Indian Public Policy Review 2024, 5(3): 94-137
https://doi.org/10.55763/ippr.2024.05.03.004

IPPR

Economic Growth and Human Development in India – Are States Converging?[#$]

Janak Raj **Vrinda Gupta** **Aakanksha Shrawan**[*]

Abstract

This study focusses on three aspects of the association between human development and economic growth in India: (i) the pattern of the relationship between economic growth and human development in India at the national and state levels; (ii) whether economic growth was converging at the state level; and (iii) whether human development was converging at the state level. In the last two decades, India outperformed advanced and developing economies in per capita income growth and health and education indicators, propelling itself into the virtuous category (high-EG, high-HD). By employing data for 26 states and union territories (UTs) for three decades (1990–2019), a diverse pattern was observed in the relationship between economic growth and human development, with most of the states (16) in the virtuous category, and the others in three different categories. However, no clear pattern emerged from the dynamic movements in the last three decades, as there were cases of states moving from one category in one decade to another category in different decade. There was no evidence of economically weaker and low HD states catching up with economically well-off and high HD states, respectively. However, club convergence was occurring, i.e., economically weaker states were catching up with economically well-off states in the low-income, high-HD club. Economically weaker and low HD states can catch up with economically well-off and high HD states only if similar conditions are created.

Keywords: Economic Growth, Human Development, Unconditional convergence, Conditional convergence, Virtuous category, HD-lopsided, EG-lopsided

JEL Codes: I15, I25, O15, O40, O47, C01

Publication Date: 17 June 2024

[$] This paper was originally published as a Working Paper on the CSEP website.

[*] Janak Raj is Senior Fellow; Vrinda Gupta and Aakanksha Shrawan are Research Associates at Centre for Social and Economic Progress, New Delhi.

Abbreviations

CAGR	Compound Annual Growth Rate
EG	Economic Growth
GDP	Gross Domestic Product
GNI	Gross National Income
GSDP	Gross State Domestic Product
HD	Human Development
HDI	Human Development Index
IQR	Inter-Quartile Range
LE	Life Expectancy
NSDP	Net State Domestic Product
OLS	Ordinary Least Square
SCI	Supporting Conditions Index
UNDP	United Nations Development Programme
UT	Union Territory

1. Introduction

India's economic growth (EG) accelerated to 5.9 per cent per annum (compound annual growth rate [CAGR]) after the launch of structural economic reforms in the early 1990s from the 4.2 per cent CAGR during the 1960s to 1990s. As with EG, India also made significant progress in its human development (HD) indicators of health and education. Between 1990 and 2019, the under-five mortality rate reduced from 126 to 34 (per 1,000 live births). Similarly, the maternal mortality ratio also declined from 384 per 100,000 live births in 2000 to 116 per 100,000 live births in 2019. In education, India has achieved near-universal enrolment in primary education, and the literacy rate has increased from 48 per cent in 1991 to 74 per cent in 2018 (World Development Indicators, 2022)[1]. Based on the Human Development Index (HDI) compiled by the UNDP, India's HDI score increased from 0.434 in 1990 to 0.645 in 2019, propelling it from the low to medium-HDI category. India's EG has both contributed to higher HD, as well as benefitted from it, as a result of a strong two-way relationship between the two.

However, large inter-state variations exist both in EG and HD. For instance, while states such as Andhra Pradesh and Gujarat grew economically at a CAGR of 7 per cent during 1990–2019, others such as Uttar Pradesh and Bihar grew at a low annual growth rate of 4 per cent during the same period. Likewise, HD indicators of states like Kerala and Tamil Nadu are comparable to those of advanced economies, while those of states such as Bihar and Uttar Pradesh are worse than some of the least developed economies. Kerala and Tamil Nadu are economically well-off states, while Bihar and UP are economically poor states. Some states have performed well in terms of EG indicators for some period but not HD (for example, Gujarat), while others have done well in HD for some period but not in EG (for example, Meghalaya). In general, large inter-state variations characterise India's EG and HD pattern. While many studies in the Indian context have been devoted to the inter-linkages between EG and HD, only a few explain the relationship pattern between EG and HD, *i.e.,* map the HD–EG performance of the states together against some benchmark. In this context, this paper attempts to analyse the relationship between EG and HD at the national and state levels and assesses the dynamic movements of states from one type of pattern to another over three decades (1990–2000, 2000–10, 2010–19). The study also attempts to explain the conditions that helped states to transition from one category to another. In this context, we compute a Supporting Conditions Index (SCI) to assess the extent to which other supporting conditions also matter in the relationship between EG and HD.

According to the neoclassical growth model, there are diminishing marginal returns on capital. By implication, economically poor nations or states should, over time, converge with economically well-off nations/states (convergence hypothesis). In contrast to this, the endogenous growth model of the 1980s argued that long-term growth rates depend on investment in human capital which may or may not be subjected to diminishing returns. (Romer, 1990). Therefore, economically poor nations may not be able to converge economically rich ones, if there are differences in human capital. In other

words, economically poor nations can catch up with economically rich nations only if they achieve similar levels of HD as of those of economically rich nations.

Given the large divergences in EG and HD amongst states in India, it is of interest to know whether economically poor states are catching up with the economically well-off states. Likewise, it would be insightful to learn whether low-HD states are catching up with high-HD states. If not, what are the underlying reasons for the persisting divergence?

Some of the key questions to which we seek answers in this paper are: (i) What has been the relationship patterns between EG and HD at the all-India level and state levels? Have economically poor states been catching up with economically well-off states? (iii) Have HD-deficient states been converging with high-HD states? The key findings emerging from the analysis are as follows: First, in the last two decades, India as a whole, has outperformed the world as well as developing economies in terms of the rate of change of income and non-income components of HD (health and education). As a result, India has moved into the virtuous category, in which income and non-income components mutually reinforce each other. Second, at the state level, 16 states were in the virtuous category and only two in the adverse feedback category (in which EG and HD stifle each other). Third, there is lack of unconditional convergence among states. That is, economically poor states continue to grow at a slower pace than economically rich states. Likewise, low-HD states have continued to lag high-HD states. However, conditional convergence could be observed, that is, economically poor states can catch up with economically rich ones if HD is held constant. Likewise, low-HD states can converge with high-HD states, if economic conditions remain constant. These results suggest that income and non-income convergence among Indian states can only occur if other conditions also become similar.

The paper is organised in five sections. Section 2 sets out the review of literature of the relationship between EG and HD, and also of convergence hypothesis, that is, whether economically poor states catch up with economically rich states. Section 3 analyses the trends in the HDI and details the pattern of the relationship between EG and HD in India at the national and state levels. Section 4 tests the convergence in income and non-income HDI among Indian states. The concluding section sums up the key findings and spells out the policy implications.

2. Review of Literature

2.1 Relationship of Non-income Human Development and Economic Growth

Economic growth and non-income HDI are intrinsically linked (Preston, 1975; Floud *et al.*, 1990; Fogel, 1994; Arora, 2001). Better health and education lead to higher EG by enhancing productivity (Uzawa, 1965; Romer, 1986; Lucas, 1988; Barro, 1991; Schultz, 1971, 1981; Benhabib & Speigel, 1994). Education is a key factor in promoting HD as it provides people with knowledge, skills, and abilities to improve their lives and contribute to the economy. Furthermore, education enhances the efficiency and productivity of the workforce, leading to higher EG (Becker, 1964). It facilitates the

transfer and absorption of knowledge/techniques from one economy to another, fostering quicker growth (Nelson & Phelps, 1966; Benhabib & Spiegel, 1994). Education also fosters innovative thinking, thereby boosting a country's own capacity to create new knowledge, products, and processes (Romer, 1990; Pelinescu, 2015; Teixeira & Queirós, 2016). People with higher educational qualifications are more likely to find employment, upskill themselves, and earn more compared to those with lower educational attainment.

Similarly, there are many pathways through which better health levels lead to higher EG. It increases labour market participation and productivity of labour (Strauss & Thomas, 1998; Arora, 2001; Schultz, 2002; Bloom & Canning, 2003). Higher life expectancy incentivises investment in education and physical capital (Cervellati & Sunde, 2013; Prettner, 2013). Not only does better health facilitate higher EG, but poor health levels create a drag on a country's resources, and slow down EG (Bloom *et al.*, 2022).

Health and education are also closely inter-linked. An increase in the expected life span boosts investment in schooling by increasing returns to schooling (Arora, 2001). Poor health in childhood is correlated with lower educational attainment and lower earnings as adults (Case, Fertig & Paxson, 2005). Similarly, schooling induces prudent health-conscious behaviour by increasing awareness of health-related behaviour as well as the opportunity cost of poor health. Education also facilitates women empowerment, which is shown to switch household allocation of resources towards health and education, improving human capital outcomes for women themselves, as well as children.

Economic growth gives individuals a greater command over resources, enabling them to consume basic goods such as food, medical care and education. Higher EG also enhances the government's capacity to spend on essentials such as water, sanitation, primary health education, and so on (Anand & Ravaillon, 1993; Ranis *et al.*, 2000).

However, EG by itself is not sufficient for sustained HD; it needs to be supported by other factors. The beneficial impact of EG on HD can be enhanced if growth is inclusive and jobs-generating, that is, as far as possible, growth should be well-distributed and include all sections of society. Well-distributed EG will not only spur HD, but also promote social harmony and allow policymakers to focus on addressing the challenges faced by the economy. Likewise, jobless growth by perpetuating inequality and poverty will be inimical to HD and ultimately derail the growth process (UNDP, 1996).

Apart from inclusive and job-generating growth, some affirmative measures can also strengthen the relationship between EG and HD. Considering the impact of EG on HD trickles down over a period of time, well-targeted social sector spending by the government, especially on health and education, can help the sections of the population that were unable to partake in the growth process and hence could not be gainfully employed. Such spending can reduce impoverishment due to catastrophic expenditure, as well as school and college dropouts. Financial inclusion can ensure safe and secure forms of savings to even the poorer sections of society and provide credit to households and businesses to promote/strengthen an entrepreneurial culture in the country (UNDP, 1996).

Promotion of gender equality is key both for EG and HD. Enhancing women's capabilities and increasing their decision-making power aids their overall development as well as contributes to EG (UNDP, 1996). Eliminating barriers to women working could boost output by increasing their participation and labour productivity (Cuberes & Teignier-Baqué, 2011). Since women are often the primary educators and care givers of children, investing in girls' education can yield significant returns (Summers *et al.*, 1992). Giving women more control over household resources can also change the spending patterns of a household in favour of children's food and education which ultimately enhances a country's growth prospects (Afridi *et al.,* 2016; World Bank, 2012).

With the theoretical understanding and empirical evidence of bi-directional causality between HD and EG, the literature also discusses their relative importance as a rung of the development ladder. Using data of 35 to 76 developing countries between 1960 to 1992, Ranis *et al.* (2000) mapped several developing countries into four quadrants, viz. (i) *vicious*, (where both EG and HD are lower than the average of all countries); (ii) *EG-lopsided* (higher EG and lower HD); (iii) HD-lopsided (higher HD and lower EG); (iv) and *virtuous (*where both the HD and EG are higher than the average of all the countries). They found that while many countries in the HD-lopsided category were able to transition to the virtuous category, countries in the EG-lopsided category slipped to the vicious cycle. Suri *et al.* (2010) extended the analysis for another decade (1990 to 2000) and reached the same conclusion. They further noted that India was an exception as it was the only country which remained in EG-lopsided category for a long time. Thus, for a country to move to the virtuous category, Ranis *et al.* (2000) and Suri *et al.* (2010) argued that the strengthening of HD must precede the emphasis on EG.

There are various studies in the Indian context that have explored the relationship between HD and EG. While Dholakia (2003) found no statistically significant evidence of an increase or decrease in the disparities in per capita income among the Indian states for 1977–2000, he found a significant decline in the HDI disparities for the 1981–2001 period. Further, while examining the potential two-way relationship between HDI and per capita income, it was found that an improvement in income translates into faster improvement in HDI (with a lag of two years). However, an improvement in HD would take eight years to translate into higher levels of average per capita income, implying a focus on EG by the governments which would translate into lower income disparities as well as an improvement in HD over time (Dholakia 2003). Ghosh (2006) endorsed the findings of Dholakia (2003) when he reported that despite a divergence in the incomes of states there had been significant convergence in HD and its components (literacy rates and life expectancy) between 1981and 2001. Further, he established the existence of a two-way relationship between the average per capita of income of the states and HDI indicators such as (literacy rate and life expectancy) using cross-sectional data. Viswanath *et al.* (2009) also empirically estimated the relative impact of physical and human capital (proxied by mean years of schooling) in driving net state domestic product (NSDP) for Indian states from 1995–96 to 1998–99 and reported that human capital (with a lag) played a more important role in determining NSDP. Similarly, Haldar and Malik (2010) conducted a cointegration test between 1960 and 2005 and found that spending on health and education had a favourable and significant effect on India's long-term per-capita EG.

Mukherjee and Chakraborty (2010) used data from 28 states for 1983, 1993, 1999 and 2005 and discovered that an increase in per capita gross state domestic product (GSDP) resulted in an increase in HDI score, though its significance decreases over the decades, indicating a non-linear relationship. Both Mukherjee and Chakraborty (2010) and Mukherjee *et al.* (2014) found evidence of reverse causality, that is, a positive and statistically significant impact of HD on EG. Mehrotra and Parida (2021) also found that HDI positively impacts states' GSDP. They conducted Granger causality tests to find the direction of causality between HDI and EG. They found that while HDI Granger caused EG, EG did not directly result in higher HDI, but rather, led to a fall in poverty rates which, in turn, led to higher HDI. They thus highlighted the significance of higher levels of HD in achieving higher EG rates among the states.

2.2 Convergence in Income and Non-Income Human Development

The theory of convergence in income is rooted in the neoclassical growth model. The basic principle of the neoclassical growth model established the existence of diminishing returns on physical capital. This implied that countries with initial lower level of physical capital should have higher marginal product of capital enabling them to grow at a relatively faster pace as they accumulate more capital relative to their richer counterparts. In other words, the growth of rich and poor economies should converge to a steady state over time (Solow, 1956; Baumol, 1986; Barro & Sala-i-Martin, 1992, 1997; Mankiw et al., 1992). Convergence in HD is expected because there are physiological limits to individuals' health and education. Therefore, nations with high HD at some stage will experience the maximum possible levels of health and education indicators. The varying levels of HD, along with income levels, witnessed in different countries as a result of diverse government policies and country characteristics, have drawn researchers to analyse whether there is a convergence in HDI across and within countries (Nissan & Niroomand, 2005; Apergis, 2009; Goswami et al., 2021). Nissan and Niroomand (2005) investigated the convergence for HDI as well as income for a sample of 100 countries during the 1975–98 period, further dividing them into low-, middle- and high-income countries based on a per capita income threshold level. The authors found that while there was convergence for HDI, incomes diverged for all three country sub-groups.

Box 2.1: Different Concepts of Convergence Explained

Absolute (or Beta) or unconditional convergence: There is absolute convergence if poor countries/states tend to grow at a faster pace than rich ones. This can be measured by average annual growth rate in real per capita income over a period of time.

Sigma (or dispersion) convergence: This type of convergence occurs when the disparity in real per capita income decreases over time. This can be simply measured by standard deviation/coefficient of variation of growth rates in real per capita income of a group of economies.

Conditional Convergence: According to conditional convergence, only if all economies have a similarly steady state or similar conditions such as technology, institutions, etc, will poor countries grow faster than rich countries.

Goswami *et al.* (2021) explored the trends in HDI convergence using a sample of 189 countries for the 1990–2018 period. The authors found empirical evidence of strong absolute or beta convergence for all the countries, irrespective of the levels of HDI (very high, high, middle and low). With regard to sigma convergence, the authors established that countries falling in the low- and medium-HDI groups displayed a faster reduction in the disparities in HDI during the period of study vis-à-vis the very high- and high-HDI country groups.

Marchante and Ortega (2006) investigated the phenomenon of convergence of living standards of the population across the Spanish regions in 1980–2001, by estimating an augmented version of the HDI in Spain. While the authors established either stagnation or a slow degree of convergence in the income measures, the results showed a strong degree of convergence in the quality-of-life indicators – such as mean years of schooling, unemployment, augmented HDI, and infant survival rate – across the Spanish regions. De Almeida, *et al.* (2021) conducted a similar study for Brazil, to analyse the income and HD convergence among the Brazilian states for the 1990–2010 period. Allowing for spatial dependence among the states and employing the OLS and fixed-effects regression model, the authors obtained beta and sigma convergence for the income indicator (GDP per capita) as well as the HD indicators such as life expectancy and years of schooling.

In the Indian context, the literature has extended the concept of inter-country convergence to inter-state convergence. The results of these studies vary based on the sample of states used and time period covered. Using data from 20 Indian states for 1961–1991, Cashin and Sahay (1996) found strong evidence of beta convergence and established that it took approximately 45 years to close half the gap between a state's initial income level and the long-term average income of all the states combined. However, except for a few sub-periods, there has been an observed widening in the dispersion of states' net domestic product (NSDP) per capita (sigma divergence). Over a similar period, Rao *et al.* (1999) observed unconditional divergence in income levels across states. Aiyar (2001) studied 19 states from **1971 to 1996 and** found evidence of absolute divergence, **as well as**

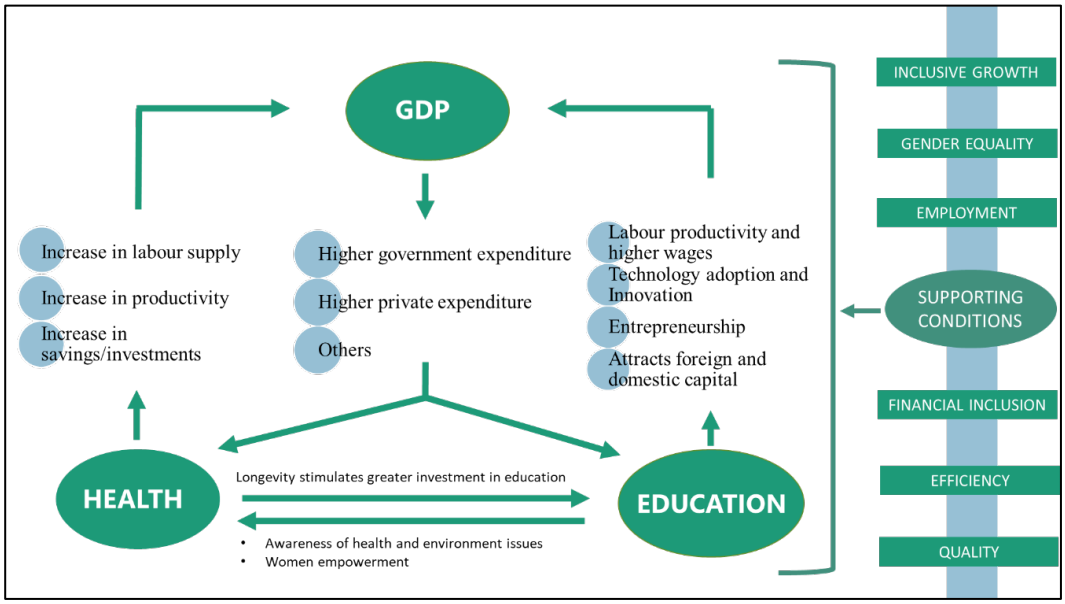
conditional convergence after controlling for the literacy rate and private capital investment. Studies covering recent time periods, that is, the post-2000s also present mixed results. Employing district-level night light data for 520 districts, Chanda and Kabiraj (2020) investigated absolute convergence at the district level for the 1996–2010 period. Not only did they investigate convergence at a more granular level, but this novel methodology allowed them to examine rural-urban convergence as well. The authors found robust evidence of absolute and conditional convergence in their sample, which was at odds with the existing literature on growth that established divergence, by employing state-level data (Kumar & Subramanian, 2012; Chakravarty & Dehejia, 2017).

Some studies also examined the inter-state convergence for HDI in India. In contrast to the studies on income convergence, studies on HDI find evidence of strong convergence in HD indicators (Dholakia, 2003; Ghosh, 2006). Chaurasia (2019) tested for beta and sigma convergence across Indian states during the 1990–2015 period, to find existence of both beta as well as sigma convergence for all three components of HDI (income, health, and education).

A few studies have tested for conditional convergence and club convergence, whereby states with common characteristics tend to converge to a steady state equilibrium, which may be different from the steady state of another club (Phillips & Sul, 2007; Baddeley *et al.*, 2006). Bandopadhyay (2011) used empirical techniques to examine income convergence across Indian states between 1965 and 1997 and found evidence of two convergence clubs: one at 50% of the national average income (poor states club) and another at 125% of the national average (rich states club). Infrastructure, irrigation and literacy were the main differentiators across clubs. Using data from 15 states from 1968–69 to 2008–09, Ghosh *et al.* (2013) found the existence of three convergence clubs at the aggregate level as well as a few clubs at the sectoral level. Haldar *et al.* (2021) attempted to extend the concept of club convergence to HDI. They employed four rounds of the National Family Health Survey data to examine the existence of clubs among Indian states as well as the movement of states from one club to another, over the years. They found that five states – Bihar, Madhya Pradesh, Odisha, Rajasthan, and Uttar Pradesh – were consistently a part of the lower convergence club. Human capital investments, infrastructure and lagged HDI values impact the current status of HDI.

In sum, both international and the Indian literature affirms the two-way relationship between HD and EG generally. An improvement in health and education enhances the productivity of the workforce, encourages savings, and facilitates technology adoption. Economic growth, on the other hand, gives the government and households greater command over resources for spending on health and education. Supporting conditions such as inclusive and job-generating growth are key to strengthen and sustain the relationship between the two. The pathways have been summarised diagrammatically (Chart 2.1).

Chart 2.1: Economic Growth and Human Development – Pathways



Source: Ranis et al., 2000.
Note: "Others" in the diagram constitute indirect effects of increase in GDP, for instance, better housing etc. These factors indirectly impact human development.

While many studies have assessed the inter-linkages between HD and EG in India, few have mapped states' HD-EG performance against some benchmark or assessed the movements of states between any of the four quadrants: (i) virtuous cycle (high-EG, high-HD), (ii) EG-lopsided (high-EG, low-HD), (iii) HD-lopsided (low-EG, high-HD) and (iv) vicious cycle (low-EG, low-HD). Ghosh (2006) based on the study years 1981, 1991 and 2001, and Saksena and Deb (2016) based on the 1990-2010 period, observed strong and sticky regional patterns: nine states remained in the virtuous category and another nine in the vicious cycle category throughout, with only four to five states changing quadrants over the three decades. Based on this, they concluded strong reinforcement effects between income and HD. Both these papers, unlike Ranis *et al.* (2000) and Suri *et al.* (2011), divided the states based on income and HDI levels rather than growth or improvement. Another shortcoming of the two papers was that they formed the quadrants based on all-India averages, which biased the results since by definition, half of the states would be above the average and the other half below it. Both these methodological choices resulted in sluggish dynamic movements from one category to another, over the decades. To avoid these issues, this paper compares EG with improvement in HD, rather than outstanding income levels and HD. Also, our quadrant thresholds are based on developing countries' averages rather than an all-India average, to ensure that the thresholds are exogenous.

Most cross-country studies do not find any evidence of absolute convergence. In the case of India, evidence of convergence remains mixed, though most studies have found absolute divergence. A few studies have tested for conditional convergence and club convergence, whereby states with common characteristics tend to converge to a steady state equilibrium that may be different from the steady state of another club (Baddeley *et al.*, 2006; Bandyopadhyay, 2011; Ghosh *et al.*, 2013). While most

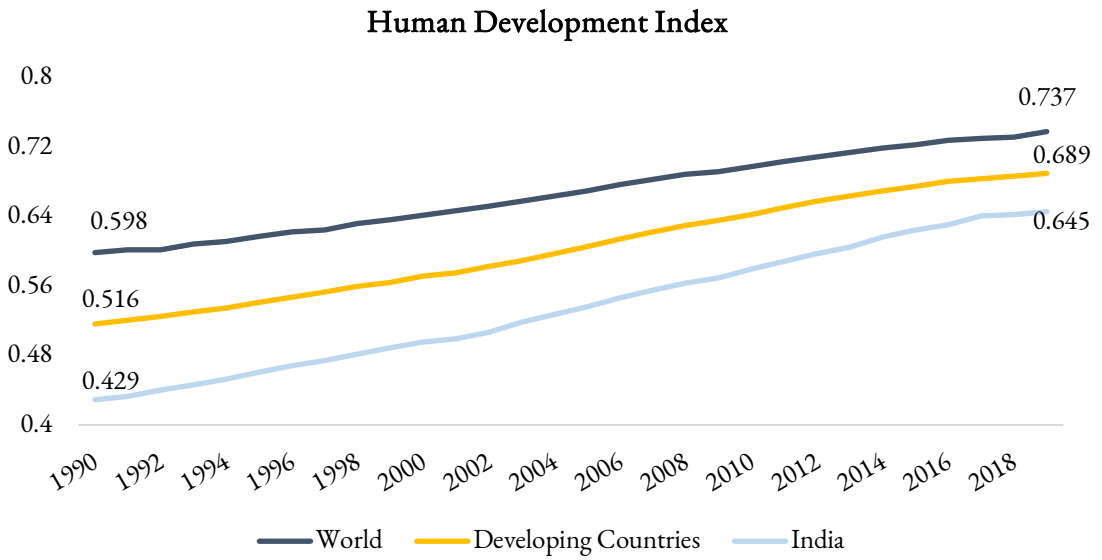
club convergence studies in India revolve around EG, very few studies on this topic exist for HD (Haldar *et al.*, 2021). This paper adds to the literature by examining club convergence in HD, in addition to EG. Also, to assess the inter-dependence between EG and HD, this paper takes a unique approach of forming clubs based on both HD and income levels, rather than just one of these.

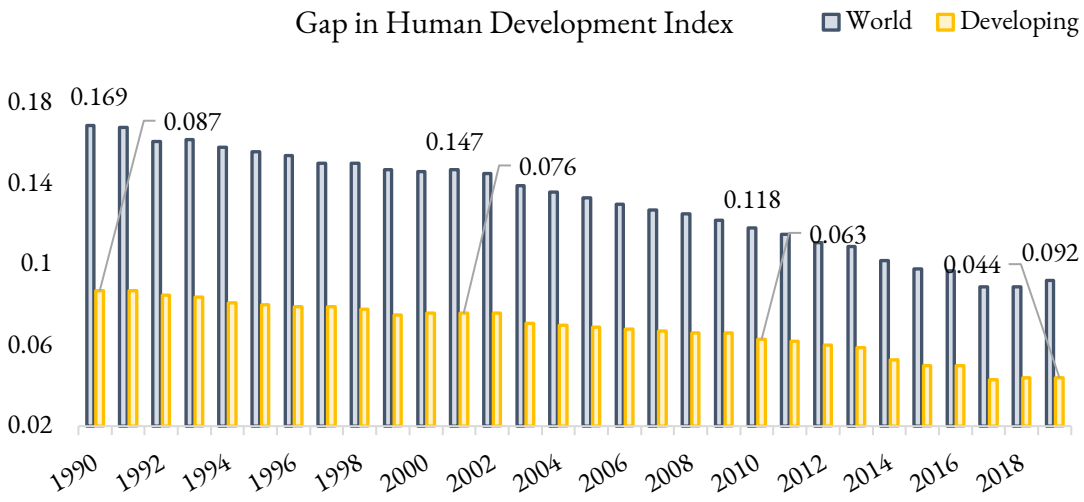
3. Economic Growth and Human Development in India: Pattern of Relationship

3.1 Trends in HDI: All-India level

Human Development Index data (see Annex A for details on HDI calculation) for India and the rest of the world between 1990 to 2019 shows that though India's HDI score has always been lower than the world average and developing-country average, it has been converging, with the gap narrowing from 0.169 in 1990 to 0.092 in 2019 relative to the world HDI, and from 0.087 to 0.044 with respect to the developing countries' HDI. Though the gap between India and the rest of the world has almost halved in last 30 years, a significant part of this improvement occurred only after 2000, with the largest reduction in this gap taking place in the last decade. This was despite the fact that India's HDI has remained broadly unchanged since 2017 (Chart 3.1).

Chart 3.1: Human Development Index – India's Performance



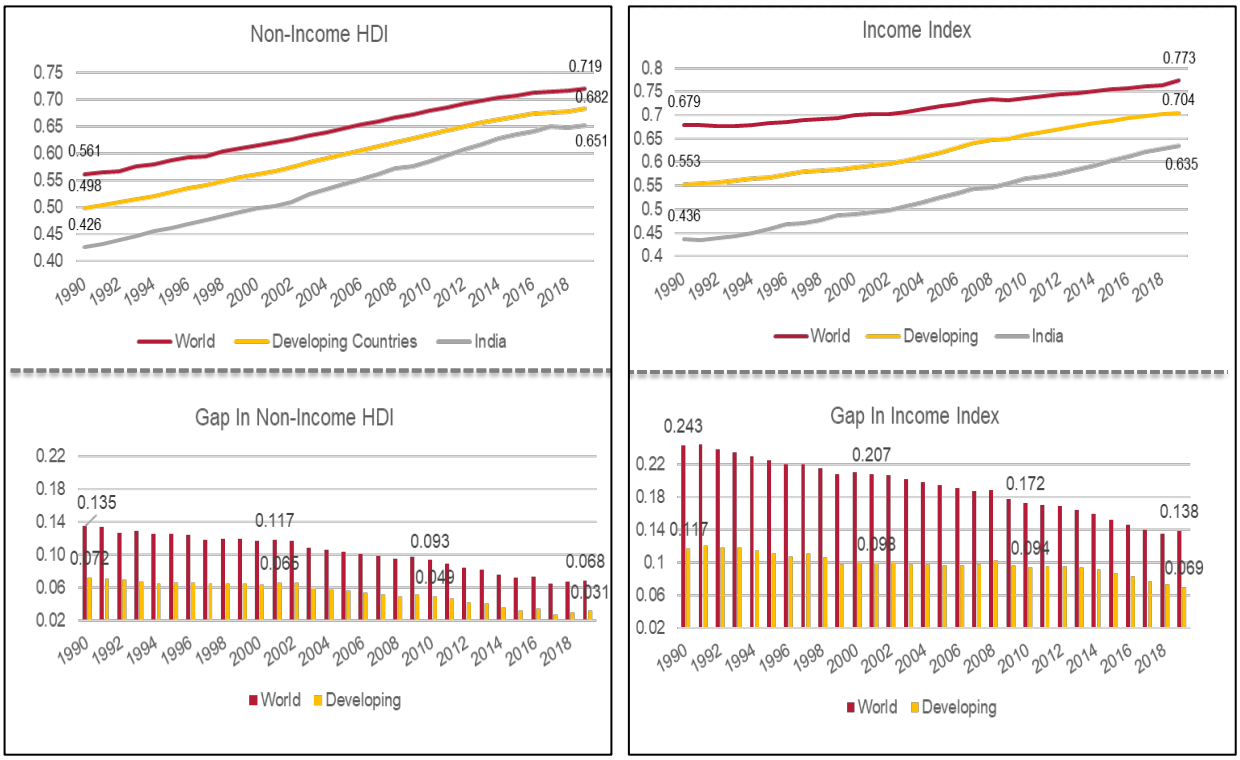


Source: Human development report 2019.

Interestingly, the improvement in the HDI has mainly been on account of an improvement in non-income components (health and education indicators) rather than in the income component (Charts 3.2 and 3.3). While India has been able to halve the gap between its HDI score and the world and developing countries' average in non-income components, the corresponding reduction in gap in the income component was just over 40 per cent. Unlike the advanced economies that are very close to the highest possible HDI level, and do not have much scope for incremental improvement, developing economies still have a long way to go towards achieving optimal health and education indicators. In this context, the gradual narrowing of the gap in India's non-income HDI even with respect to developing economies, is significant.

Chart 3.2: Non-Income Human Development Index: India's Performance

Chart 3.3: Income Index: India's Performance



Source: Human development report 2019.

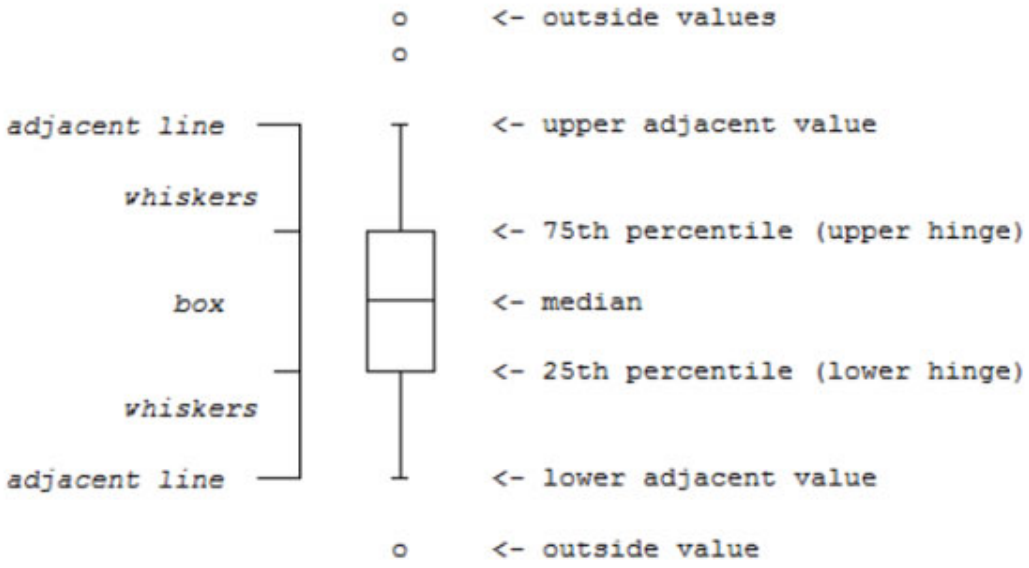
3.2 Trends in HDI: State-level

Over the years, HDI scores have improved consistently, as reflected in the gradual upward movement in (i) lowest HDI; (ii) highest HDI; and (iii) median HDI. Normal distribution of most of the box plots imply a symmetrical distribution of states above and below the median (Box 3.1). The size of the boxplot has remained almost the same across the years, implying constant variance over time *i.e.,* the performance of states overall has been consistent (Chart 3.4).

Box 3.1: Box Plot-Explanatory Note

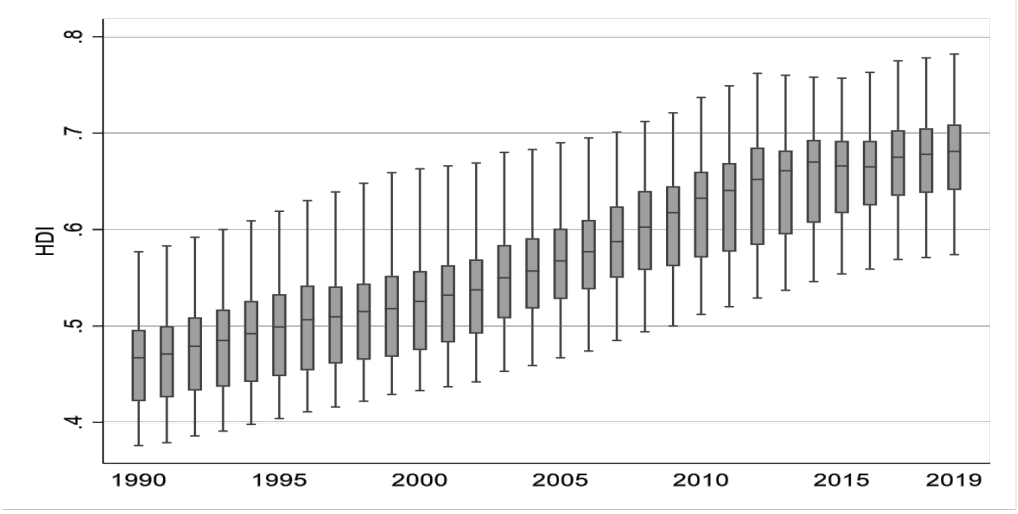
A box-whisker plot, also known as a box plot, is a graphical representation of the frequency distribution of a variable through quartiles. The middle line in the box corresponds to the median (or 50th percentile); the upper hinge represents the 3rd quartile (or 75th percentile); and the lower hinge represents the 1st quartile (or 25th percentile). The length of the box gives the inter-quartile range (IQR), which helps measure dispersion. Skewness (a measure of asymmetry) can be gauged from the distance between the 75th percentile and the median, and the median and the 25th percentile of the box. The data points that are outside 1.5 times the IQR value, on either side of the box, are considered outside values (or outliers) and are shown as dots. The upper and lower adjacent values indicate the maximum and minimum values of the data series, excluding the outliers. The vertical lines stemming from the boxes are called whiskers and they connect the upper and lower adjacent values, indicating variation outside the IQR (Williamson, 1989; RBI, 2017).

The box plot can be shown as:



Source: STATA Graphics Reference Manual

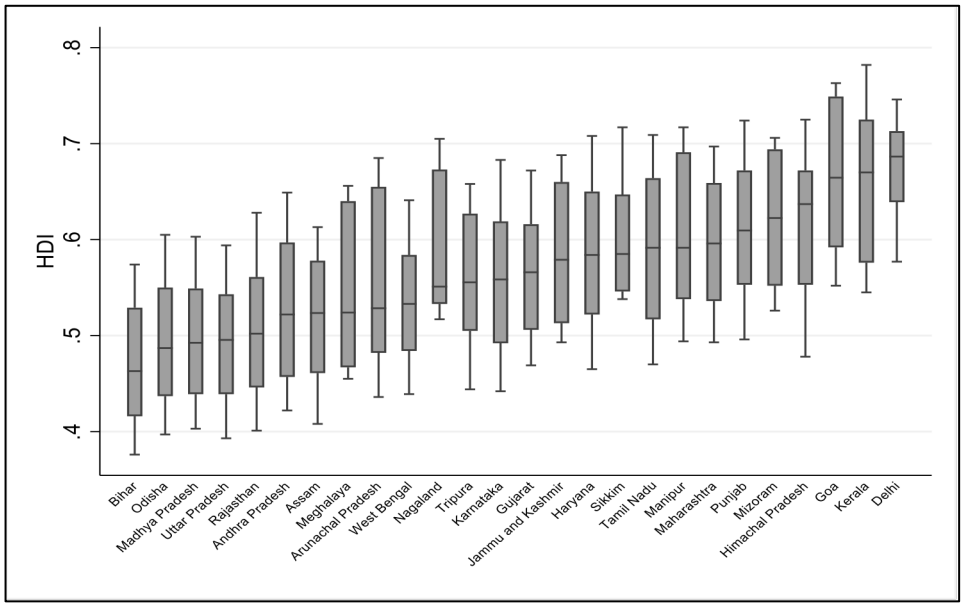
Chart 3.4: Movement in HDI – All States



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

However, large variations were observed in the HDI values across states. Of all the states and union territories, while Bihar, Uttar Pradesh and Odisha consistently recorded the lowest HDI scores, Delhi, Goa and Kerala have consistently recorded the highest values. Delhi stands out in terms of having a narrower range of HDI, relative to the other states. Most of the plots are normally distributed around their median (Chart 3.5). Though not visible from the chart, most of the states reached their median HDI value in 2005 and the improvement has remained consistent before and after 2005, except for six states. Four of these states, *viz.*, Nagaland, Arunachal Pradesh, Meghalaya, and Manipur showed significant improvements in HDI post-2005 (which incidentally is also evident from the right skew of box plots of these states), while two states, *viz.*, Kerala and Himachal Pradesh showed slower improvement in HDI post-2005 (which incidentally is evident from the left skew of box plots of these states) (Chart 3.5).

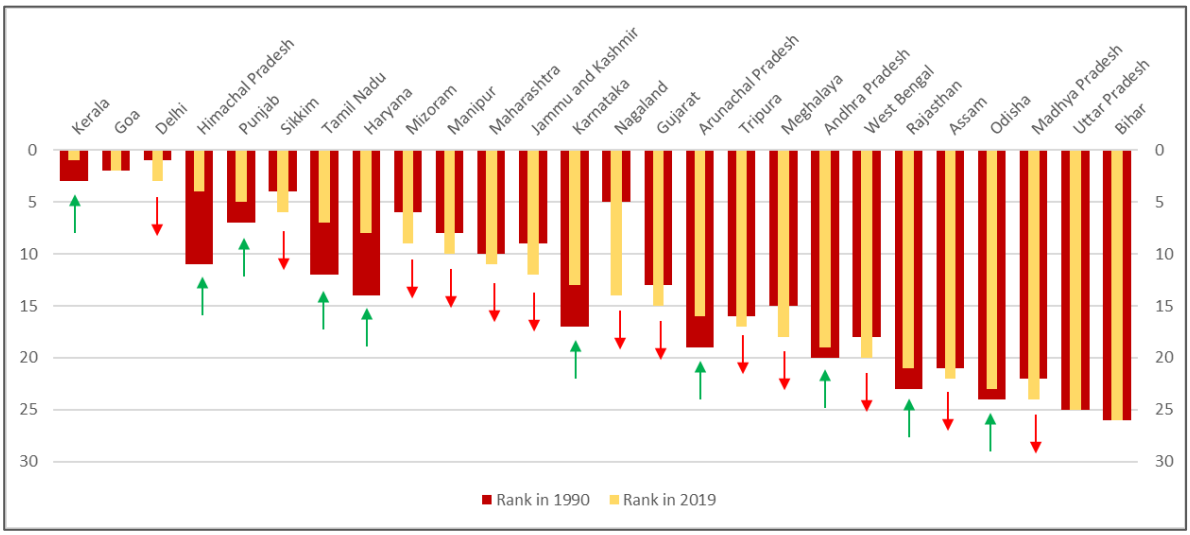
Chart 3.5: Movement in HDI – State-wise: 1991-2019



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

Apart from the state-wise HDI movements, states' HDI rankings are also important (Chart 3.6). Delhi, Goa and Kerala occupied the top three positions in 1990 and 2019, while Bihar, Uttar Pradesh and Odisha were at the bottom, with Uttar Pradesh and Bihar occupying the last two positions in both the periods. Some significant movements were observed in the ranking of states between 1990 and 2019. Four states saw marked improvements in their rankings between 1990 and 2019: Himachal Pradesh (from the 11th to 4th position), Tamil Nadu (from the 12th to 7th position), Haryana (from the 14th to 8th position) and Karnataka (from the 17th to 13th position). In contrast, the rankings of most north-eastern states declined, with Nagaland showing the steepest decline (from the 5th to 14th position) during the same period. Rankings of most other states remained broadly sticky.

Chart 3.6: HDI: State-Level Ranking



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

3.3 Economic Growth and Human Development in India: Pattern of Relationship

Having analysed the income and non-income components of the HDI separately, we now study their relationship. The relationship between EG and HD is not straightforward and automatic, as alluded to earlier. It is rather complex and depends on many factors. The relationship may vary from time to time and among countries. As mentioned briefly above, four relationship patterns between HD and EG[2] could be identified, as depicted in Chart 3.7 (Ranis *et al.*, 2000; Suri *et al.* 2011).

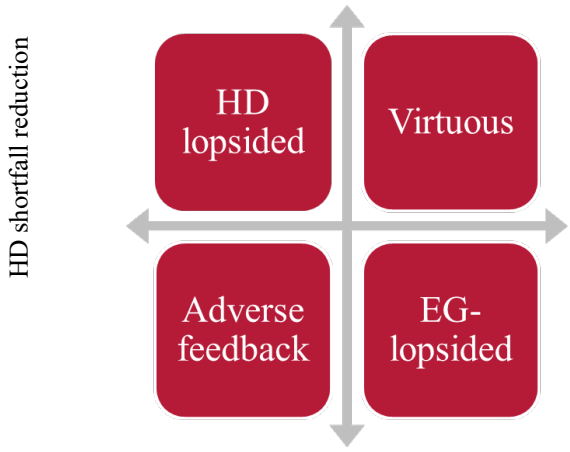
i. Strong relationship: In this pattern, both HD and EG are high and mutually reinforcing. Strong relationships are the outcome of balanced development of both HD and EG such they support and reinforce each other.

ii. Weak relationship: In this pattern, both HD and EG are low and mutually stifling, as the deficiency of one undermines the other (adverse feedback cycle).

iii. Economic growth lopsided: In this pattern, EG is high, but HD is relatively low. EG without the support of HD is not able to sustain, because of which EG also moderates after a decade or so.

iv. Human development lopsided: In this pattern, HD is high, but EG is weak or low. High HD without the support of high EG cannot sustain itself beyond a point. A large pool of educated people alone is not sufficient to propel growth. They also need opportunities to be productively employed. Slow/low EG severely constrains the ability of governments and households to fund further investments in health and education.

Chart 3.7: Economic Growth and Human Development: Pattern of Relationship



Source: Ranis et al, 2000

Before we proceed further, a discussion on three caveats regarding the indicators used is in order. First, following Ranis *et al.* (2000) and Suri *et al.* (2011), the relationship has been analysed in terms of per capita EG and improvement in non-income HDI. The latter has been measured as the reduction in shortfall of non-income HDI (in percentage terms) from the maximum possible value of 1 (Morris, 1978; Morris & McAlpin, 1982; Dholakia, 1990; Ranis *et al.*, 2000; Dholakia, 2003; Suri *et al.*, 2011). Second, for the purpose of the analysis of linkages between HD and EG, India's performance, both in income and non-income components, has been benchmarked against that of developing economies (the average of EG and improvement in non-income HDI). The other option was to use the world average for these two components. However, this would have overstated India's performance, because as alluded to before, advanced economies are growing at a slower pace both in income and non-income components relative to developing economies. Three, following the Human Development Reports, the income component is represented by the gross national income (GNI) instead of gross domestic product, because in many countries, overseas citizens contribute significantly to the development of their economies, which is captured in the GNI and not in GDP.

The relationship between EG and HD in India has strengthened significantly in the last two decades. In the 1990s, India' non-income HD shortfall reduction was lower than that of developing economies, whereas the per capita growth rate was higher than the average growth rate of developing economies. As a result, India was among the EG-lopsided nations in the 1990s. However, in the following two decades, India outperformed developing economies, both in terms of per capita GNI growth and non-income HD shortfall reduction. This pushed India from the EG-lopsided category in the 1990s to the virtuous category in the 2000s and 2010s (Table 3.1). This result contrasts with the overall finding of Suri *et al.* (2011), who observed that no country was able to move from the EG-lopsided to virtuous cycle directly. At the same time, they also noted India being the only exception as it did not fall into the adverse feedback category from the EG-lopsided cycle; it was able to remain in the EG-lopsided category through the 1980s and 1990s.[3] India's inclusion in the EG-lopsided category in the 1990s is also confirmed by our analysis. It was, however, further found that instead of falling back into the adverse feedback loop category, as was experienced by many other countries, India moved to the virtuous category in the 2000s and remained there in the 2010s as well.

Table 3. 1: Pattern of Relationship between Economic Growth and Human Development – India

Region	1990-2000		2000-2010		2010-2019		1990-2019	
	Total HD shortfall reduction	Annual GNI per capita growth rate	Total HD shortfall reduction	Annual GNI per capita growth rate	Total HD shortfall reduction	Annual GNI per capita growth rate	Total HD shortfall reduction	Annual GNI per capita growth rate
World	12.14%	1.29%	16.72%	2.35%	12.62%	2.17%	36.06%	1.93%
Developing Countries	12.62%	2.19%	16.69%	4.54%	13.08%	3.45%	36.73%	3.39%
India	12.55%	3.64%	17.52%	5.10%	15.77%	5.35%	39.25%	4.67%
Pattern of Relationship in India (vis-à-vis developing countries)	EG lopsided		Virtuous		Virtuous		Virtuous	

3.4 Pattern of relationship between EG and HD – State Level

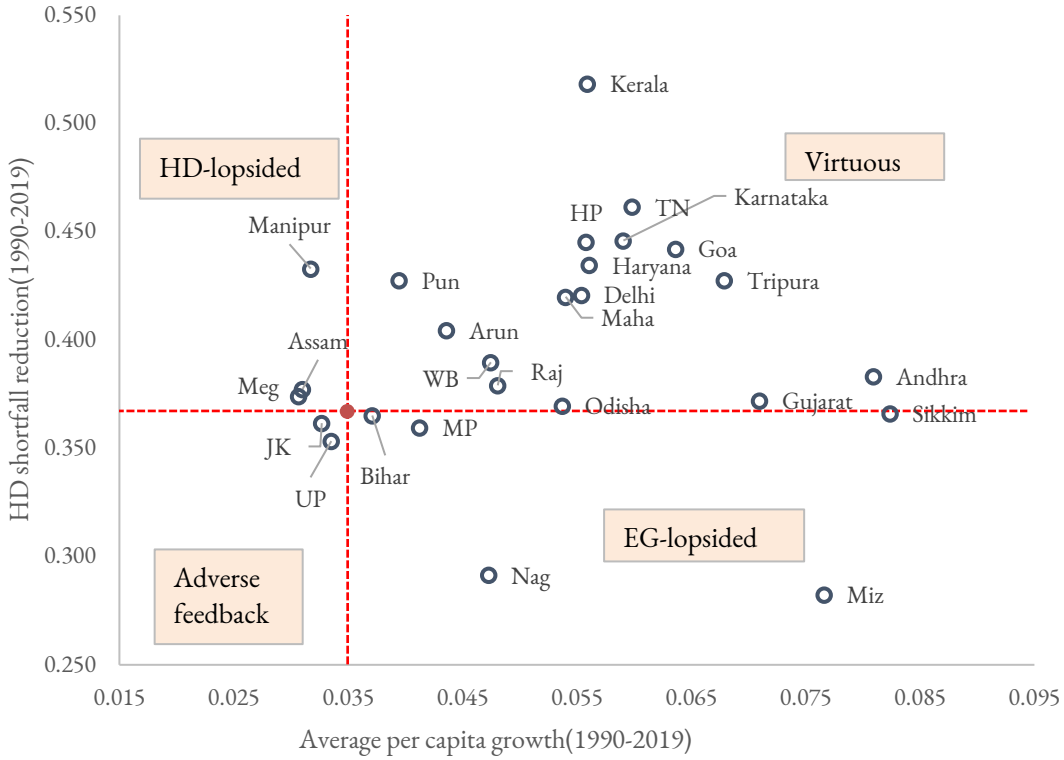
The pattern of relationship between EG and HD at the state level in India in the long run (1990-2019) has been diverse as detailed below:

i. Sixteen states (Andhra Pradesh, Arunachal Pradesh, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Odisha, Punjab, Rajasthan, Tamandu, Tripura and West Bengal) were in the virtuous category.

ii. Two states (Jammu and Kashmir and Uttar Pradesh) were in the adverse feedback loop category.

iii. Of the remaining eight states, three (Assam, Manipur, and Meghalaya) were in the HD lopsided category, while five (Bihar, Madhya Pradesh, Mizoram, Nagaland, and Sikkim) in the EG-lopsided category (Chart 3.8).

Chart 3.8: Economic Growth and Human Development – Long-term Relationship (1990–2019)



Source: Author's calculation based on Global Data Lab of the Institute of Management Research of the Radboud University, the Netherlands.

As alluded to earlier, it is not possible to sustain HD for a long period of time without the support of EG, and *vice versa*. This suggests that over a long period of time, a country or a state should either be in the virtuous category or in the adverse feedback loop category. Since 30 years is a long period of time, how have some states remained in the EG-lopsided or HD-lopsided categories for so long? While it is unlikely that a country or a state would remain in the HD/EG lopsided category for a long period of time, it is more likely that it moves from one category to another over different sub-periods. This indeed has been the case with many states in India, as is evident in the dynamic relationship observed when we divide the 30-year period into three sub-periods (Table 3.2).

i. Seven states (Haryana, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Tamil Nadu and Tripura) were in the virtuous category throughout, that is, in the 1990s, 2000s and 2010s.

ii. Three states (Andhra Pradesh, Gujarat and Sikkim) moved from the EG-lopsided category in the 1990s to the virtuous category in the 2000s and remained in this category in the following

decade; Odisha and Rajasthan transitioned to the virtuous category in the 2010s after remaining in the EG-lopsided category in the previous two decades.

iii. Two states (Punjab and West Bengal) were in the virtuous category in the 1990s and 2010s; however, in the 2000s, Punjab was in the HD-lopsided category, while West Bengal was in the EG-lopsided category.

iv. Two states (Bihar and Madhya Pradesh) shifted from the adverse feedback loop category in the 1990s to the virtuous category in the 2010s, though their pathways in the 2000s varied. Bihar moved via the EG-lopsided path, whereas MP took the HD-lopsided path in the 2000s.

v. Only Delhi moved into the EG-lopsided category after being in the virtuous category in the previous two decades.

vi. Only one state (Assam) moved from the HD-lopsided category in the 1990s to the adverse feedback loop category in the 2000s.

vii. No clear pattern is discernible for the other states. However, no state stayed in EG/HD lopsided category continuously for 30 years.

viii. In the last decade, 16 states were in the virtuous category, nine in EG-lopsided and one in the HD-lopsided category; no state was in the adverse feedback category.

The analysis on a five-year period basis also suggests that no state has stayed in the EG-lopsided or HD-lopsided category continuously for more than 15 years (Table B1, Annex B). Unlike the findings of Ranis *et al.* (2000) and Suri *et al.* (2011) in the cases of other countries, we find more instances of states moving from the EG-lopsided category to the virtuous category than from HD-lopsided category to the virtuous category. This is evident from data on a 10-year period basis (Table 3.2), as well as five-year period basis (Table B1, Annex B).

It is important to note that the above analysis on the non-income component (health and education indicators) is based on the reduction in shortfall method than the usual percentage variation method. However, we do not observe any significant difference in the overall results by using the latter methodology (Box 3.2).

Table 3.2: Economic Growth and Human Development Relationship: Dynamic Movements (State-level)

States	1990-2000	2000-2010	2010-2019
Andhra Pradesh	EG-lopsided	Virtuous	Virtuous
Arunachal Pradesh	EG-lopsided	Virtuous	EG-lopsided
Assam	HD-lopsided	Adverse feedback cycle	EG-lopsided
Bihar	Adverse feedback cycle	EG-lopsided	Virtuous
Delhi	Virtuous	Virtuous	EG-lopsided
Goa	EG-lopsided	Virtuous	EG-lopsided
Gujarat	EG-lopsided	Virtuous	Virtuous
Haryana	Virtuous	Virtuous	Virtuous
Himachal Pradesh	Virtuous	Virtuous	Virtuous
Jammu and Kashmir	EG-lopsided	HD-lopsided	EG-lopsided
Karnataka	Virtuous	Virtuous	Virtuous
Kerala	Virtuous	Virtuous	Virtuous
Madhya Pradesh	Adverse feedback cycle	HD-lopsided	Virtuous
Maharashtra	Virtuous	Virtuous	Virtuous
Manipur	EG-lopsided	HD-lopsided	EG-lopsided
Meghalaya	EG-lopsided	HD-lopsided	HD-lopsided
Mizoram	-	Virtuous	EG-lopsided
Nagaland	Adverse feedback cycle	Virtuous	EG-lopsided
Odisha	EG-lopsided	EG-lopsided	Virtuous
Punjab	Virtuous	HD-lopsided	Virtuous
Rajasthan	EG-lopsided	EG-lopsided	Virtuous
Sikkim	EG-lopsided	Virtuous	Virtuous
Tamil Nadu	Virtuous	Virtuous	Virtuous
Tripura	Virtuous	Virtuous	Virtuous
Uttar Pradesh	Adverse feedback cycle	Adverse feedback cycle	EG-lopsided
West Bengal	Virtuous	EG-lopsided	Virtuous

Source: Author's calculation based on the data from Global Data Lab of the Institute of Management Research of the Radboud University, the Netherlands.

Box 3.2: Measuring Improvement in the Human Development Index

The most commonly used approach to assess improvement/deterioration of any indicator is the percentage variation in the value between any two periods. This is how the performance of the income component of HDI is also measured. However, Ranis *et al.* (2000), Morris and McAlpin (1982), Dholakia (2003), Suri *et al.,* (2011) and Nathan and Mishra (2010) measure the improvement in health and education indicators in HDI in terms of reduction in shortfall from the maximum level observed in any country. The two methods, *viz.,* percentage variation (Method I) and reduction in shortfall (Method II) may yield very different lists of countries

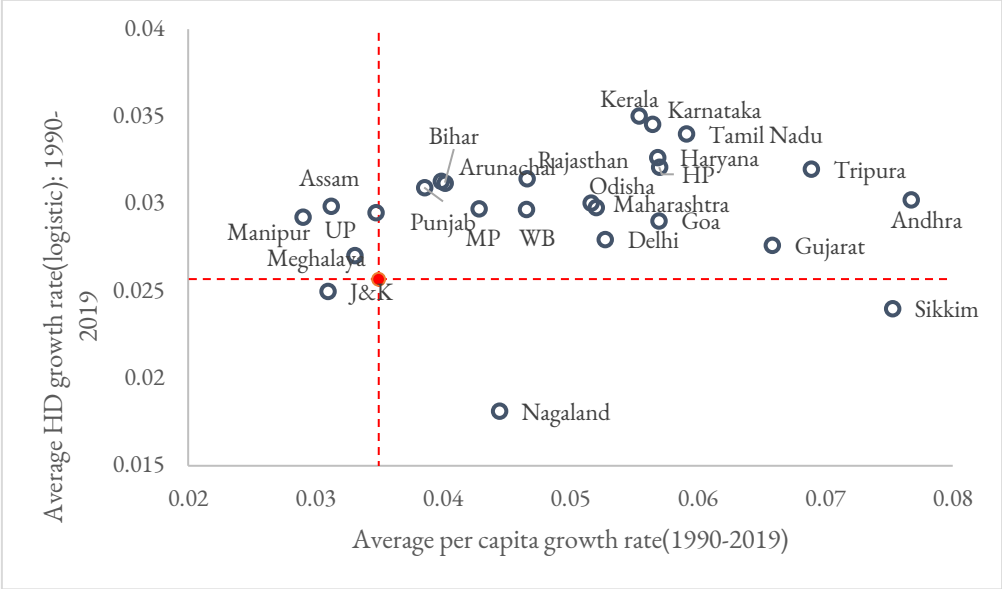
based on their HDI performance. While the first method benefits the countries with initial low levels of development, the second favours countries that start with higher levels of development. For instance, for the same 10-year increase in life expectancy, Country A (with an initial low level of development) shows higher improvement (25 per cent) in 2020 with Method I, as compared to 22.2 per cent with Method II. However, for a 10-year increase in life expectancy, Country B (with a higher level of development initially) shows higher improvement with Method II, relative to Method I.

Maximum Level of Life Expectancy = 85 years

	Country A (With initial low level of development)			**Country B** (With initial high level of development)		
Year	LE	Improvement with Method I	Improvement with Method II	LE	Improvement with Method I	Improvement with Method II
2010	40			60		
2020	50	25.0%	22.2%	70	16.7%	40.0%

One could argue that improvement in health and education indicators from a very low level is more important than at a higher level. Therefore, Method I should be adopted. However, this measure does not capture the greater efforts required to sustain the improvement in health and education indicators at higher levels. Convergence in HD using the first method may simply occur because rich countries have already reached an upper limit of a particular health or education indicator. To address this concern, some researchers prefer to make these indices unbounded by taking a logit transformation of the variables/index (Molina & Purser, 2010). In this paper, following the methodology of Ranis *et al.* (2000) and Suri *et al.* (2011), we followed the reduction in shortfall (Method II). However, to check the robustness of our results, we also used a logit transformation of health and education indicators. We find that overall, the results do not show any significant variation from those obtained without logit transformation. The only significant difference, as expected, was observed in the performance of states with low health and education indicators, *viz.,* Bihar, Uttar Pradesh and Madhya Pradesh (Chart [a]). Considering the overall results as well as the fact that most studies follow the reduction in shortfall approach, we preferred Method II.

Chart (a) Economic Growth and Human Development – Long-term Relationship (1990-2019)



Source: Author's calculation based on Global Data Lab of the Institute of Management Research of the Radboud University, Netherlands.

Many states such as Arunachal Pradesh, Assam, Jammu and Kashmir, Manipur and Nagaland kept moving from one category to another. What are the underlying reasons for these movements? As seen in the literature review, several factors help strengthen the relationship between EG and HD. Many of these states had several low supporting elements, as captured in the Supporting Conditions Index (SCI) computed based on six indicators (Box 3.3). The relationship between EG and HD may be tenuous in the absence of other supporting conditions. For instance, EG may not contribute much to HD if it is not inclusive and jobless.

Box 3.3: Supporting Conditions Index – Methodology

The Supporting Conditions Index (SCI) is based on the following six indicators for three years (1995, 2005, 2019):

i. State-wise poverty rate (in percentage terms)
ii. Gender Development Index to capture gender equalities.
iii. Gini Coefficient for per capita consumption expenditure to capture the extent of inclusive growth
iv. State-wise unemployment
v. State-wise credit as a ratio of total credit to capture the extent of financial inclusion.
vi. Ratio of social sector expenditure to total expenditure.

For each indicator, states were ranked in a descending order, with the highest-ranking (best-performing) state at the top and the lowest-ranking (least-performing) at the bottom. A

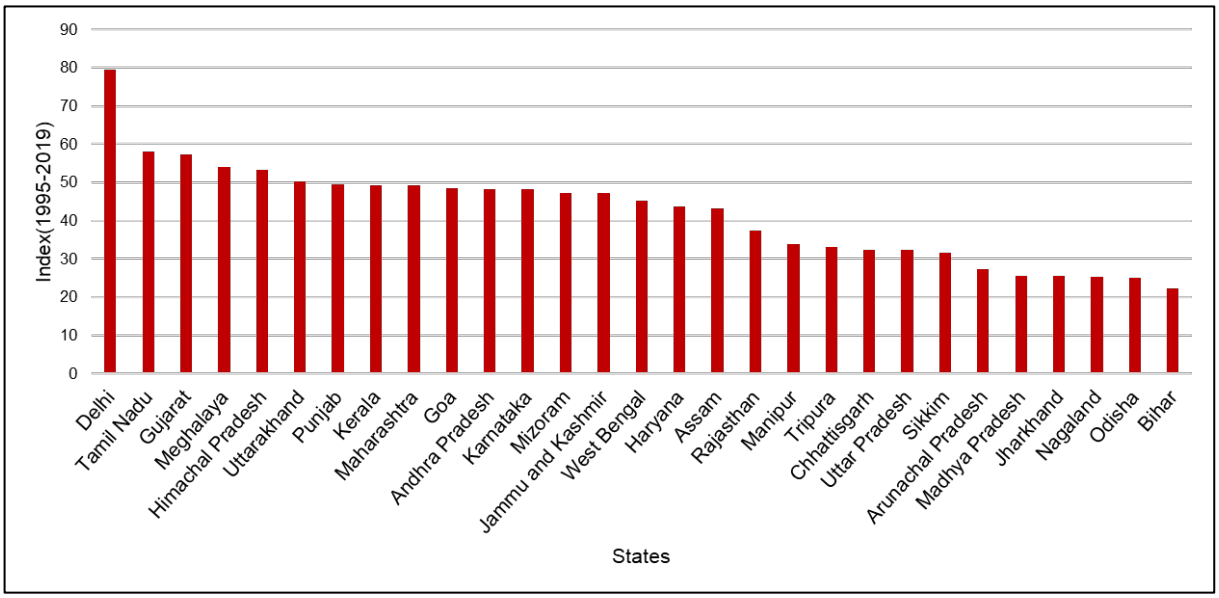
score was assigned to each state; the highest-ranking state in each indicator was given a score of 100, and the lowest-ranking state was given score of 100 divided by its rank. For instance, if there are 25 states, the top-ranking state was scored 100, and the lowest ranking state, four. The index for each period was arrived at by taking the geometric mean of all six indicators. The ranking was worked out for each indicator for 3 different years (1995, 2005 and 2019). The Supporting Conditions Index for 1995–2019 was arrived at by taking the geometric mean of all the three years.

While state-wise poverty rate (in percentage) was taken from the National Sample Survey Organisation (NSSO) and NITI Aayog, the Gini coefficient data were sourced from the Handbook of Statistics, Reserve Bank of India (RBI). Data for Gini coefficient for 2016 were accessed from a study by Mishra and Joe (2020). Data for the Gender Development Index was collected from Global Data Lab, while that for state-wise unemployment were collected from the NSSO Employment and Unemployment Survey Reports, NITI Aayog, and Periodic Labour Force Surveys (PLFS). We collected data for state-wise credit (as a ratio of total credit) from Basic Statistical Returns of Scheduled Commercial Banks, RBI. Finally, data on the ratio of social expenditure to total expenditure were worked out from the RBI, State Finances report.

There is a high correlation (0.74) between the HDI and SCI, which suggests that they are closely related and that one is likely to suffer without the support of the other. One could question the usefulness of the SCI on the grounds that many of its indicators are just alternative measures of income and HD, and, therefore, correlation between the two is expected. However, it needs to be recognised that these indicators act as important links between EG and HD. For instance, Mehrotra (2021) found that EG does not directly increase HD. Rather, it leads to a fall in poverty which, in turn, leads to higher HD. While it is generally true that EG can help reduce poverty, the extent of poverty reduction varies depending on the distribution of income (equality). Beneficial impact of economic growth on human development can be enhanced if growth is inclusive and jobs-generating. Similarly, prioritisation of social sector expenditure is important to strengthen the relationship between EG and HD. It may be pointed out that for long economic growth was believed to automatically result in human development and hence was considered adequate to consider all elements of human development. However, the empirical evidence did not support this assertion and the need was felt to also capture the other elements of human development, which led to the birth of HDI. Given the high yet imperfect correlation, we hypothesise that the differences in SCI could explain much of the observed pattern of relationship between HD and EG. We thus assess SCI and its importance in explaining the strong or tenuous relationship between EG and HD.

Significantly, many of the states in the virtuous category as discussed before are those which also rank high in the SCI. Delhi, Tamil Nadu and Gujarat were at the top of SCI, Likewise, states in the adverse feedback category or lower in HDI such as Bihar and Odisha also rank low in SCI (Chart 3.9).

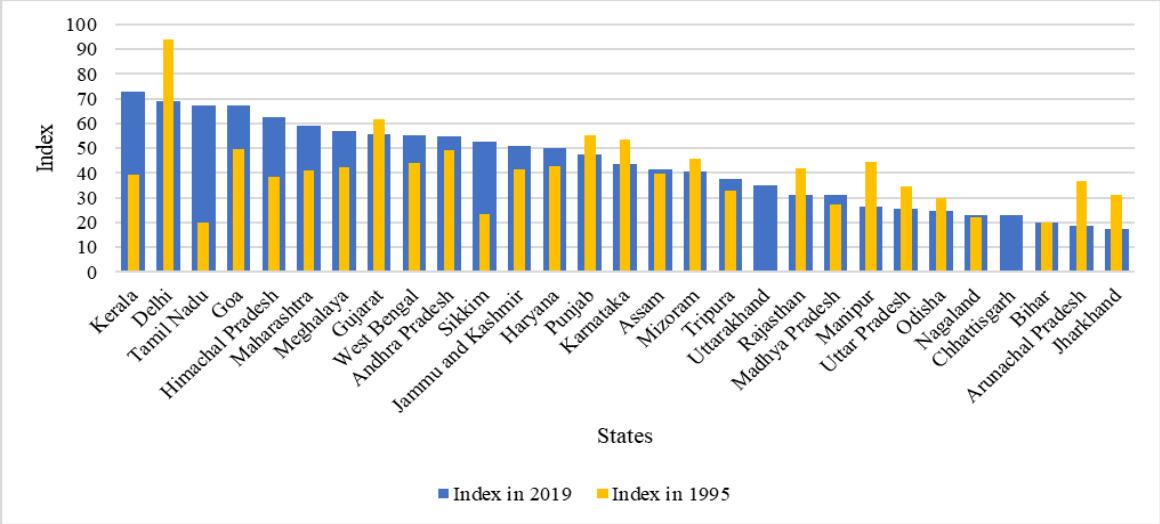
Chart 3.9: Supporting Conditions Index



Note: Authors' computations.

For assessing the movements of the states from one category to another over the decades, we compare their 1995 SCI with 2019 SCI (Chart 3.10). Except for Tripura, the states which were in the virtuous category throughout the three decades had high supporting conditions index (SCI). Three states, *viz.*, Andhra Pradesh, Gujarat and Sikkim moved into the virtuous category in the 2000s from the EG-lopsided category in the 1990s and stayed there in the following decade. While Andhra Pradesh and Gujarat performed well on the supporting conditions index all throughout, Sikkim saw the highest increase in its score. Bihar and Rajasthan also moved into the virtuous category in the 2000s. While their SCI score was low, they stood apart from others in that they prioritised health and education more than most other states. While Bihar spent 24% of its total expenditure on health and education, Rajasthan spent 22%, placing them in the top 10 ranking states in health spending. It is interesting that states (Delhi, Mizoram, Manipur and Arunachal Pradesh) registering a decline in HDI performance in 2019 vis-à-vis 1995 were those that also showed a decline in their SCI scores during the same period. Odisha was the only notable exception, whose HDI performance improved during 2019 vis-à-vis 1995, even when its SCI score declined during the same period. The above analysis suggests that inclusive and job-generating growth, gender equality and prioritisation of the social sector in state budgets significantly strengthen the relationship between EG and HD.

Chart 3.10: Supporting Conditions Index: 2019 versus 1995



Note: Authors' computations.

To sum up, India's movement to the virtuous category in the 2000s and 2010s from the EG-lopsided category in the 1990s was enabled by its relative outperformance both in EG and HD indicators, relative to the average performance of developing countries. At the state level, a diverse pattern was observed: 16 states were in the virtuous category, two in the adverse feedback category, three in HD-lopsided category and five in the EG-lopsided category. The analysis of dynamic movements in the last three decades did not show any clear pattern. There were cases of states moving from the EG-lopsided to the HD-lopsided category and *vice versa*. Some states also moved from EG-lopsided/HD-lopsided category to the virtuous category and *vice versa*. In all, there were six instances during which states were in the adverse feedback category (four in the 1990s and two in the 2000s), but they all had divergent paths in the following decade/s. It is, however, comforting that while many states transitioned from the EG-lopsided to the virtuous category, none moved back from the EG-lopsided to the adverse feedback category in the 2010s. The strength EG and HD relationship depends on other supporting conditions such as inclusive and jobs generating growth and social sector spending. Most of the states in the virtuous category also ranked high in the SCI.

4. Convergence Analysis

The analysis in the above section suggests that although the HDI scores for all the states have improved, their rankings have remained almost sticky throughout the three decades. This, *prima facie*, indicates that the economically poor and low-HD states have continued to lag the economically rich and high-HD states, respectively, and do not seem to be catching up. To test this hypothesis, we perform two convergence exercises: first, for EG and second, for non-income HDI.

We focus on three different types of convergence, *viz*, absolute, conditional and club convergence, as outlined earlier.

- *Absolute (or Beta) or unconditional convergence*: Growth literature considers the following regression framework to test for unconditional beta convergence:

$$\Delta lnPCGSDP_{it} = \alpha + \beta lnPCGSDP_{it-1} + \in_{it} \tag{7.1}$$

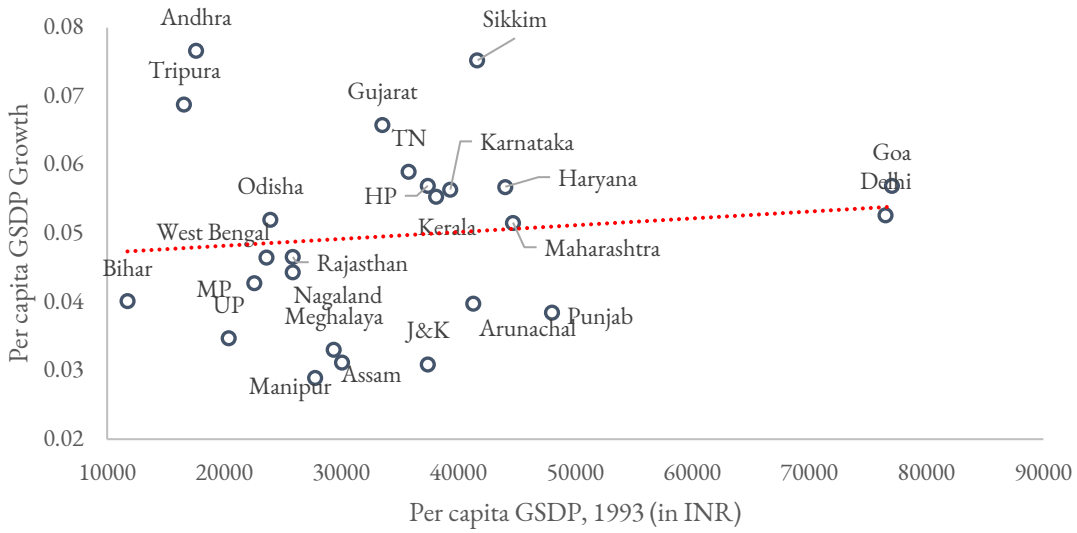
  Here $\Delta lnPCGSDP_{it}$ denotes the annual growth rate of GSDP for state i; $lnPCGSDP_{it-1}$ is the lagged (logarithm of) GSDP for state i and $\in_{it}$ is the error term. Absolute convergence holds if there is a negative and statistically significant coefficient for the lagged GSDP per capita variable. *i.e.*, β.
- *Conditional Convergence*: To test for conditional convergence among the states, Eq. (7.1) was augmented by adding controls variables that determine the growth rate of the economy:

$$\Delta lnPCGSDP_{it} = \alpha + \beta_1 lnPCGSDP_{it-1} + \beta_2 \boldsymbol{X}_{it} + \varepsilon_{it} \tag{7.2}$$

  Here $\Delta lnPCGSDP_{it}$ and $lnPCGSDP_{it-1}$ are the same as previously defined. $\boldsymbol{X}_{it}$ is a vector which specifies the other control variables that might influence EG for state i and ε_{it} is the random error term. A statistically significant negative value of β_1 would establish conditional convergence.
- *Club convergence*: This involves grouping or clustering of countries into different sub-groups or *clubs* according to similar initial conditions such as income (Durlauf & Johnson, 1995; Phillips & Sul, 2007), and all the states in a *club* are expected to converge to one steady state.

In line with the extant literature on the Indian economy (Marjit & Mitra, 1996; Ghate, 2008; Kumar & Subramanian, 2012), we do not find any evidence of absolute convergence in income in the case of Indian states (Chart 4.1). On the contrary, there is evidence of absolute divergence. In other words, poor states with initial low levels of income have grown at a slower pace than those with an initial high-income level.

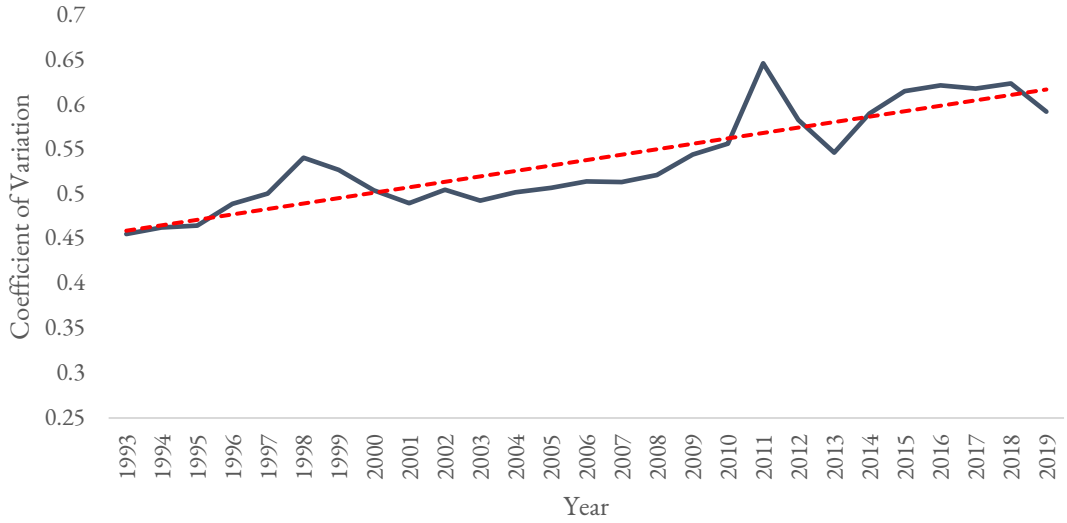
Chart 4.1: Testing for Unconditional Convergence in Income (1993–2019)—All States



Note: Authors' calculations.

Reflecting the growing absolute divergence, income inequalities at the state level have widened in the last 30 years, as is evident from the rising coefficient of variation for the 1993–2019 period (Chart 4.2).

Chart 4.2: Testing for Sigma Convergence in Income (1993–2019) - All States

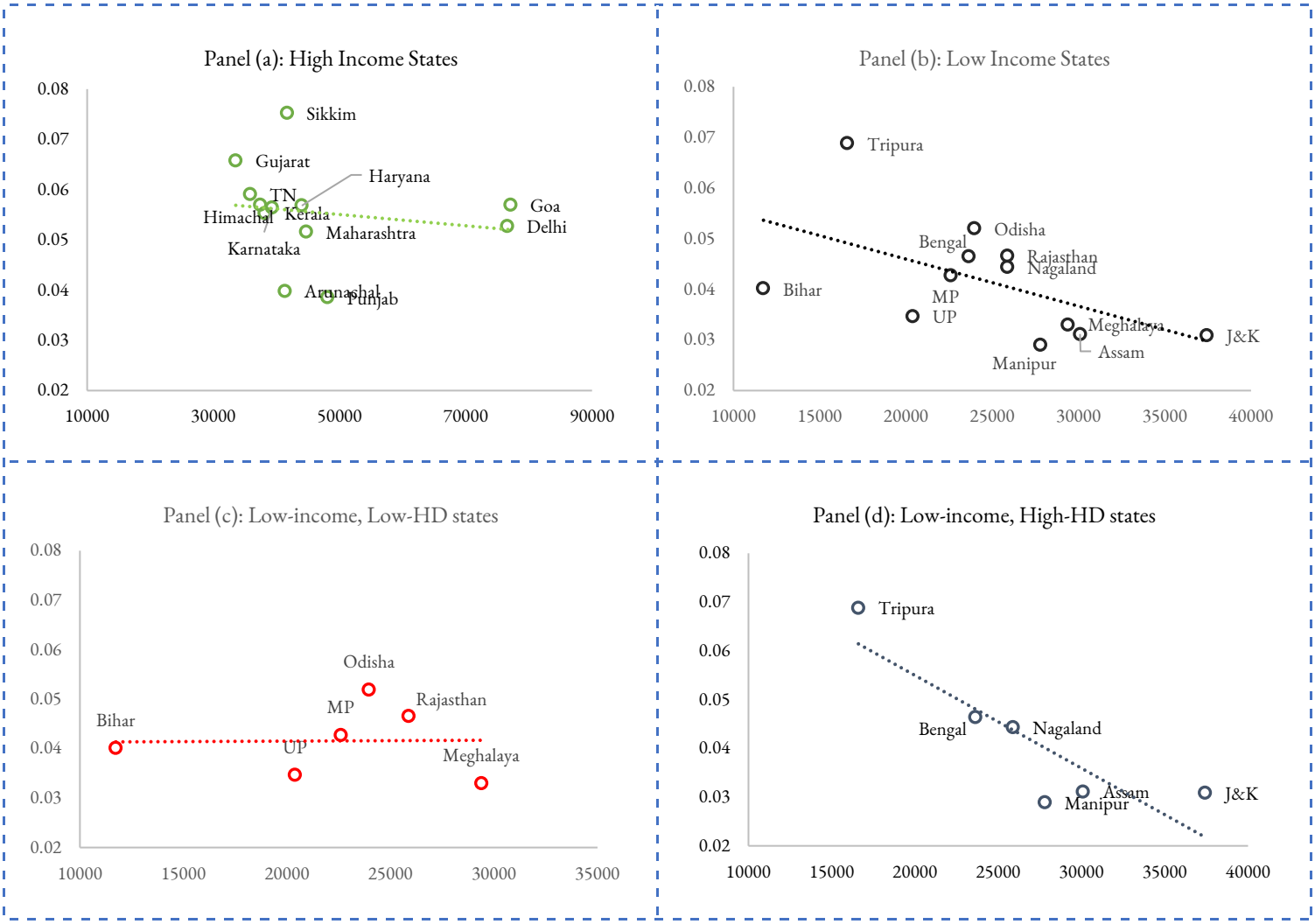


Note: Authors' calculations.

Since Indian states are quite heterogeneous in terms of socio-economic and HD indicators, it is not appropriate to club them in one category. We, therefore, divided all the states into two broad categories based on the average values of GSDP in the sample: *low-income* and *high-income states*. Given the large inter-state heterogeneity even among the *low-income states*, we further, classified these states into two categories: *low-income, low-HD states and low-income, high-HD states*[4] based

on the all-India average of the non-income HDI values in the sample. Thus, in all, there are four categories: (i*) high-income states*, (ii*) low-income states*, (ii*) low-income, low-HD states*, (iii) *low-income, high-HD states*. There is now evidence of unconditional convergence, other than within low-income, low-HD states. Interestingly, within low-income states, convergence was observed within low-income, high HD- states, while there was no evidence of convergence within low-income, low-HD states (Chart 4.3 Panel [c] and Panel [d])]. This highlights the importance of HD in facilitating convergence in income levels.

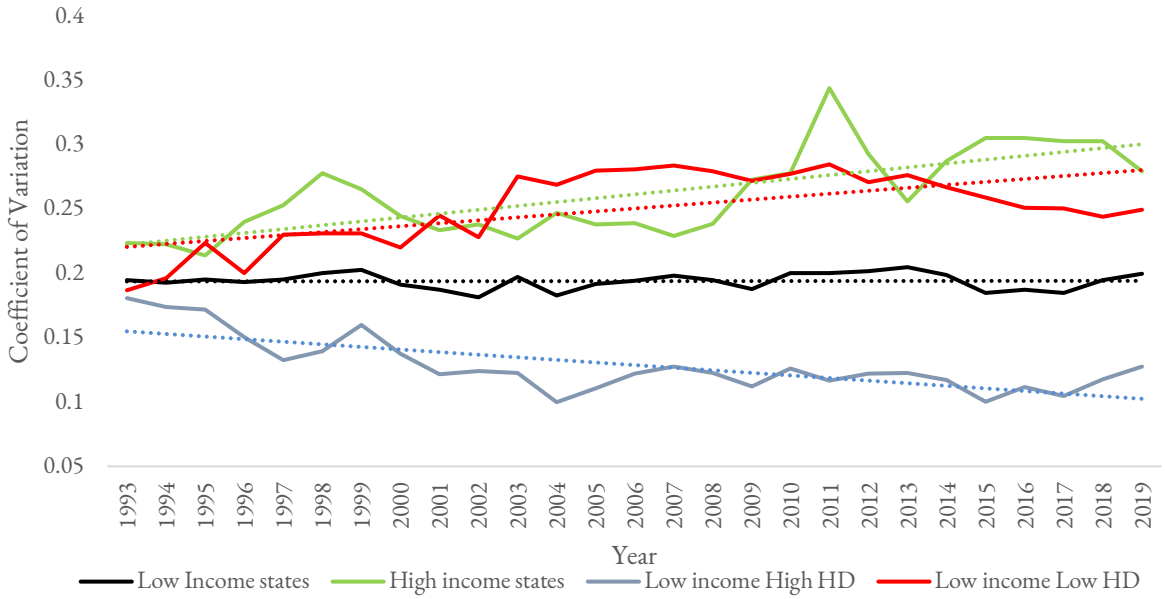
Chart 4.3: Unconditional Convergence in Income (1993-2019)



Note: Authors' calculations.

No uniform pattern was observed in sigma convergence in the four categories of states. The coefficient of variation has remained broadly unchanged for low-income states during the reference period, while it has increased slightly for high income states. Furthermore, dispersion has risen among low-income, low-HD states and has fallen for low-income high-HD states, suggesting, rising income inequalities in the former and falling inequalities among the latter (Chart 4.4).

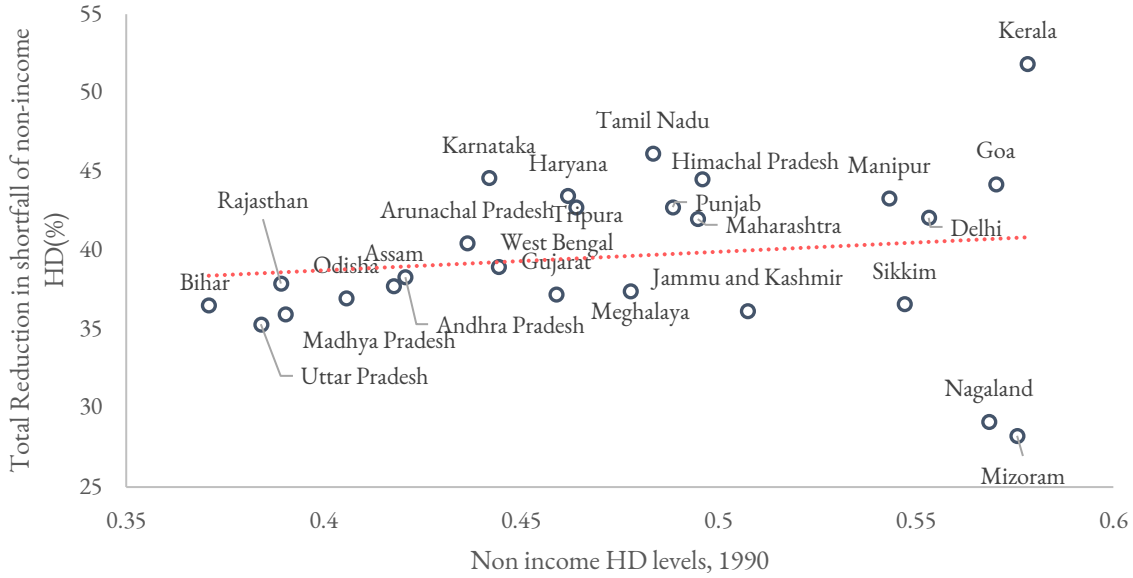
Chart 4.4: Testing for Sigma Convergence in Income (Low-income, Low-HD; High-income, High-HD; and High-income, High-HD)



Note: Authors' calculations.

We also tested for absolute convergence among states in HD. In other words, we assessed whether states with low levels of HD have been catching up with states with high level of human development. It is found that in terms of HD, states with low levels of HD have continued to progress at a slower pace relative to those with high-HD levels (Chart 4.5), *i.e.,* we do not find evidence of absolute convergence in non-income HDI among states. There are two possible reasons why catching up in HD has not occurred. First, though some states have achieved higher levels of HD vis-à-vis others, these are still far from the maximum possible health and education levels. Therefore, high-HD states continue to make greater progress in HD, given their initial high HD conditions. However, as they progress, they will reach a stage when it becomes increasingly difficult for them to maintain the same pace of improvement. Second, there are some institutional bottlenecks in low-HD states that are limiting their performance.

Chart 4.5: Testing for Convergence in Improvement in Non-income HDI (1990–2019)-All States

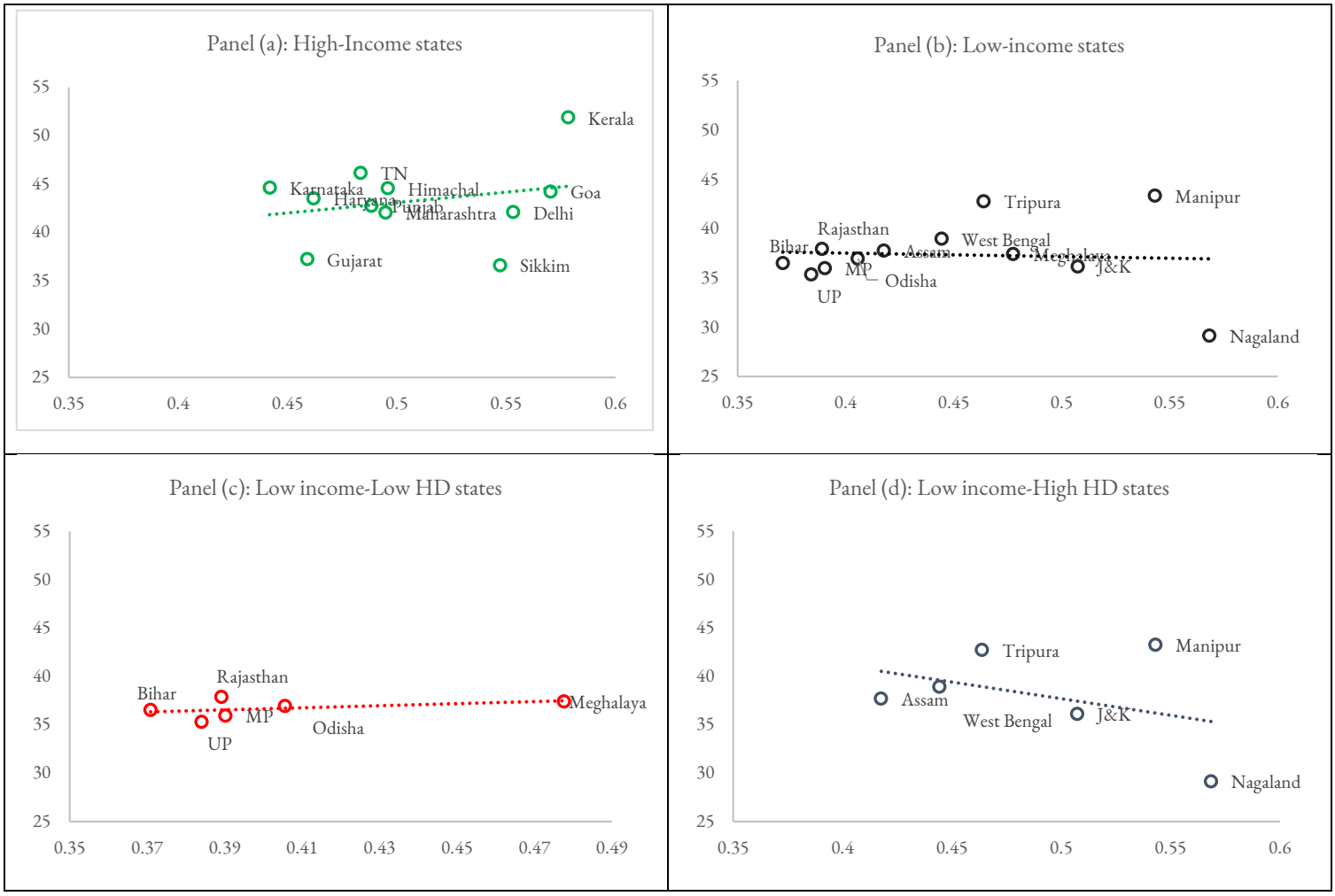


Note: Authors' calculations.

To check for club convergence, we divided the states into high-income and low-income states (Chart 4.6). First, we do not find convergence in HD, both among high-income (Panel a) and low-income states (Panel b). Second, on further classifying the low-income states as low-HD and high-HD, it is found that while there has been no evidence of convergence within low-income, low HD states (Panel c), convergence within low-income, high-HD states has occurred (Panel d).

To formally test for convergence, we ran regressions for unconditional and conditional convergence (Table 4.1 and 4.2). Even based on the regressions, we do not find any evidence of unconditional convergence as the coefficient of GSDP per capita is positive and statistically significant (Column 2, Table 4.1). This, in fact, is evidence of divergence, which is in line with the above finding as well as those of previous studies (Ghate, 2008; Chakravarty & Dehejia, 2017). However, after controlling for HD, the coefficient of the lagged GSDP per capita turns negative and statistically significant, providing evidence of conditional convergence (Column 3, Table 4.1). This implies that economically poor states could have caught up to economically well-off states, if HD was held constant, *i.e.,* if we do not allow the differences in HD to impact income levels.

Chart 4.6: Testing for Convergence in Improvement in Non-income HDI (1990–2019)



Note: Authors' calculations.

Table 4. 1: Testing for Unconditional and Conditional Convergence (Dependent Variable: Economic Growth)

Variable	Unconditional convergence	Conditional convergence
(1)	(2)	(3)
L. (log GSDP per capita)	0.011** (0.0001)	-0.047*** (0.020)
L.HDI	-	0.918*** (0.45)
L2.HDI	-	-0.558 (0.400)
L. Gross capital formation (as % of GSDP)	-	0.005*** (0.0001)
L2. Gross capital formation (as % of GSDP)	-	-0.004*** (0.0001)

Constant	-0.066*** (0.050)	0.317*** (0.110)
Observations	670	669
R^2	0.015	0.125

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

We also tested for absolute and conditional convergence in non-income HDI (health and education combined). There is no evidence of absolute convergence in non-income HDI among the Indian states. On the contrary, there is evidence of unconditional divergence. That is, low-HD states have continued to perform poorly, relative to the high-HD states (Column 2, Table 4.2). Evidence of conditional convergence in non-income HDI is also present (Column 3 of Table 4.2). This implies that low-HD states could have caught up with high-HD states, if economic growth rate was held constant, *i.e.,* if we do not allow differences in income to impact HD. This finding is consistent with the findings of other studies (Gopalakrishna & Rao, 2012; Lolayekar & Mukhopadhyay, 2020).

Table 4. 2: Testing for Unconditional and Conditional Convergence

Dependent Variable: Reduction in Shortfall of HDI

Variable	Unconditional Convergence	Conditional Convergence
(1)	(2)	(3)
L. Human Development Index	0.018** (0.010)	-0.103** (0.040)
Log (per capita GSDP)	-	0.008* (0.0001)
Total public expenditure (as % of GSDP)	-	-0.001 (0.0001)
D.log (per capita GSDP)	-	0.048** (0.020)
Constant	0.007 (0.0001)	-0.003 (0.010)
Observations	754	754
R^2	0.010	0.064

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

In sum, the study did not find any evidence of unconditional convergence in income and non-income HD, which is in line with the findings of studies by Ghate (2008), Kumar and Subramanian (2012) and Chakravarty and Dehejia (2017). Since there exists significant heterogeneity among the Indian states, they were divided into four categories/clubs to test for club convergence*: (i) high-income; (ii)low-income* (iii) *low-income, low HD; and* (iv) *low-income, high-HD states*. The study did find evidence of either absolute or unconditional convergence, both in income and non-income HD, only in one category, *viz.*, the *low-income, high-HD club.* Apart from this, the study found evidence of conditional convergence, that is, economically weaker states were found to converge with economically well-off states, when HD was held constant. Likewise, low-HD states were found to catch up with high-HD states, when EG was held constant.

5. Conclusions and Policy Implications

Economic growth and human development are inter-related. No country with fast growth and slow HD has maintained the same pace of growth for a long period time (UNDP, 1996). Though the two mutually reinforce each other, for forging a strong relationship between them, several other conditions also need to be created such as inclusive and job-generating growth, gender equality, large public expenditure on health and education, and financial inclusion, among others.

This paper examined the key aspects of the relationship between EG and HD at the all-India and state-level. Several important findings emerge from the study. First, India outperformed advanced and developing economies in terms of per capita income growth, and improvement in health and education indicators in the last two decades. As a result, India moved from the EG-lopsided category in the 1990s to the virtuous category in the last two decades. The state-level analysis shows that most states (16 states) were in the virtuous category, two in the adverse feedback category, and the others (eight) in the EG/HD–lopsided categories. The dynamic movements in each of the last three decades suggest that there are cases of states moving from the EG-lopsided to the HD-lopsided category and vice versa. There are also cases of states moving from the HD/EG–lopsided categories to the virtuous category. It is, however, disappointing that some states also moved from the virtuous to EG-lopsided category. Interestingly, there were more instances of states moving from the EG-lopsided category to the virtuous category than from the HD-lopsided category to the virtuous category. What determines the movements of states from one category to another? Our analysis reveals that except for Tripura, the states in the virtuous category throughout the three decades had a high supporting conditions index (SCI). Three states, viz., Andhra Pradesh, Gujarat and Sikkim moved from the EG-lopsided category in the 1990s to the virtuous category in the 2000s, and remained there in the following decade. While Andhra Pradesh and Gujarat performed well on the SCI throughout, Sikkim saw the highest increase in its score. Two states – Bihar, Odisha– moved into the virtuous category in the 2010 decade. While their SCI score was low, they stood apart from others in that they prioritised health and education more than many other states. This suggests that inclusive and jobs-generating growth,

gender equality and prioritisation of the social sector in state budgets significantly strengthen the relationship between EG and HD.

That India was in the EG-lopsided category in the 1990s was expected given the advent of neo-liberal reforms that placed excessive focus on physical capital at the expense of human capital. While government health expenditure fell from 0.97% of the GDP in 1991 to 0.87% in 2001, government expenditure on education remained stagnant at 3.3%. It is significant that India moved from the EG-lopsided to virtuous category, as there is no evidence of such a movement among other countries at the global level (Ranis et al., 2000; Suri et al., 2011). These findings question why the pattern of EG and HD has been different in India vis-a-vis other countries, which could be an interesting area of future research.

Our results on conditional and club convergence confirm the two-way relationship between HD and EG. There is no evidence of unconditional convergence either in income or non-income components. Economically poor states continued to lag economically rich states in the pace of EG. Likewise, states with low levels of HD were not able to catch up to those with high levels of HD level of human development. However, conditional convergence was observed, that is, convergence does occur in EG when HD is held constant, and in HD when income is held constant. These findings imply that with an improvement in HD levels, economically poor states will be able to step up their growth rates. Likewise, with similar economic conditions, states with low HD can achieve higher HD levels. Given the heterogeneity among states, states were grouped into four categories/clubs to test for club convergence: (i) high-income; (ii)low-income (iii) low-income, low-HD; and (iv) low-income, high-HD states. While our study found only one category of club convergence (low-income, high-HD), other studies have found existence of two to three clubs. This could be because of the differences in the methodologies used. For instance, Bandopadhyay (2011) and Ghosh et al. (2013) found physical and social capital to be the main differentiators across clubs, in addition to human capital. Similarly, Haldar et al. (2021) found population in addition to income levels as the main differentiators across clubs.

What are the policy implications of this study? At present, the focus of policy in India is on spurring EG. Health and education have not been given adequate attention and India continues to lag its peer countries in key health and education indicators. Though higher EG has undoubtedly improved HD, it needs to be recognised that this improvement in HD as a trickle-down effect of EG, is an extremely slow process. For instance, India's HDI score has improved only by 0.225 in last 30 years. Therefore, it may take a long time to bridge the gap with the average of developing economies. We, therefore, cannot rely only on the effects of EG to percolate down to HD. There is a need for concerted efforts and specific and affirmative measures aimed directly at promoting HD, and given the strong impact of HD on EG, such efforts will generate higher EG as well.

Several states were found to be in the adverse feedback, HD-lopsided and EG-lopsided categories. How can these states move into the virtuous category? This will require policy actions on multiple fronts, and will be a long-drawn process. It requires much greater efforts from states, which are in the

adverse feedback category vis-à-vis those which are in the EG-lopsided or HD-lopsided categories. The states in the adverse feedback category have been long mired in the low-growth, low-HD adverse feedback cycle, which would need to be broken. However, it will not matter much whether these states break out from the adverse feedback loop by focussing first on EG or HD. In the case of other countries, the only path would have been from adverse feedback to the HD-lopsided to EG-lopsided and/or to the virtuous category. However, in the Indian context, there has been overwhelming evidence at the national and state levels that it is possible to move directly from the EG-lopsided to the virtuous category. Therefore, these states could focus on EG or HD first, though we strongly believe that a balanced development of both components will hasten the process of their movement to the next category, and also help sustain their position in the next category. These states need to focus not only on the quantitative aspects of EG and HD, but also on their qualitative characteristics such as inclusive and job-generating growth, increased social sector spending, and affirmative policy actions to reduce income and gender inequalities.

States in the EG-lopsided category are in a relatively better position than those in the adverse feedback category. While it is possible for states in this category to move directly into the virtuous category, it is important that they first correct the EG-lopsided development by focussing more on HD, in order to sustain their position when they move in the virtuous category. Likewise, the states in the HD-lopsided category need to focus on EG. We refrain from prescribing specific policy measures as these need to be tailored to the unique conditions in each state. However, the policy measures need to be well thought out and sequenced for maximum impact and to avoid any rollback later on, and their impact monitored from time to time.

References

Afridi, F., Mukhopadhyay, A., & Sahoo, S. (2016). Female labor force participation and child education in India: Evidence from the National Rural Employment Guarantee Scheme. *IZA Journal of Labor and Development*, *5*(1). https://doi.org/10.1186/s40175-016-0053-y

Aiyar, S. (2001). Growth theory and convergence across Indian states: A panel study. In T. Callen, P. Reynolds and C. Towers (Eds.), *India at the Crossroads: Sustaining Growth and Reducing Poverty*. International Monetary Fund.

Anand, S., & Ravallion, M. (1993). Human development in poor countries: On the role of private incomes and public services. *Journal of Economic Perspectives*, *7*(1), 133–150. https://doi.org/10.1257/jep.7.1.133

Apergis, N. (2009). Technology, human capital and growth: Further evidence from threshold cointegration. *The Open Economics Journal*, *2*(1), 80–86. https://doi.org/10.2174/1874919400902010080

Arora, S. (2001). Health, human productivity, and long-term economic growth. *The Journal of Economic History*, *61*(3), 699–749. http://www.jstor.org/stable/2698133

Baddeley, M., McNay, K., & Cassen, R. (2006). Divergence in India: Income differentials at the state level, 1970–97. *The Journal of Development Studies*, *42*(6), 1000–1022. https://doi.org/10.1080/00220380600774814

Bandyopadhyay, S. (2011). Rich states, poor states: Convergence and polarisation in India. *Scottish Journal of Political Economy*, *58*(3), 414–436. https://doi.org/10.1111/j.1467-9485.2011.00553.x

Barro, R. J. (1991). Economic growth in a cross section of countries. *The Quarterly Journal of Economics*, *106*(2), 407–443. https://doi.org/10.2307/2937943

Barro, R. J., & Sala-i-Martin, X. (1997). Technological diffusion, convergence, and growth. *Journal of Economic Growth*, *2*(1), 1–26. https://doi.org/10.1023/A:1009746629269

Barro, R. J., & Sala-i-Martin, X. (1992). Convergence. *Journal of Political Economy*, *100*(2), 223–251. http://www.jstor.org/stable/2138606

Baumol, W. J. (1986). Productivity growth, convergence, and welfare: What the long-run data show. *The American Economic Review*, *76*(5), 1072–1085. http://www.jstor.org/stable/1816469

Becker, Gary S. (1964). Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education. *University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership Historical Research Reference in Entrepreneurship*. Retrieved from https://ssrn.com/abstract=1496221

Benhabib, J., & Spiegel, M. M. (1994). The role of human capital in economic development: Evidence from aggregate cross-country data. *Journal of Monetary Economics*, *34(2)*, 143–173. https://10.1016/0304-3932(94)90047-7

Bloom, D. E., Kuhn, M., & Prettner, K. (2022) Modern infectious diseases: Macroeconomic impacts and policy responses. *Journal of Economic Literature*, *60*(1), 85–131. https://doi.org/10.1257/jel.20201642

Bloom, D., & Canning, D. (2003). The health and poverty of nations: From theory to practice. *Journal of Human Development*, *4*(1), 47–71. https://doi.org/10.1080/1464988032000051487

Case, A., Fertig, A., & Paxson, C. (2005). The lasting impact of childhood health and circumstance. *Journal of Health Economics*, *24*(2), 365–389. https://doi.org/10.1016/j.jhealeco.2004.09.008

Cashin, P., & Sahay, R. (1996). Regional economic growth and convergence in India. *Finance and Development*, *33*, 1–4.

Cervellati, M., & Sunde, U. (2013). Life expectancy, schooling, and lifetime labor supply: Theory and evidence revisited. *Econometrica*, *81*(5), 2055–2086. https://doi.org/10.3982/ecta11169

Chakravarty, P., & Dehejia, V. (2017). Will GST exacerbate regional divergence? *Economic and Political Weekly*, *52*(25-26), 97-101.

Chanda, A., & Kabiraj, S. (2020). Shedding light on regional growth and convergence in India. *World Development*, *133*, 104961. https://doi.org/10.1016/j.worlddev.2020.104961

Chaurasia, A. R. (2019). Empirics of human development in India,1990–2015. *Indian Journal of Human Development*, *13*(2), 135–158. https://doi.org/10.1177/0973703019869148

Cuberes, D., & Teignier-Baqué, M. (2011). Gender inequality and economic growth. Background Paper for World Development Report 2012: Gender Equality and Development. World Bank, Washington, DC

de Almeida, R. D. C., Ehrl, P., & Moreira, T. B. S. (2021). Social and economic convergence across Brazilian states between 1990 and 2010. *Social Indicators Research*, *157*(1), 225–246. https://doi.org/10.1007/s11205-021-02659-x

Dholakia, A. (1990). *Benefits from Government Expenditure in India: A Welfare Indicator Approach*. Mumbai: Himalaya Publishing House.

Dholakia, R. H. (2003). Regional disparity in income and human development in India. *Economic and Political Weekly, 38(39)*, 4166–4172.

Durlauf, S. N., & Johnson, P. A. (1995). Multiple regimes and cross-country growth behaviour. *Journal of Applied Econometrics*, *10*(4), 365–384. https://doi.org/10.1002/jae.3950100404

Floud, R., Wachter, K., & Gregory, A. (1990). *Height, Health and History: Nutritional Status in the United Kingdom, 1750–1980* (1st ed.). Cambridge University Press. https://doi.org/10.1017/CBO9780511983245

Fogel, R. W. (1994). Economic growth, population theory, and physiology: The bearing of long-term processes on the making of economic policy. *The American Economic Review*, *84*(3), 369–395. http://www.jstor.org/stable/2118058

Ghate, C. (2008). Understanding divergence in India: A political economy approach. *Journal of Economic Policy Reform*, *11*(1), 1–9. https://doi.org/10.1080/17487870802031411

Ghosh, M. (2006). Economic growth and human development in Indian states. *Economic and Political Weekly*, *41*(30), 3321–3327.

Ghosh, M., Ghoshray, A., & Malki, I. (2013). Regional divergence and club convergence in India. *Economic Modelling*, *30*, 733–742. https://doi.org/10.1016/j.econmod.2012.10.008

Gopalakrishna, B. V., & Rao, J. (2012). Economic growth and human development: The experience of Indian states. *Indian Journal of Industrial Relations, 47*(4), 634–644. http://www.jstor.org/stable/23267365

Goswami, A., Roy, H., & Giri, P. (2021). Does HDIs level sustainable during 1999/2018 across cross-nations? An application of bootstrap quantile regression approach. *Sustainable Operations and Computers*, *2*, 127–138. https://doi.org/10.1016/j.susoc.2021.06.001

Haldar, S. K., & Mallik, G. (2010). Does human capital cause economic growth? A case study of India. *International Journal of Economic Sciences and Applied Research*, *3*(1), 7–25

Haldar, S. K., Hembram, S., & Das, S. (2021). Multidimensional human deprivation in India: Does club convergence exist? *Millennial Asia*, 097639962098100. https://doi.org/10.1177/0976399620981008

Kumar, U., & Subramanian, A. (2012). Growth in India's states in the first decade of the 21st century: Four facts. *Economic and Political Weekly*, *47*(3), 48–57. http://www.jstor.org/stable/41419741

Lolayekar, A. P., & Mukhopadhyay, P. (2020). Understanding growth convergence in India (1981-2010): Looking beyond the usual suspects. *PloS One*, *15*(6). doi: 10.1371/journal.Pone.0233549.

Lucas, R. E. (1988). On the mechanics of economic development. *Journal of Monetary Economics*, *22*(1), 3–42. https://doi.org/10.1016/0304-3932(88)90168-7

Mankiw, N. G., Romer, D., & Weil, D. N. (1992). A contribution to the empirics of economic growth. *The Quarterly Journal of Economics*, *107*(2), 407–437. https://doi.org/10.2307/2118477

Marchante, A. J., & Ortega, B. (2006). Quality of life and economic convergence across Spanish regions, 1980–2001. *Regional Studies*, *40*(5), 471–483. https://doi.org/10.1080/00343400600757460

Marjit, S., & Sandip Mitra. (1996). Convergence in regional growth rates: Indian research agenda. *Economic and Political Weekly*, *31*(33), 2239–2242. http://www.jstor.org/stable/4404523

Mehrotra, S., & Parida, J. K. (2021). Why human development should precede economic growth in the states. *Economic and Political Weekly, 56*(38), 54–61.

Mishra, U. S., & Joe, W. (2020). Household Assets and Wealth Quintiles, India 2006-16: Insights on economic inequalities. E*conomic and Political Weekly,* 55(6), 83-91

Molina, G. G., & Purser, M. (2010). Human development trends since 1970: a social convergence story (human development research paper 2010/02). United Nations Development Programme.

Morris, M. D. (1978). A physical quality of life index. *Urban Ecology*, *3*(3), 225–240. https://doi.org/10.1016/0304-4009(78)90015-3

Morris, M. D., & McAlpin, M. B. (1982). *Measuring the condition of India's poor: The physical quality of life index*. New Delhi: Promilla.

Mukherjee, S., & Chakraborty, D. (2010). Is there any relationship between economic growth and human development? Evidence from Indian states. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.1624465

Mukherjee, S., Chakraborty, D., & Sikdar, S. (2014). Three decades of human development across Indian states: Inclusive growth or perpetual disparity? Working Paper No. 2014-139, National Institute of Public Finance and Policy.

Nathan, H. S. K., & Mishra, S. (2010). Progress in human development: Are we on the right path? *International Journal of Economic Policy in Emerging Economies*, *3*(3), 199-221. https://doi.org/10.1504/IJEPEE.2010.035178

Nelson, R. R., & Phelps, E. S. (1966). Investment in humans, technological diffusion, and economic growth. *The American Economic Review*, *56*(1/2), 69–75. http://www.jstor.org/stable/1821269

Nissan, E., & Niroomand, F. (2005). Convergence and divergence of basic needs and income: An international comparison. *The Journal of Developing Areas*, *39*(1), 151–167. https://doi.org/10.1353/jda.2005.0039

Pelinescu, E. (2015). The impact of human capital on economic growth. *Procedia Economics and Finance*, *22*, 184–190. https://doi.org/10.1016/s2212-5671(15)00258-0

Phillips, P. C. B., & Sul, D. (2007, November). Transition modeling and econometric convergence tests. *Econometrica*, *75*(6), 1771–1855. https://doi.org/10.1111/j.1468-0262.2007.00811.x

Preston, S. H. (1975). The changing relation between mortality and level of economic development. *Population Studies, 29*(2), 231-248. https://10.1080/00324728.1975.10410201

Prettner, K. (2013). Population aging and endogenous economic growth. *Journal of Population Economics*, *26*(2), 811–834. https://doi.org/10.1007/s00148-012-0441-9

Ranis, G. (2004). Human development and economic growth. Working Paper 887, Economic Growth Center, Yale University. Retrieved from https://ssrn.com/abstract=551662

Ranis, G., Stewart, F., & Ramirez, A. (2000). Economic growth and human development. *World Development*, *28*(2), 197–219. https://doi.org/10.1016/S0305-750X(99)00131-X

Rao, M.G., R.T. Shand, & K.P. Kalirajan. (1999). Convergence of incomes across Indian states: A divergent view. *Economic and Political Weekly*, *34*, 769-778.

RBI. (2017). Report of the Internal Study Group to Review the Working of the Marginal Cost of Funds Based Lending Rate System.

Romer, P. M. (1986). Increasing returns and long-run growth. *Journal of Political Economy*, *94*(5), 1002–1037. http://www.jstor.org/stable/1833190

Romer, P. M. (1990). Endogenous technological change. *Journal of Political Economy*, *98*(5), S71-S102. http://www.jstor.org/stable/2937632

Schultz, T. P. (2002). Wage gains associated with height as a form of health human capital. *The American Economic Review*, 92(2), 349–353. http://www.jstor.org/stable/3083430

Schultz, T. W. (1971). *Investment in human capital: The role of education and research*. The Free Press.

Schultz, T. W. (1981). *Investing in people: The economics of population quality*. Los Angeles, CA: University of California Press.

Solow, R. M. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics*, *70*(1), 65. https://doi.org/10.2307/1884513

Strauss, J., & Thomas, D. (1998). Health, nutrition, and economic development. *Journal of Economic Literature*, *36*(2), 766–817. http://www.jstor.org/stable/2565122

Summers, L. H., Khan, M. A., & Sabot, R. H. (1992). Investing in all the people (with comments). *The Pakistan Development Review*, *31*(4), 367–404. http://www.jstor.org/stable/41259577

Suri, T., Boozer, M. A., Ranis, G., & Stewart, F. (2011). Paths to success: relationship between human development and economic growth. *World Development*, 39(4), 506–522. https://doi.org/10.1016/j.worlddev.2010.08.020

Teixeira, A. A. C., & Queirós, A. S. S. (2016). Economic growth, human capital and structural change: A dynamic panel data analysis. *Research Policy*, *45*(8), 1636–1648. https://doi.org/10.1016/j.respol.2016.04.006

United Nations Development Programme (UNDP). (1996). Human Development Report 1996 (Economic Growth and Human Development). Retrieved from https://hdr.undp.org/content/human-development-report-1996

Uzawa, H. (1965). Optimum technical change in an aggregative model of economic growth. *International Economic Review*, *6*(1), 18. https://doi.org/10.2307/2525621

Viswanath, J., Reddy, K. L. N., & Pandit, V. (2009). Human capital contributions to economic growth in India: An aggregate production function analysis. *Indian Journal of Industrial Relations, 44*(3), 473–486. https://www.jstor.org/stable/27768219

Williamson, D. F. (1989). The Box Plot: A Simple Visual Method to Interpret Data. *Annals of Internal Medicine*, 110(11), 916. https://doi.org/10.7326/0003-4819-110-11-916

World Bank. (2012). World Development Report 2012: Gender Equality and Development. *World Bank*. Retrieved from https://openknowledge.worldbank.org/handle/10986/4391

Annex A: HDI and its Components

DIMENSIONS	HEALTH	KNOWLEDGE	STANDARD OF LIVING
Indicators	Life expectancy Number of years a new born child would live if subject to the prevailing mortality risks.	Mean years of schooling Average number of completed years of education of population aged 25 years and older. Expected years of schooling 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.	GNI per capita (PPP US$)
Index	↓ LE index $\frac{LE-20}{85-20}$	↓ MYSI $\frac{MYS}{15}$ ↓ EYSI $\frac{EYS}{18}$ ↘ ↙ Education Index $\frac{MYS+EYS}{2}$	↓ Income index $\frac{\ln(GNIpc)-\ln(100)}{\ln(75000)-\ln(100)}$
	↘	↓ HDI $\sqrt[3]{LE\ index * Education\ index * Income\ index}$	↙

Source: UNDP. Note: Index of Non-Income human development has been calculated by taking the geometric average of the health and education indices.

Annex B: Pattern and Movement of States - Quinquennial Analysis

States	1993-97	1998-02	2003-07	2008-12	2013-2017
Andhra Pradesh	Vicious	EG-lopsided	Virtuous	Virtuous	Virtuous
Arunachal Pradesh	HD-lopsided	EG-lopsided	HD-lopsided	HD-lopsided	EG-lopsided
Assam	HD-lopsided	HD-lopsided	Vicious	Vicious	Virtuous
Bihar	Vicious	EG-lopsided	Vicious	Virtuous	Virtuous
Delhi	Virtuous	HD-lopsided	Virtuous	EG-lopsided	Virtuous
Goa	EG-lopsided	HD-lopsided	Virtuous	Virtuous	EG-lopsided
Gujarat	EG-lopsided	Vicious	EG-lopsided	EG-lopsided	Virtuous
Haryana	Virtuous	EG-lopsided	Virtuous	Virtuous	Virtuous
Himachal Pradesh	Virtuous	Virtuous	Virtuous	EG-lopsided	Virtuous
Jammu and Kashmir	Vicious	HD-lopsided	HD-lopsided	HD-lopsided	EG-lopsided
Karnataka	Virtuous	HD-lopsided	Virtuous	Vicious	Virtuous
Kerala	Virtuous	Virtuous	Virtuous	EG-lopsided	Virtuous
Madhya Pradesh	Vicious	Vicious	HD-lopsided	EG-lopsided	Virtuous
Maharashtra	EG-lopsided	Virtuous	Virtuous	Virtuous	Virtuous
Manipur	Vicious	Vicious	HD-lopsided	HD-lopsided	EG-lopsided
Meghalaya	EG-lopsided	EG-lopsided	HD-lopsided	Virtuous	Vicious
Mizoram			HD-lopsided	EG-lopsided	EG-lopsided
Nagaland	Vicious	EG-lopsided	EG-lopsided	Virtuous	Vicious
Odisha	EG-lopsided	Vicious	EG-lopsided	EG-lopsided	Virtuous

Punjab	HD-lopsided	Vicious	Vicious	Virtuous	Virtuous
Rajasthan	EG-lopsided	Vicious	Vicious	EG-lopsided	Virtuous
Sikkim	EG-lopsided	EG-lopsided	Virtuous	Virtuous	Virtuous
Tamil Nadu	Virtuous	HD-lopsided	Virtuous	EG-lopsided	Virtuous
Tripura	Virtuous	EG-lopsided	Vicious	Virtuous	Virtuous
Uttar Pradesh	HD-lopsided	Vicious	Vicious	EG-lopsided	Virtuous
West Bengal	Virtuous	EG-lopsided	Vicious	EG-lopsided	Virtuous

Notes

[#] The authors would like to thank Rakesh Mohan, Ajay Mahal, Nachiket Mor, Ravinda H. Dholakia, Santosh Mehrotra and Sandhya Venkateswaran for their useful comments and suggestions on an earlier version of the paper. We would also like to thank Shauryavir Dalal for his research assistance. Also, we sincerely thank our colleagues at CSEP for their helpful suggestions during an internal seminar.

[1] Source: World Bank. (2022). Retrieved from https://data.worldbank.org.

[2] The HD and EG measures are based on improvement in non-income HD and average annual growth in per capita in GDP, respectively. Improvement in HD has been defined as reduction in shortfall of HDI from the maximum possible value of 1.

[3] It is noteworthy that India was in the EG-lopsided category in the 1960s, but despite falling back to the vicious or adverse feedback category in the following decade, sprang back to being EG-lopsided subsequently.

[4] High income states have not been further subdivided in high-HD and low-HD, because there are only two states in the *high income, low-HD* category.