (0.04)
L2. *LE*	-1.108*** (0.05)
lnPCGSDP	0.324*** (0.08)
L. *lnPCGSDP*	-0.124 (0.07)
Health Exp	0.015 (0.02)
L. Health Exp	-0.031 (0.03)
L2. Health Exp	0.074** (0.02)
Constant	1.314*** (0.30)
Observations	28
Durbin-Watson statistic	1.173

Source: Authors' Analysis

*Note: ***, **, and * denote statistical significance at 1%, 5%, and 10%, respectively. Figures in parentheses denote standard errors.*

6.3. Impact of Human Development on Economic Growth

We also tested for the impact of human development on economic growth. As described in Box 3.2, the connection between health and economic growth is intricate. Many argue that the correlation between the two is non-linear. However, in the case of India, we found no evidence of a non-linear relationship (Box 6.2). Therefore, in our study, we hypothesised a positive and linear impact of health on economic growth in India.

The results of the short-run and long-run impacts of human development on economic growth in India are presented in Table 6.3. Broadly, the findings align with expectations. A negative and statistically significant adjustment term (ECT) implies a long-term relationship between the variables under study. The coefficients of GCF and HDI were statistically significant, indicating that GCF and human development influence economic growth positively in the long run. *Ceteris paribus,* a 0.1-point improvement in the non-income HDI results in, on average, a 48% increase in per capita GSDP of states in the long run. Similarly, a 0.1-point improvement in gross capital formation (as % of GDP) leads to, on average, a 1.3% increase in per capita GSDP of states. None of the variables had a statistically significant short-run impact on per capita GSDP (Table 6.3).

We also regressed economic growth on EYS and LE individually to find out the impact of education and health on economic growth, separately (Table 6.4). A negative and statistically significant estimate of the adjustment term (-0.043) signified that the variables under study returned to long-run equilibrium after a deviation. While all three explanatory variables —GCF, EYS, and LE—had a positive impact on per capita GSDP in the long-run, only EYS showed a statistically significant positive impact on per capita GSDP in the short-run. A one-year increase in the expected years of schooling can result in an increase of 16% in per capita GSDP in the long-run. On average, a one-year increase in life expectancy can lead to a 4% increase in a state's per capita GSDP.

It is intriguing that over the last 30 years, while life expectancy (at all-India level) increased by 12 years, expected years of schooling increased by only 5 years, yet the size of the coefficient of education was higher than the coefficient of health, implying that contribution of education to EG was higher than that of health. The results remained robust even after including additional controls (Appendix 3).

Table 6.3: Impact of Non-Income HDI on Economic Growth (Dependent Variable: D. log Per Capita GSDP)

Variable	Coefficient
Long-run estimation	
GCF	0.133***
	(0.020)
Non-Income HDI	4.763***
	(1.46)
Short-run estimation	
D. *GCF*	0.001
	(0.0001)
D. *Non-Income HDI*	0.032
	(0.270)
Constant	0.265***
	(0.020)
Adjustment term	-0.043***
	(0.010)
Fixed effects	Yes

Source: Authors' Analysis.

*Note: ***, **, and * denote statistical significance at 1%, 5%, and 10%, respectively. Figures in brackets denote standard errors.*

Box 6.2: Impact of Health on Economic Growth in India—Is it Non-Linear?

As empirical evidence regarding the impact of health on EG is not unequivocal, understanding the nature of the relationship between health and EG becomes crucial. To ascertain whether the relationship between health and EG in India is linear or non-linear, we conducted a threshold regression of economic growth over life expectancy. However, the coefficient of the threshold was found to be insignificant, suggesting the absence of non-linearity. The threshold regression, based on Hansen (1999), endogenously identifies the existence and significance of threshold values using the data themselves for panels with individual-specific fixed effects. The regression equation is given below:

$$PCGSDPgrowth_{it} = u_i + \theta \boldsymbol{X}_{it} + \beta_1 LE_{it} I(LE_{it} \leq \gamma) + \beta_2 LE_{it}(LE_{it} \geq \gamma) + \varepsilon_{it}$$

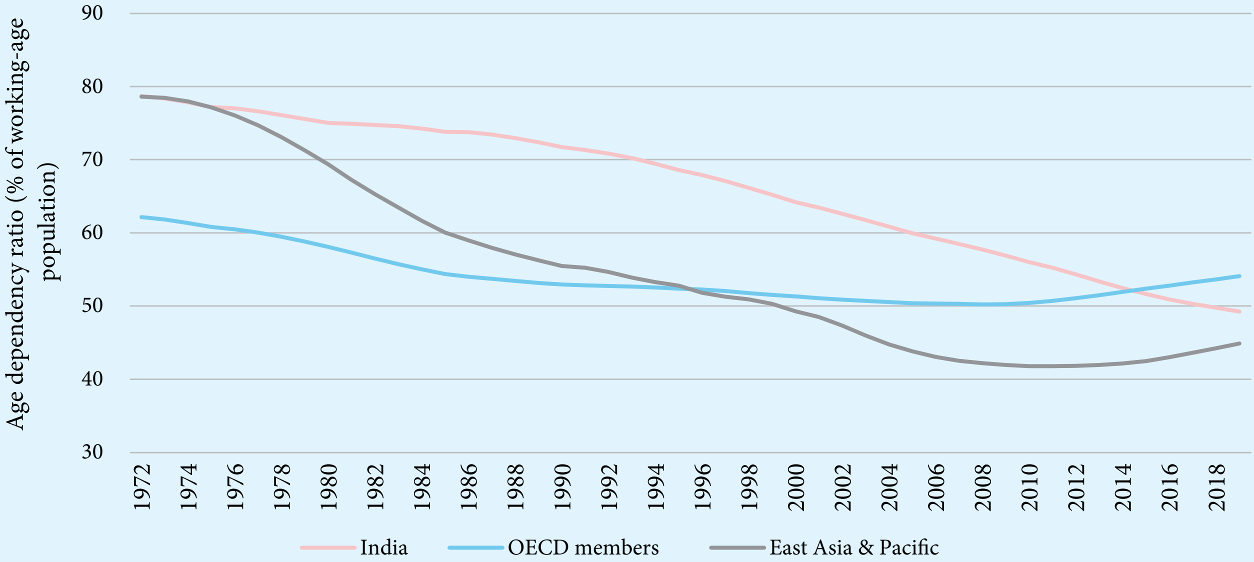
Where the dependent variable $PCGSDPgrowth_{it}$ represents per capita economic growth.

$\boldsymbol{X}_{it}$ is a vector of control variables that may impact EG, including gross capital formation as a share of GSDP. γ is the threshold parameter that divides the equation into two regimes based on life expectancy. The third and the fourth terms capture the impact of LE on EG in the two regimes. Our results rejected the existence of a threshold.

Threshold	F statistic	p-value
Single	30.29	0.30

The demographic transition is a primary factor contributing to the non-linear association between LE and EG. India is presently in the third stage of demographic transition (RBI, 2019). The dependency ratio in India has has been falling continuously unlike many advanced economies where it has risen recently (Figure B). Thus, India has not reached the threshold stage where the impact of health on economic growth would turn negative.

Figure B: Age Dependency Ratio (% of Working-Age Population)



Source: World Development Indicators Database, World Bank.

Note: Age dependency ratio is defined as the ratio of dependents—people younger than 15 and older than 64—to the working-age population aged 15–64.

Table 6.4: Impact of Human Development Indicators on Economic Growth (Dependent Variable: D. log Per Capita GSDP)

Variable	Coefficient
Long-run estimation	
GCF	0.125***
	(0.010)
EYS	0.160***
	(0.050)
LE	0.040*
	(0.020)
Short-run estimation	
D. *GCF*	0.001
	(0.0001)
D. *EYS*	0.013*
	(0.01)
D. *LE*	-0.006
	(0.010)
Constant	0.208***
	(0.050)
Adjustment term	-0.044***
	(0.0001)
Fixed effects	Yes

Source: Authors' Analysis.

*Note: ***, **, and * denote statistical significance at 1%, 5%, and 10%, respectively. Figures in brackets denote standard errors.*

6.4. Levels of Education and Economic Activity

The analysis above clearly indicates a strong impact of education on economic growth. There are different levels of education, and it is of interest to understand how these different levels of education are related to a particular economic activity such as agriculture, manufacturing, and services. Consequently, we assessed the relationship between the different levels of education and components of economic activity. The levels of education were approximated by enrolments in primary, secondary, and tertiary education, while economic activity in each sector was gauged by value added in agriculture, manufacturing, and service sectors. We utilised data on gross state value added (at current prices) for 25 states spanning from 2000 to 2019. Data for the gross enrolment ratio in primary and higher secondary education were collected from the Department of School Education and Literacy, Ministry of Education. Additionally, data on enrolment ratios in higher education (18–23 years) were collected from the various annual reports of the All-India Survey on Higher Education (Ministry of Education).

Following the literature, we controlled for (logarithm of) gross capital formation per capita as a key driver of economic growth. We posited that primary and secondary enrolment ratios were the main determinants of agriculture, while secondary and higher education were important determinants for manufacturing and services sector value added. Our regressions incorporated 3-year lags.

Table 6.5 reports the results of the relationship between the gross enrolment rate (in %) and the (logarithm of) gross state value added in the agricultural, manufacturing, and services sectors. Through a fixed-effects regression model, we found that the gross enrolment ratio (in %) in secondary education had a positive and statistically significant impact on gross value added in agriculture, while the enrolment ratio in primary education (in %) had no impact on agriculture (Column 2, Table 6.5). The enrolment ratio in secondary education (in %) had a positive and statistically significant impact on value added in manufacturing but no influence on services. Meanwhile, the enrolment ratio in higher education (in %) had a positive and statistically significant impact on services; however, it did not have a statistically significant impact on manufacturing.

In quantitative terms, a 1% increase in the enrolment ratio for secondary education resulted, on an average, in a 0.3% increase in gross value added in agriculture as well as manufacturing, while a 1% increase in the gross enrolment ratio for higher education led to a 1.2% increase in the gross value added in the service sector for the states. Consequently, the impact of higher education enrolment on services was four times larger than that of secondary education enrolment on manufacturing. It is the development of cognitive skills of individuals rather than mere school enrolment or attainment that is related to economic growth. Recent studies suggest that investing in secondary education yields a substantial economic growth advantage, surpassing the impact achievable solely through universal primary education (Grant, 2017).

In essence, for primary education to substantially contribute to economic growth, it is important to supplement it with widespread provision of secondary education. Notably, the UN Sustainable Development Goals (SDGs) now include specific targets for primary and secondary education, in contrast to the Millennium Development Goals (MDGs), which solely emphasised universal primary education (United Nations, 2015).

Figure 6.1 plots the (logarithm of) primary, secondary, and tertiary enrolments (in %) for India for the period 1960–2020. It is clear that the gap between secondary and tertiary enrolment widened from 1986 to 1997. However, it gradually narrowed down thereafter (other than in the last few years when it stagnated). This suggests that after completing their secondary education, a greater number of students are now pursuing higher education. Post 1997, tertiary enrolment increased significantly. When seen in conjunction with the tertiary enrolments as a factor driving the value added in the service sector, it is not surprising that the share of the service sector in India's GDP increased sharply from 39.08% in 1997 to 50.11% in 2019.

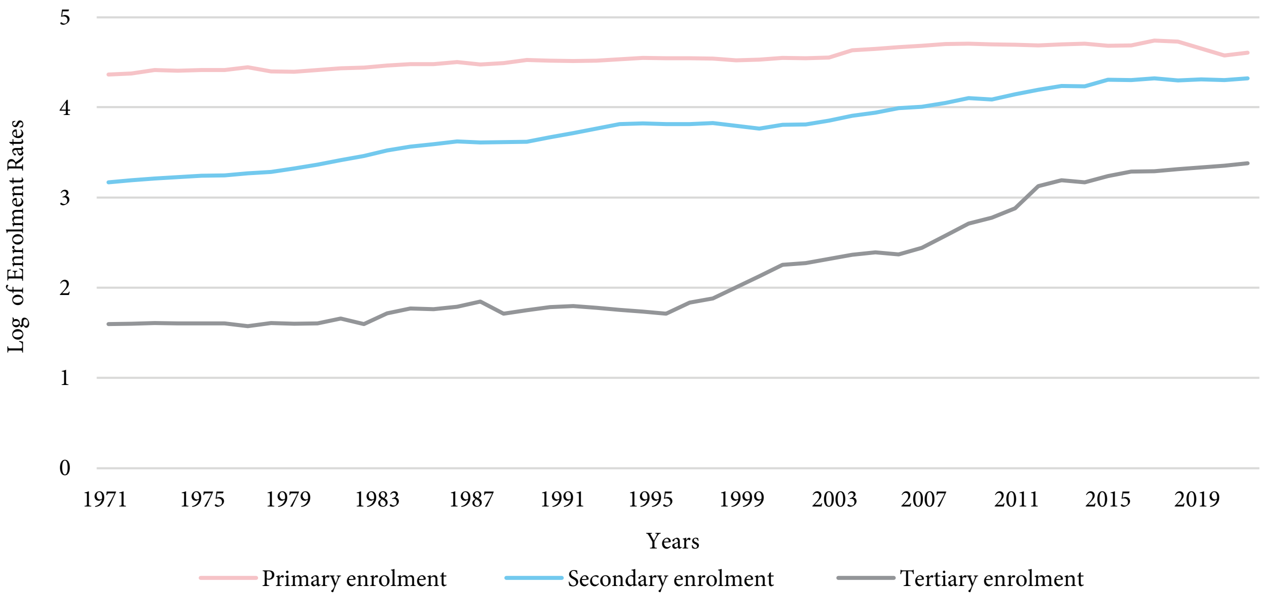
Table 6.5: Relationship Between Enrolment Ratios (in %) and Sectoral Gross State Value Added

Variable	log (Gross state value added in agriculture)	log (Gross state value added in manufacturing)	log (Gross state value added in services)
(1)	(2)	(3)	(4)
Lagged gross enrolment ratio, primary (in %)	-0.001 (0.001)	-	-
Lagged gross enrolment ratio, secondary (in %)	**0.003***** **(0.001)**	**0.003*** **(0.001)**	-0.0003 (0.001)
Lagged gross enrolment ratio, higher education (in %)	-	-0.002 (0.003)	**0.012***** **(0.002)**
	0.933*** (0.088)	1.216*** (0.080)	1.072*** (0.048)
Constant	5.302*** (0.885)	1.432 (0.774)	4.468*** (0.465)
F-statistic	121.95***	213.45***	617.36***
Fixed Effects	Yes	Yes	Yes

Source: Authors' Analysis.

*Note: ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively. Figures in brackets denote standard errors.*

Figure 6.1:Trends in Primary, Secondary, and Tertiary Enrolments



Source: World Development Indicators Database, World Bank

6.5. Causal Analysis

The Dumitrescu and Hurlin (2012) panel causality test was used to establish the presence of a causal relationship between HD and EG and to ascertain the direction of causality. It tests the null hypothesis of no causality against the alternative hypothesis that causality exists for at least some cross-sections in the heterogeneous panel. For robustness, the test was conducted both in level form and in terms of economic growth and improvement in non-income HDI (defined as shortfall reduction). Results from the level-based test indicated a bi-directional causality between GSDP per capita and human development at a 99% confidence level (Table 6.6). There is also evidence of bi-directional causality from improvement in HD to economic growth (at 99% confidence level) and *vice versa* (at 90% confidence level) (Table 6.7).

Table 6.6 Dumitrescu and Hurlin Panel Causality—GSDP and Non-Income HDI

Null hypothesis	Z- bar Statistic	p-value
Per capita GSDP does not Granger cause non-income HDI	14.003	0.0001***
Non-income HDI does not Granger cause per capita GSDP	29.037	0.0001***

Source: Authors' Analysis.

*Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.*

Table 6.7: Dumitrescu and Hurlin Panel Causality—Economic Growth and Improvement in Non-Income HDI

Null hypothesis	Z- bar Statistic	p-value
Economic growth does not Granger cause improvement in non-income HDI	-1.649	0.099*
Improvement in non-income HDI does not Granger cause economic growth	5.873	0.0001***

Source: Authors' Analysis.

*Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.*

7. Conclusions and Policy Implications

Traditionally, economic development was considered the sole indicator of human development. However, it is now widely recognised that human development is multi-faceted. Though human development may comprise many elements, health and education are currently considered its two key determinants, apart from income. Given that economic growth and human development are interrelated, a country cannot maintain a fast pace of economic growth for an extended period of time without commensurate improvement in human development (UNDP, 1990; 1996). To understand the dynamics between income and human development in India over the long term, an ARDL model with error-correction parameterisation was employed for 26 Indian states spanning 1990–2019.

The results suggest a strong two-way relationship between EG and HD in India. This is evident from: (i) co-integration of a series of EG and HD (negative and significant error-correction term); (ii) a long-term relationship between EG and HD; and (iii) bi-directional causality. These findings have significant policy implications. Historically, policymakers in India have prioritised economic growth, with a relative neglect of health and education. While economic growth indirectly influences human development, the pace is notably slow. For instance, India's HDI improved by only 0.225 units over the past 30 years. Despite being one of the fastest-growing economies in the world for the last several years, India lags its peers in key health and education indicators. To catch up, India cannot rely on economic growth alone and its trickle-down effect on human development. It must implement direct, specific, and affirmative measures aimed at promoting human development. Since human development also catalyses economic development, prioritising human development in policymaking will not only enhance the welfare of people but will also fortify economic growth. One method to strengthen the interlinkages between human development and economic growth is to create and improve supporting conditions such as employment generation gender equality, and financial inclusion (Raj *et al.,* 2023).

States that have maintained high economic growth and equally high human development (Haryana, Himachal Pradesh, Karnataka, Kerala, Maharashtra, and Tamil Nadu) have also maintained significantly better supporting conditions (low poverty, low unemployment, more equality, financial inclusiveness, and prioritisation of the social sector). Conversely, economically less developed states like Bihar, Uttar Pradesh, and Odisha have low levels of HD (health and education). An effective way to boost overall economic growth is to prioritise human development in economically less-developed states (Raj *et al.,* 2023).

The level of education plays a significant role in determining sectoral economic activity. The results indicate that secondary education leads to increased economic activity in the agriculture and manufacturing sectors, with a lag of three years, while higher education drives economic activity in the service sector. Primary education was not found to impact economic activity. Cross-country research now emphasises the criticality of at least secondary-level quality education for developing cognitive skills. Hence, educational reforms should focus on providing education for all, at least up to the secondary level.

Our study found that public health and education expenditures (% of GDP) had no impact on human development outcomes. This could be due to low efficiency in the public sector and the fact that public expenditure accounts for only 40–50% of the total expenditure on health and education, with the remainder coming from households or the private sector. This aligns with our other finding that while public expenditure does not impact health and education outcomes, total expenditure does. A negative relationship between public and private expenditure on health and education implies that the two are substitutes. Low public expenditure on health has been forcing households to spend on healthcare and education from their own pockets. For instance, a study suggests that out-of-pocket expenditure (OOPE) on healthcare pushed 55 million people in India into poverty in 2011–2012 (Selvaraj *et al.*, 2018). High OOPE can force households to adopt harmful coping mechanisms such as liquidation of productive assets, borrowing at high rates of interest, and dissaving (Selvaraj *et al.*, 2018), eventually resulting in impoverishment.

Public spending on education remains low at about 4% of GDP against the target of 6%. It is a matter of concern that even after nearly 40 years, the target of 6% remains significantly unmet from its original goal set for 1985–1986 (Tilak, 2006). The low public spending on education has been one of the key factors for a large proportion of children in the country still not being able to attain school education beyond the elementary level. India must significantly increase its public spending on health and education, and ensure its effective targeting. This would reduce people's out-of-pocket expenses, allowing them to allocate funds to their other crucial needs and strengthen the interlinkages between human development and economic growth.

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Appendix 1: Description of Variables

Variable	Name	Definition	Data Source
Variables of interest	Gross state domestic product (GSDP) per capita (current INR)	The gross domestic product (GDP) of a state is divided by its population and measured in current INR.	RBI and NSO
	Human Development Index (HDI)	Measured by UNDP, HDI is a composite index that provides an indication of the standard of living of the population.	Global Data Lab; UNDP HDR database
	Non-income HDI	This indicator takes into account only the health and education aspects. It takes the geometric average of the health and education indices	Global Data Lab; UNDP HDR database
	Expected Years of Schooling (EYS)	Number of years of schooling a child of school entrance age can expect to receive if the current age-specific enrolment rates persist throughout the child's years of schooling.	Global Data Lab; UNDP HDR database
	Mean Years of Schooling (MYS)	Average number of completed years of education of population aged 25 years and older.	Global Data Lab; UNDP-HDR database
	Life Expectancy (LE)	Number of years a newborn child would live if subject to the prevailing mortality risks.	Global Data Lab; UNDP-HDR database
	Gross enrolment ratio (in %)	The ratio of total enrolments (primary, secondary, or tertiary), irrespective of age, to the total population in the age group that corresponds to the particular level of education, i.e., primary, secondary, or tertiary.	Ministry of Education and world bank
	Public expenditure on education (as a % of GSDP)		Union and state Budgets, RBI State Finances Report, CMIE, Ministry of Education
	Public expenditure on health (as a % of GSDP)		Union and State Budgets, RBI State Finances Report, CMIE
Control variables	Gross capital formation (GCF), public expenditure on education (in %), and public expenditure on health (in %)		RBI

Note: Gross capital formation for each state has been calculated based on the assumption that each state's share in GCF is equal to its contribution to the economy's GDP.

Appendix 2: Robustness Checks—Impact of Economic Growth on Human Development

Variable	D.EYS	D.LE	D.MYS	D.IMR
(1)	(2)	(3)	(4)	(5)
Long-run estimation				
Log (real per capita GSDP)	3.515***	3.608***	0.795	-29.461***
	(0.481)	(0.977)	(0.521)	(2.210)
Public expenditure on education (as % of GSDP)	-0.353**		-0.287*	
	(0.167)		(0.148)	
Pupil-teacher ratio	-0.021		-0.043***	
	(0.016)		(0.017)	
Public expenditure on health (as % of GSDP)		-1.604		-3.761
		(1.130)		(2.709)
HCs per million population		0.232		1.352***
		(0.151)		(0.297)
Short-run estimation				
D. Log (real per capita GSDP)	0.117	-0.019	-0.138	7.818**
	(0.183)	(0.213)	(0.127)	(3.179)
D. Public expenditure on education (as % of GSDP)	-0.119***		0.032	
	(0.034)		(0.024)	
D. Pupil-teacher ratio	-0.001		-0.000	
	(0.002)		(0.001)	
D. Public expenditure on health (as % of GSDP)		0.123		8.071***
		(0.112)		(1.677)
D. HCs per million population		-0.011		-0.122
		(0.009)		(0.136)
Constant	-2.174***	1.332***	0.092	70.460***
	(0.581)	(0.355)	(0.416)	(8.325)
Adjustment term	-0.089***	-0.039***	-0.064***	-0.208***
	(0.016)	(0.009)	(0.012)	(0.023)
Fixed effects	Yes	Yes	Yes	Yes

Source: Authors' Analysis.

*Note: ***, **, and * denote statistical significance at 1%, 5%, and 10%, respectively.*

Appendix 3: Robustness Checks—Impact of Human Development and Its Components on Economic Growth

Dependent Variable: D. Log (real GSDP per capita)

(1)	(2)	(3)	(4)	(5)	(6)
Long-run estimation					
GCF (as a % of GSDP)	0.033***	0.002	0.014***	0.016**	0.012***
	(0.004)	(0.003)	(0.005)	(0.006)	(0.003)
Non-income HDI	7.993***	7.812***			
	(0.314)	(0.252)			
EYS			0.274***	0.289***	
			(0.025)	(0.031)	
LE			0.039***	0.028	
			(0.015)	(0.018)	
MYS					0.261***
					(0.017)
IMR					-0.014***
					(0.002)
Fiscal deficit		-0.395***		-0.135	-0.623***
		(0.083)		(0.121)	(0.102)
Short-run estimation					
D. GCF (as a % of GSDP)	0.006***	0.008***	0.008***	0.009***	0.008***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
D. Non-income HDI	-1.284**	-1.103***			
	(0.608)	(0.400)			
D. EYS			-0.024*	-0.018	
			(0.014)	(0.013)	
D. LE			-0.014	-0.024	
			(0.020)	(0.015)	
D.MYS					0.016
					(0.020)
D.IMR					0.001
					(0.001)
D. Fiscal deficit		0.064***		0.034**	0.066***
		(0.018)		(0.015)	(0.019)
Constant	0.559***	0.741***	0.556***	0.536***	0.917***
	(0.194)	(0.129)	(0.117)	(0.103)	(0.195)
Adjustment term	-0.094***	-0.106***	-0.099***	-0.085***	-0.087***
	(0.035)	(0.019)	(0.023)	(0.018)	(0.019)
Observations	650	650	670	670	650
Fixed effects	Yes	Yes	Yes	Yes	Yes

Source: Authors' Analysis.

*Note: ***, **, and * denote statistical significance at 1%, 5%, and 10%, respectively.*

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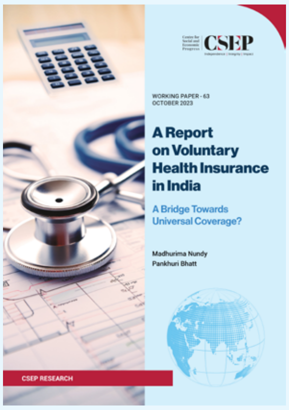

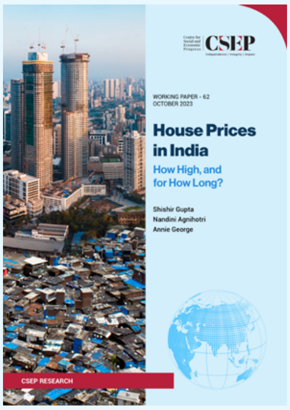

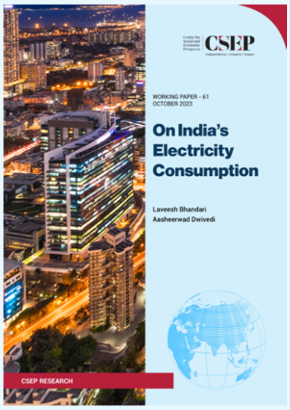

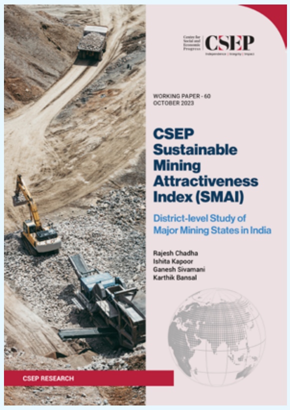

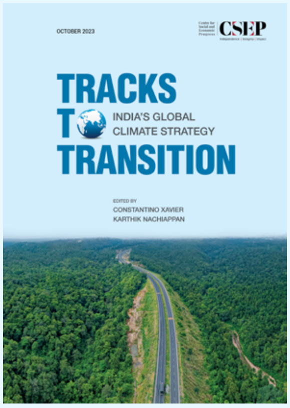

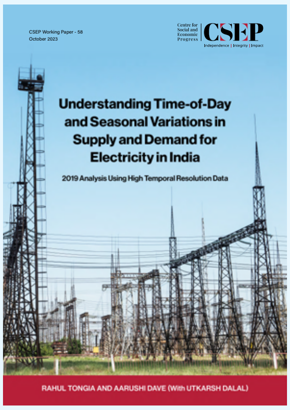

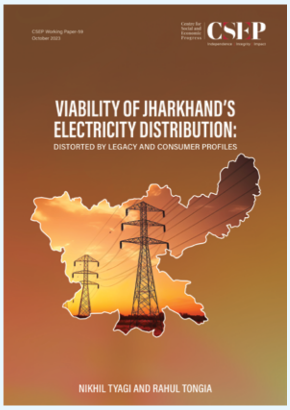

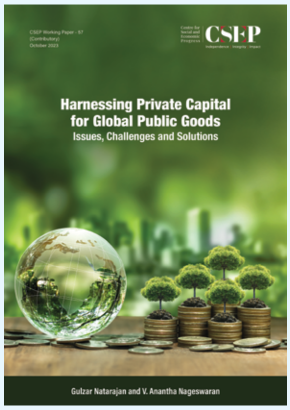

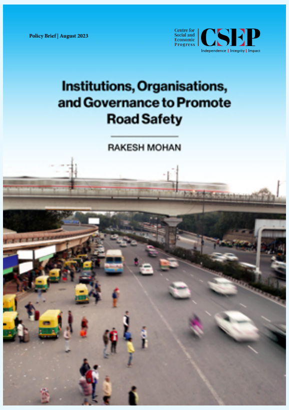

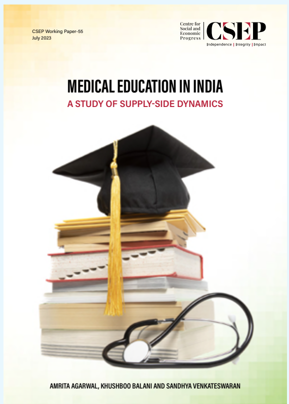

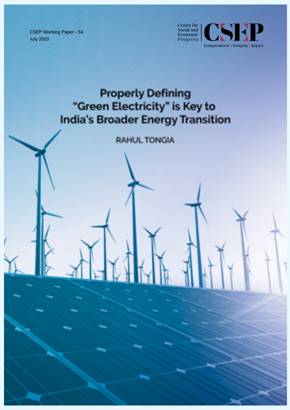

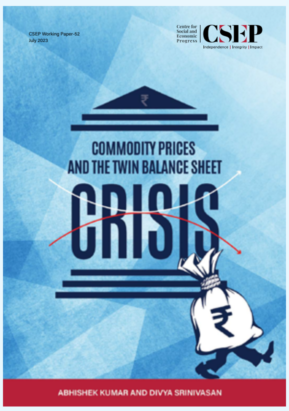

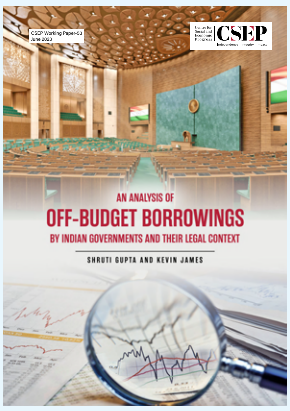

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