Monk Prayogshala Working
Paper # 2021-08

Abhijit Chakraborty
Anirudh Tagat
Sanchari Roy Mukherjee

August, 2021

STATE-LEVEL ESTIMATES OF THE HUMAN CAPITAL INDEX FOR INDIA

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DEPARTMENT OF ECONOMICS

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Abhijit Chakraborty
Department of Economics, University of North Bengal, Siliguri, India

Anirudh Tagat
Department of Economics, Monk Prayogshala, Mumbai, India

Sanchari Roy Mukherjee
Department of Economics, University of North Bengal, Siliguri, India

Address correspondence to Anirudh at at@monkprayogshala.in

The authors are grateful to Akshaya Balaji for helpful comments and suggestions. All errors are sole responsibility of the authors.

State-level estimates of the Human Capital Index for India

Abstract

Despite making improvements in economic growth and poverty reduction in India there is little evidence of improvement in education and health indicators of human capital. We use data from various sources to construct a novel state-level measure of the Human Capital Index to highlight the shortfall in terms of human capital at sub-national levels in India. The results indicate that there is a large gap among the states Our measure of HCI for India is consistent with the country-level measure in that we find similar correlations between HCI and other indicators of economic growth. We conclude with implications for policy in a country like India, where health policy is the mandate of state governments.

Keywords: education, health, survival, South Asia

JEL Codes: O15, H75, I15, I20, C43

State-level estimates of the Human Capital Index for India

1. Introduction

Investments in human capital leads to attainment of full potential for an individual (World Bank 2018). The challenge has, however, been measuring the various dimensions of human capital from a cross-country as well as a within country perspective, since at the disaggregated level, countries may do well on certain social indicators but may falter on the others. From a policy perspective, having sub-national level data can prove to be instrumental in designing and implementing more targeted policies, especially in countries that have federal governance structures. This has assumed importance in recent years, since there is an increasing recognition of the importance of disaggregated data as compared to national averages (Kim et al. 2021).

Take the case of India, a democratic federal country that relies on state (subnational) governments in health and education. The Indian economy has been making tremendous progress in terms of economic growth[1](Thorat et al. 2017) but has been failing on many indicators of development like health and education (Ministry of Statistics and Programme Implementation, Government of India, 2017). Notably, the pattern is not similar within the country (Dreze and Sen 2013) - for example, the eastern state of Bihar often features at the bottom of state-wise health and education parameters. In contrast, states such as Kerala, often praised for high literacy levels and robust healthcare systems, feature typically at the top of such rankings (NITI Aayog, 2019). This calls for a precise measurement of human capital

[1] Although the progress has somewhat slowed down from 2019 onwards (Subramanian and Felman 2019).

across states. In doing so we aim to pinpoint potential losses from depleting human capital for states and also from a methodological perspective provide rationale for its use in future research.

Concomitantly, there has been an evolution of measurement of human capital in recent years, one candidate measure being the Human Capital Index by the World Bank (World Bank 2018). This paper intends to compute a measure of human capital along the lines of the Human Capital Index (HCI, henceforth) for the major Indian states. To the best of our knowledge, this is the first time that a study has been undertaken at the level of Indian states from a human capital perspective. In doing so, we aim to generalize the required human capital loss for the states and also from a methodological perspective give a direction for future research. We expect to add to the large body of literature on human capital where several studies have reflected on the importance of Human capital investments for future returns.

1.1 Defining human capital

Human capital is the total productive capacity generated by any individual due to better education and health (Todaro and Smith 2003). In any country when individuals are subjected to better education facilities and better health infrastructure they contribute to the GDP of a country through increased productivity.

The importance of human capital[2] and its measurement has been emphasized in various models of economic growth and development. In particular, aspects of education and health are important determinants of human capital and the way they impact accumulation of human capital has been an area of focus in development economics (Strauss and Thomas 1995). This is especially so with

[2] Note that there are important differences between human capital and human capability. One helps us to expand the productive resource associated with human work, the other helps in enhancing the ability of human beings to lead a good life and expand the choices related to it (Sen. 1997).

developing countries as an investment in human capital can have substantial long-run effects for developing countries (Flabbi and Gatti 2018). It has been found that several dimensions of human capital are strongly related to aggregate economic performance (Rossi 2020). So, it becomes important to not only measure human capital in a manner that improves government policies on education and health, but also for future economic growth.[3]

Human capital formation requires a continuous political commitment; evidence suggests that investments made in the first 1000 days of a child's life go on to make progress in human capital formation (Kim 2018) through better education and health.

Human capital investments are intertemporal in nature i.e., any investments today yield payoffs only in the future (Flabbi and Gatti 2018). By this simple conjecture, it is likely that human capital accumulation leads to increases in productive capacity which can improve standards of living through economic growth. There is cross-country evidence to show that investments in human capital improve growth in the long run (Flabbi and Gatti 2018). Studies also point out that the proxies used for measuring human capital are strongly correlated to economic performance (Rossi 2020). Duflo (2001) has pointed out that investment in physical infrastructure has important contributions to human capital progression. Recent studies have shown that similar investments in major physical infrastructure does contribute towards human capital progression (Agenor and Moreno-Dodson, 2006).

In the last decade, there has been an expansion of basic opportunities in almost every country. Most of the developing countries today have a young population which is ready to reap the benefits of

[3] Here one might distinguish between human capital and human development. Human development is much broader in scope compared to human capital and focuses on means rather than on ends.

demographic dividend (World Bank 2004). Human capital consists of knowledge, skills and health that people accumulate over their life to realize their full potential (World Bank, 2018). However, it has been argued that education and health may not be the only factors influencing human capital and thus economic performance (Rossi 2020). Acemoglu, Gallego, and Robinson (2014) find that human capital does play an important role in determining economic growth but institutions that shape human capital play a bigger role. Scultz (1961) points out that investing in human capital happens to be the most important investment as it contributes to future income potential. Human capital investments are also designed to help better economic returns (Kraay 2019). In countries such as Sri Lanka, China, and Japan (to name a few), there has been widespread evidence that investment in human capital (especially in education and health) can have a positive impact on economic growth (Dreze and Sen 2013).

1.2. Human capital in India

The Indian economy has made substantial progress in the last decade (Thorat et al. 2017), including reductions in poverty. However, various social indicators namely education, health and gender equality continue to remain at woefully low levels (Drèze and Sen 2013, Dreze and Sen 2011). India has a huge diversity when it comes to states in terms of these social indicators (Dreze and Sen 2013). On the one hand we have states like Kerala, Tamil Nadu and Himachal Pradesh which are top performers on the other hand states like Bihar, Uttar Pradesh and Madhya Pradesh that display very low human development progress There is wide variation in the geography of social development among the Indian states, as measured using various indices of human development (Dreze and Khera 2012). Liu et al. (2019) indicate that it is largely the northern states that share a high burden of under 5 mortality rates with the exception of Assam in the North East and Odisha in East. Similarly, Alkire and Seth (2015) take note of the various dimensions of multidimensional poverty across Indian States. Their study shows that there has been a decrease in Multi Dimensional Poverty in the Southern states but the same has not happened for the BIMARU states. Thus, there is an indication in the literature on measurement of .

1.2. Measuring Human Capital

Human capital is multidimensional; it comprises an array of investments, but usually, the focus is on education and health (Strauss and Thomas 1995). Education is typically measured in terms of years of education completed.

Measuring health is a big challenge and usually an objective measure of health is considered an ideal approach (Strauss and Thomas 1995) so anthropometrics, especially child anthropometrics is used as a measure of health. Measuring height for the weight (stunting) or weight for age (undernutrition) gives us an assessment of long-term and short-term failure of nutrition. (Fogel 1986) uses height for age as an essential indicator to understand long-run economic performance.

In the second half of the twentieth century, human capital models were micro models based on the work of Schultz (1961), Becker (1962) and Mincer (1958), to name a few. All the models emphasized the importance of investment in skills and training for human capital development from the perspective of maximizing economic productivity. More broadly, Barro Mankiw, and Sala-i-Martin's (1995) work was seminal in linking human development to economic growth. There is also a significant effect of income on child health (Thomas, Strauss, and Henriques 1990). Studies have also shown that higher income is associated with greater enrollment rates and also raises years of schooling (King and Lillard 1987). Following advances in measurement and data collection globally, there has been a renewed focus on measuring human capital (among others) in the development accounting literature. Some important works in this area have been led by Mankiw, Romer, and Weil (1992), Galasso and Wagstaff (2016), and

Weil (2013). A new approach to human capital measurement has been to include the stock of human capital at an individual or aggregate level (Folloni and Vittadini 2010).

Notably, studies in development accounting that provide cross-country estimates of human capital indicators suggest that there are wide-ranging dispersion between as well as within countries. One explanation has been attributed to the lack of homogenous cross-country data on schooling and health (Rossi 2020). The same is true for intra-country variations where the data may be more diverse, making it difficult to capture the broad measures of human capital (D'Souza, Gatti, and Kraay 2019).

1.3 The human capital index

Given the multidimensional nature of human capital, as well as recent advances in development accounting in this domain, the HCI provides a unique opportunity to examine factors contributing to (or detracting from) human capital accumulation at the global level (Rama 2019). Indeed, the HCI has also been used in simulation exercises to investigate the role of investments in human capital on economic growth and poverty (Collin and Weil 2020). They argue that a majority of the gains accruing from increased investments in human capital come from poor countries.

The large variations in human capital between countries are a result of the variations of human capital within countries (D'Souza, Gatti, and Kraay 2019). Interestingly, D'Souza, Gatti, and Kraay (2019) note that the human capital outcomes across countries increases with income and the pattern is also followed within countries. There is also a large gap between the socio-economic groups for human capital. Thus, removing inequalities in human capital can greatly contribute towards eliminating the cross-countries and within-countries differences in human capital measurement.[4]

This study is motivated in part by the development of the HCI by the World Bank (2018). As a novel measure of human capital, the HCI purports to measure the loss in future productivity of a worker if as children they were subjected to full benefits of education and health. The HCI consists of three components as described in detail in the following section: (a) survival; (b) health; and (c) education; and is a geometric mean of these individual components. If the HCI for a country is .70 it would mean that the productivity of the worker for a child born today in that country would be considered to be 30% below its full potential. As it currently stands, the HCI is measured for a range of countries and is updated annually. Our study is motivated to measure the within-country variations for the Human Capital Index based on the World Bank methodology for India.

The remainder of the paper is organized as follows. Section 2 contains a brief overview of the methods and sources of data for computing state-level HCIs for India. Section 3 outlines the key results and discusses the findings in context of other state-level studies in India. Section 4 provides implications for policy, limitations, and ideas for future work.

2. Methods

This paper aims to replicate the HCI for Indian states, given the importance of tailoring state-level policies on health and education. Under the Constitution of India, health falls under the state list for

[4] It is important to note that the HCI is not without its limitations. As Stein and Sridhar (2019) suggest, the HCI emphasizes human capital only for its economic effects which are favoured by proponents of marked-based growth. They argue that it does not adequately account for equity concerns and may lead to further commercialization of health care.

policy making, whereas education falls under the concurrent list, i.e., that both the Union and state governments frame policies and regulations related to schooling.

We draw primarily on the methods described in World Bank (2018) for computing the HCI, which consists broadly of three subcomponents: (a) Survival, (b) Expected Learning-Adjusted Years of School, and (c) Health. For more details on the rationale behind each component, we refer the reader to Kraay (2019), but outline below the key formulae:

(a) **Survival**: This component is proxied by the state-wise under-five mortality rates taken from the Fourth round of the National Family Health Survey (NFHS-4). It broadly represents the idea that not all children born at time *t* will survive until the point at which human capital accumulation begins (e.g., attending school).

$$Survival = (1 - Under\ 5\ Mortality\ Rate)\ /\ 1 \tag{1}$$

(b) **Expected Learning-Adjusted Years of School**: This component is a representation of the number of school years completed, adjusting for the quality of schooling that may be heterogeneous across states. In particular, we need to account for the expected returns to schooling, expected years of school to be completed, as well as a measure of educational attainment (e.g., test scores). Specifically, the formula for this component is as below:

$$School = e^{\phi(Expected\ Years\ of\ School\ \times (Harmonized\ Test\ score\ /\ 625) - 14)} \tag{2}$$

Where, $Expected\ Years\ of\ School$ is taken from Appendix Table 2 in Chatterjee et al. (2019) using state-wise decomposition of HDI for 2016. $Harmonized\ Test\ score$ are state-level scores averaged for classes five and eight on all subjects on the National Achievement Survey 2017 (NCERT, 2020), and harmonized as per the conversion process in World Bank (2020). A key parameter in this is ϕ, which is the expected returns to schooling. Typically, this is computed using a Mincer-type estimation, and we depart from the Global HCI value for ϕ = 0.08 and use an India-specific value provided by Fulford (2012) as ϕ = 0.055 (the average between men and women)

(c) **Healt**h: This component is a composite measure of health and a proxy for the health environment which is required for human capital accumulation. It broadly consists of two components: the adult survival rate (i.e., the probability that a 15-year-old will survive till age 60), and the rate of stunting among children under the age of five. These are organized in the formula as below:

$$Health = e^{(\gamma_{ASR} \times (Adult\ Survival\ Rate - 1) + \gamma_{Stunting} \times (Not\ Stunted\ Rate - 1))/2} \quad (3)$$

Where, $Adult\ Survival\ Rate$is the ratio of individuals aged 15 years surviving up to the age of 60 years in a particular state. This data is computed using data from Ram et al. (2015), who estimated age and sex-specific adult mortality risk using district-level data. Their supplemental material (web tables 3 and 4) contains the adult survival rates for men and women separately, which are then averaged for each state and divided by 1000. It is important to note that the Ram et al. (2015) data is computed for 15-69, whereas the HCI states survival up to 60, which is a point of departure for our data compared to the global HCI. $Not\ Stunted\ Rate$is the inverse of the percentage of children stunted, computed from the NFHS-4 data for each state. In the HCI report (World Bank, 2021), the parameters $\gamma_{ASR}$and $\gamma_{Stunting}$are estimated to be 1.38, and 0.73, respectively, and stand in for the returns to future adult height, which is also a function of height at childhood. One point of departure from the original HCI computation here is our use of the returns to height from Sperling and Kjoller-Hansen (2012), $\gamma_{HEIGHT} = 0.072$, which is then multiplied by the estimate of the relationship between Height and Adult Survival Rates, and Height and Stunting, respectively. For more details on the computation based on work by Weil (2007) and Galasso and Wagstaff (2016), we refer the reader to Kraay (2018).

Taking these into account, the composite measure of HCI is the product of the three components, and is given by the following formula:

$$HCI = Survival \times School \times Health \quad (4)$$

We compute HCI scores for 20 Indian states using data roughly in the time period 2014-16, with NFHS-4 data for key indicators in health and survival coming from the fourth round (2015-16), and adult survival rates from Ram et al. (2015) computed for 2014. Data on test scores is from 2017 and expected years of schooling data (Chatterjee et al., 2019) is from 2016. Data is aggregated for Andhra Pradesh and Telangana since some measures (e.g., adult survival rates, expected years of schooling) were unavailable separately for Telangana. Thus, data presented here for Andhra Pradesh is indicative of both states.

3. **Findings**

The summary statistics for average scores on individual components of the HCI, as well as the overall HCI score and rank are provided in Table 1, and visually presented in Figure 1. The interpretation of the HCI score is in terms of productivity potential for a child born today. For example, in the top-ranked state by HCI score in India, the score is 0.358. This means that the productivity as a future worker for a child born in Kerala is nearly 64 percent below what could be achieved if there was complete education and full health. For the India average derived from these state-level scores, the corresponding figure implies a 67 percent deficit in achieving complete education and health. Importantly, the difference between the state with the highest score and the lowest score is 0.06, thus showing variations within India that would otherwise not be captured by India-level HCI estimates.

Note that the India average for 2016 derived from state-wise HCI scores computed here differs from the India average of 0.49 computed for 2020 in World Bank (2020). There might be several explanations for these variations, none of which we are able to fully explain in the absence of disaggregated data from the 2020 computation. First, the difference might be on account of the differences in the underlying variables used, or second, potentially because of state-specific variations and estimations of the individual components that make up the HCI. Last, it is possible that there is change in the underlying HCI parameters for India between 2016 and 2020, although it is unclear which components are driving this change. For example, recent results from the NFHS 5th round suggest that stunting among children under five in India has actually stayed the same or increased in certain states (Indian Institute for Population Sciences 2020), which would actually *reduce* the average HCI score.

Table 1: State-wise Human Capital Index (2014-16)

HCI Rank	State Name	Survival	School	Health	HCI
1	Kerala	0.993	0.794	0.454	0.358
2	Jharkhand	0.946	0.752	0.480	0.342
3	Jammu & Kashmir	0.962	0.749	0.471	0.340
4	Tamil Nadu	0.973	0.731	0.477	0.339
5	Andhra Pradesh	0.959	0.745	0.472	0.337
6	Uttarakhand	0.953	0.757	0.466	0.336
7	Himachal Pradesh	0.962	0.751	0.463	0.334
8	Gujarat	0.957	0.715	0.488	0.334
9	Karnataka	0.968	0.752	0.445	0.324
10	Haryana	0.959	0.733	0.460	0.323
11	Punjab	0.967	0.699	0.476	0.322
12	Maharashtra	0.971	0.730	0.449	0.319
13	Rajasthan	0.949	0.734	0.456	0.317
14	Madhya Pradesh	0.935	0.706	0.479	0.316
15	West Bengal	0.968	0.692	0.466	0.312
16	Assam	0.944	0.694	0.466	0.305
17	Chhattisgarh	0.936	0.701	0.461	0.303

18	Odisha	0.951	0.675	0.468	0.301
19	Bihar	0.942	0.715	0.439	0.295
20	Uttar Pradesh	0.922	0.701	0.450	0.291
India (average)		*0.956*	*0.726*	*0.464*	*0.322*
India (World Bank, 2021)					**0.490**

Source: Authors' own calculations using data from Ram et al. (2015), NFHS-4, Chatterjee et al. (2019), NCERT (2020), and Kraay (2018).

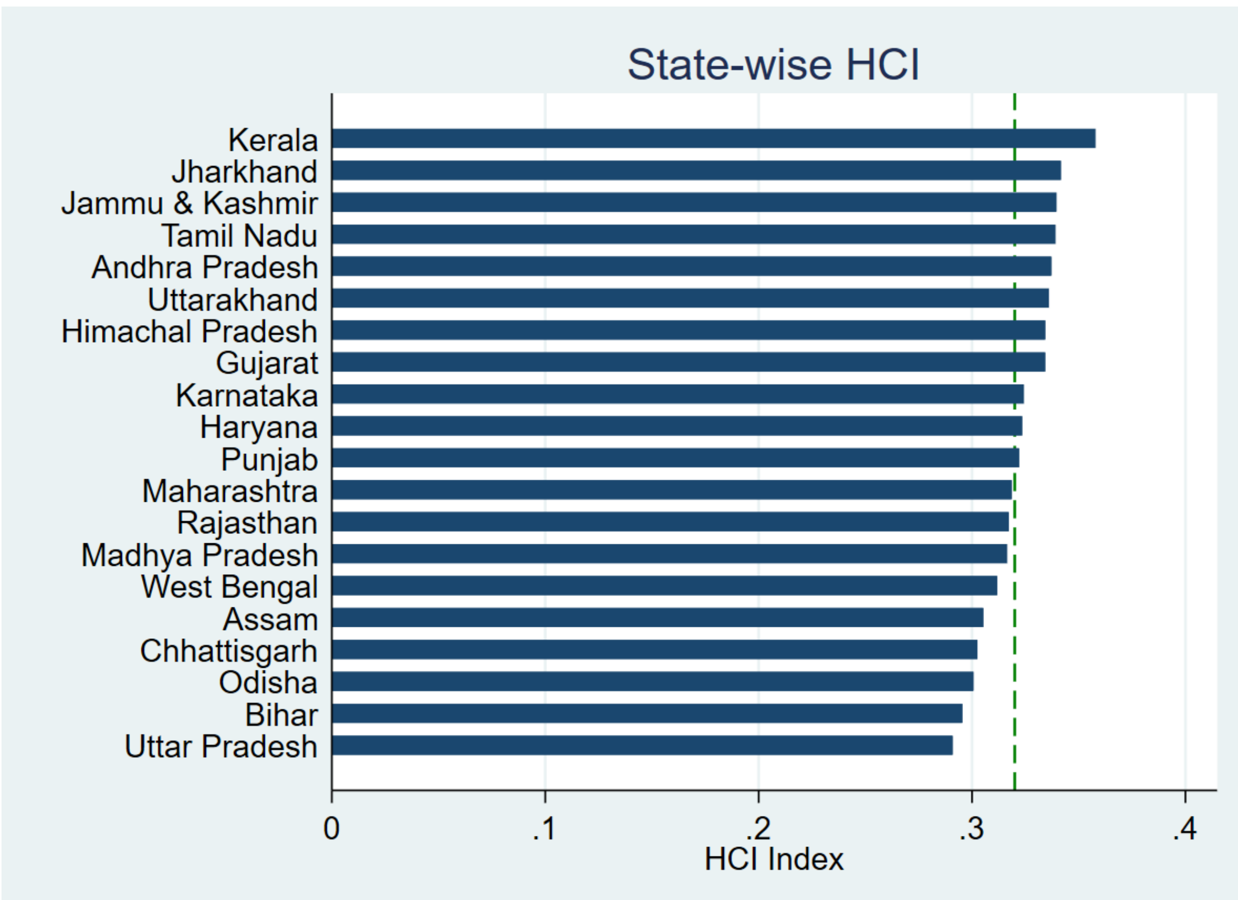

Figure 1: State-wise Human Capital Index.

Note: Green dashed line represents India average. India HCI from World Bank (2018) is 0.49 and is not marked in this figure.

Figure 2 contains the box plot of HCI scores divided across regions in India, classified according to the NFHS definitions. The only state included under Northeast is Assam, and therefore no variation is captured in that box. Additional region-wise graphs on components of the HCI (survival, health, education) are presented in the appendix (Figures A.1 to A.4) and reflect similar variations within each region. This indicates substantial heterogeneity even within regions and across states on the overall HCI as well as individual components.

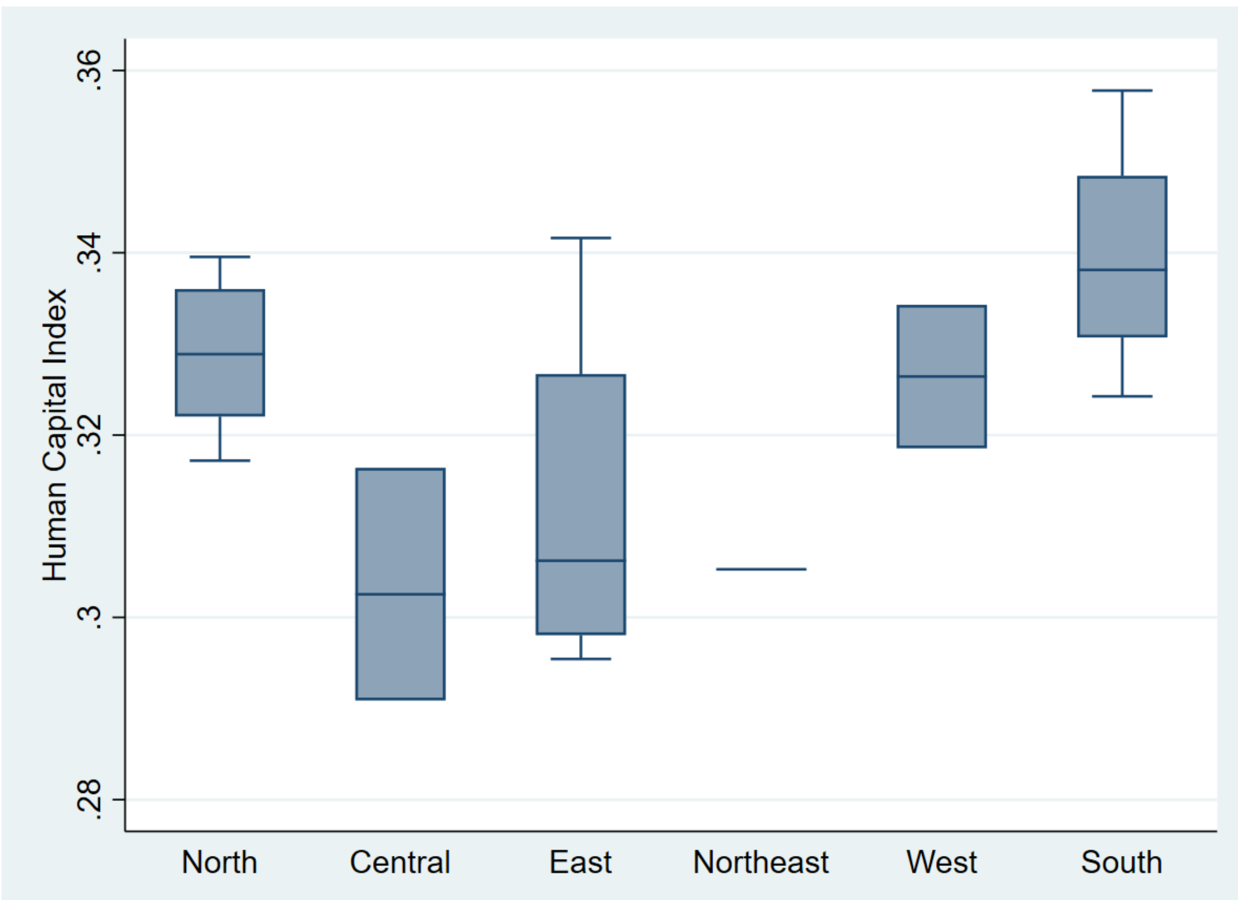

Figure 2: Box plot of HCI by region

Note: Regions classified as per the National Family Health Survey (NFHS). North includes NCT of Delhi, Haryana, Himachal Pradesh, Jammu & Kashmir, Punjab, Rajasthan, and Uttarakhand; Central includes Chhattisgarh, Madhya Pradesh, and Uttar Pradesh; East includes Bihar, Jharkhand, Odisha, and West Bengal;

Northeast includes Assam; West includes Goa, Gujarat, and Maharashtra; South includes Andhra Pradesh, Karnataka, Kerala, and Tamil Nadu.

Figures 3 to 5 present correlations between the HCI and measures of development, including economic output (measured by the natural log of per capita gross state domestic product, or GSDP) for 2015-16, the sex ratio (ratio of females to 1000 males) for 2013-15 from the Sample Registration System, and the Inequality-adjusted Human Development Index (Suryanarayana et al., 2019). As noted in the Global HCI Report by the World Bank (2021), there is a generally positive correlation between HCI and economic output. In contrast, there appears to be a weak or zero correlation between the HCI score and the sex ratio (females per 1000 males) in a particular state. There are important sex differences that could be explored by disaggregating the HCI for boys and girls. However, this exercise was impeded by a lack of disaggregated data (specifically for state-wise, gender-wise test scores on the NAS) and hence are left for future work.

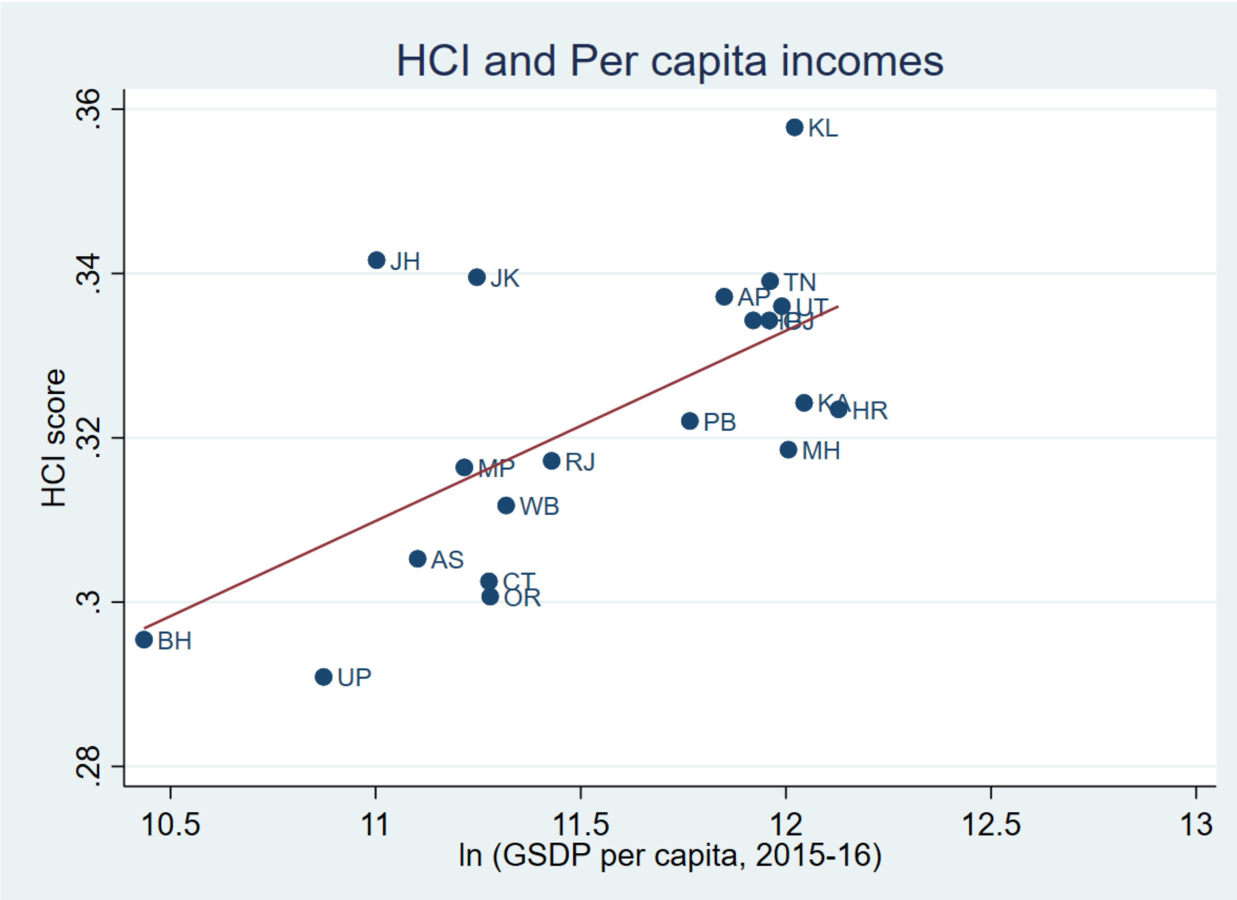

Figure 3: Correlation between HCI and Income

Note: Red line represents fitted regression line, state codes used as labels. Income is denoted by the natural log of per capita gross state domestic product (2015-16) from Reserve Bank of India's Database for the Indian Economy (DBIE), Date accessed: 13 April 2021.

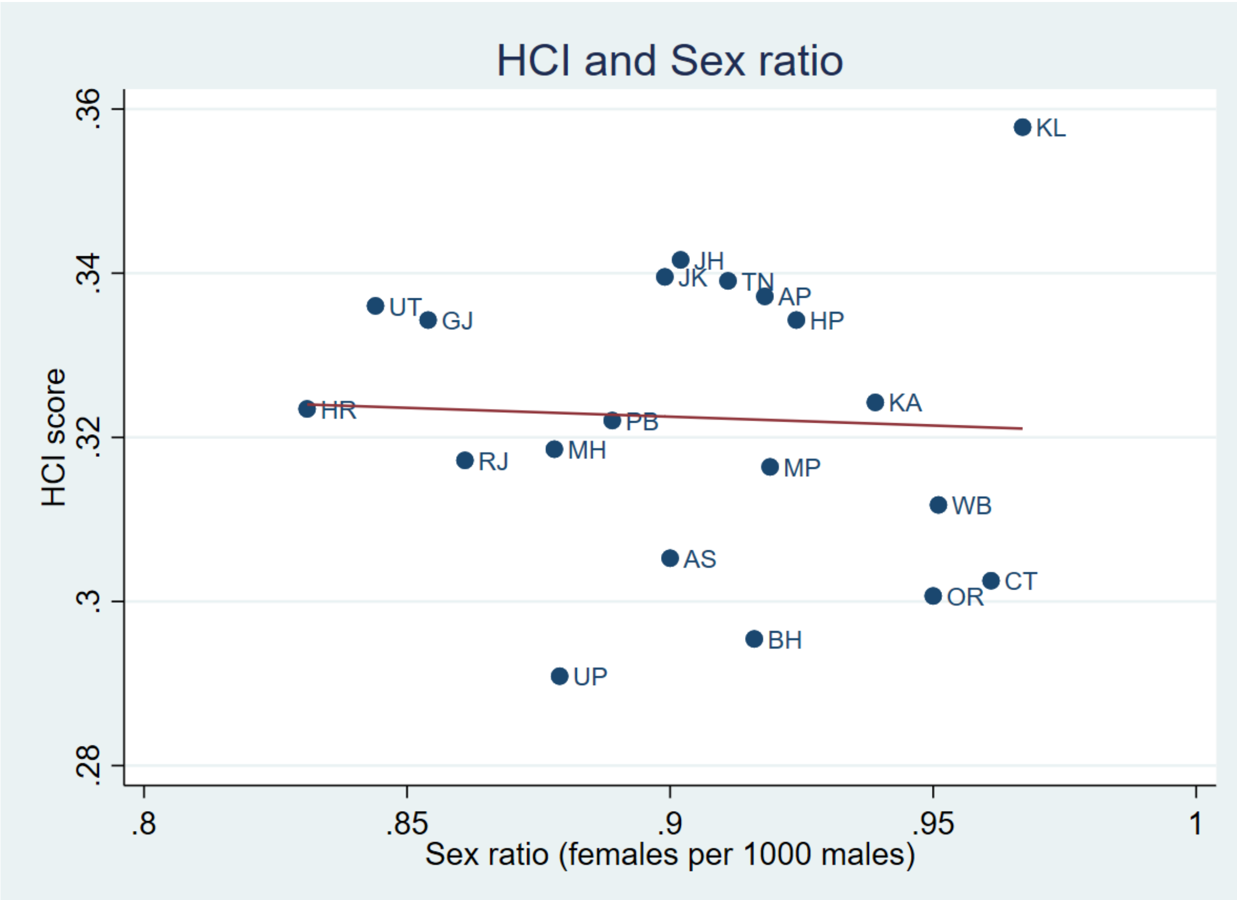

Figure 4: Correlation between HCI and Sex ratios (2013-15)

Note: Red line represents fitted regression line, state codes used as labels. *Source*: Sample Registration System and NITI Aayog (2016). Date accessed: 13 April 2021.

Figure 5 suggests that the HCI is a representative measure of human capital and correlates well with past measures of human development indices in India. We plot the HCI score against inequality-adjusted scores on the Human Development Index (IHDI), finding that there is in general a positive correlation between the two. On both measures, it is clear that states such as Kerala are doing better than other states on a range of indicators, whereas there are some instances where state score higher on the HCI than their relative IHDI index value (e.g., Jharkhand).

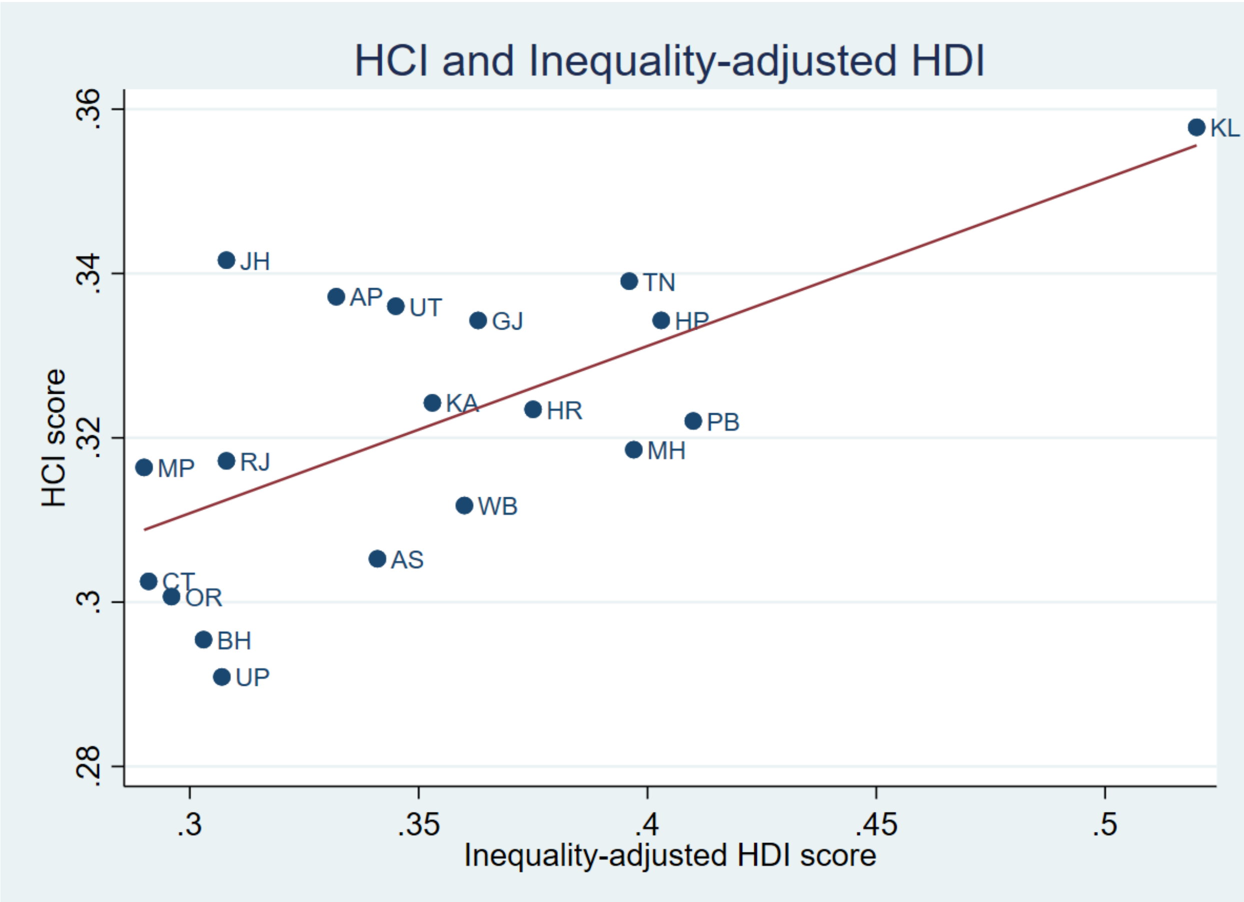

Figure 5: Correlation between HCI and Inequality-adjusted Human Development Index

Note: Red line represents fitted regression line, state codes used as labels. *Source*: Authors' own calculations, state-wise IHDI data from Suryanarayana et al. (2019).

Table 2 breaks down the individual components of the HCI for each state. There are more variations in some components (such as the fraction of children under five not stunted). Figure 5 contains the box plot of each of these to show the distribution of the individual components.

Table 2: State-wise components of Human Capital Index

State	Probability of survival to age 5	Expected years of schooling	Harmonized test score	Learning-adjusted school years	Adult survival rate	Fraction of children under-5 not stunted
Andhra Pradesh	0.96	13.60	397.66	5.35	0.92	0.69
Assam	0.94	11.20	409.99	6.65	0.91	0.64
Bihar	0.94	12.50	395.24	6.10	0.94	0.52
Chhattisgarh	0.94	12.30	383.30	6.46	0.92	0.62
Gujarat	0.96	12.00	411.77	6.09	0.93	0.80
Haryana	0.96	13.80	377.76	5.66	0.92	0.62
Himachal Pradesh	0.96	14.10	389.90	5.20	0.93	0.66
Jammu and Kashmir	0.96	14.50	377.06	5.25	0.95	0.74
Jharkhand	0.95	13.20	417.71	5.18	0.92	0.73
Karnataka	0.97	12.80	430.97	5.17	0.93	0.55
Kerala	0.99	14.80	414.49	4.18	0.95	0.64
Madhya Pradesh	0.94	12.40	386.91	6.32	0.92	0.73
Maharashtra	0.97	13.30	389.29	5.72	0.93	0.58
Odisha	0.95	11.00	390.04	7.14	0.92	0.66
Punjab	0.97	12.80	366.23	6.50	0.94	0.74
Rajasthan	0.95	11.80	443.14	5.63	0.93	0.61
Tamil Nadu	0.97	13.90	373.41	5.70	0.93	0.73

Uttar Pradesh	0.92	12.40	379.44	6.47	0.91	0.54
Uttarakhand	0.95	13.70	407.23	5.07	0.93	0.67
West Bengal	0.97	11.90	383.16	6.70	0.93	0.68
India	**0.96**	**12.90**	**396.23**	**5.83**	**0.93**	**0.66**

Source: Authors' own calculations, see Table 1 for sources.

4. Discussion and Concluding Remarks

We present data on human capital for Indian states using data between 2014 and 2016, using the methodology of the global HCI (World Bank, 2021). The results reveal that the India average from the global HCI was much higher than the India average derived from state-level HCI scores. Furthermore, there is some variation in HCI across states for the time period under consideration. The computation presented in these papers can be used for future work that looks at state-level analysis of health, education, or other aspects of human capital and development in the Indian context. This research also serves as a starting point for continuing computations of the HCI, contingent on data availability. This could also have substantial implications for policy as the state-level data could serve to focus on targeted policy changes with particular emphasis on the required indicator for human capital, instead of policy action from the Union governments.

One of the key limitations of the study is related to availability of updated data. The global HCI has been updated to 2020, but data for India may be challenging to update in the same manner given that state-level disaggregated data is not available at annual frequency for some variables (e.g, adult survival rates, test scores, stunting rates etc.). Furthermore, our computation uses a much broader definition for adult survival rates than the global HCI. We attempted to derive adult survival rates using life tables from the Sample Registration System (SRS) state-wise data, but found very little variation in adult survival rates across states. Future work can focus on refining data sources to update computations presented in this paper.

Another limitation is that of coverage - due to lack of data (mainly on adult survival rates) we have been unable to compute HCI scores for 15 states and union territories (states mainly from the North-eastern region of India). Future work can bridge this gap by using an interpolation of historical data on adult survival rates, as data on most other parameters are available.

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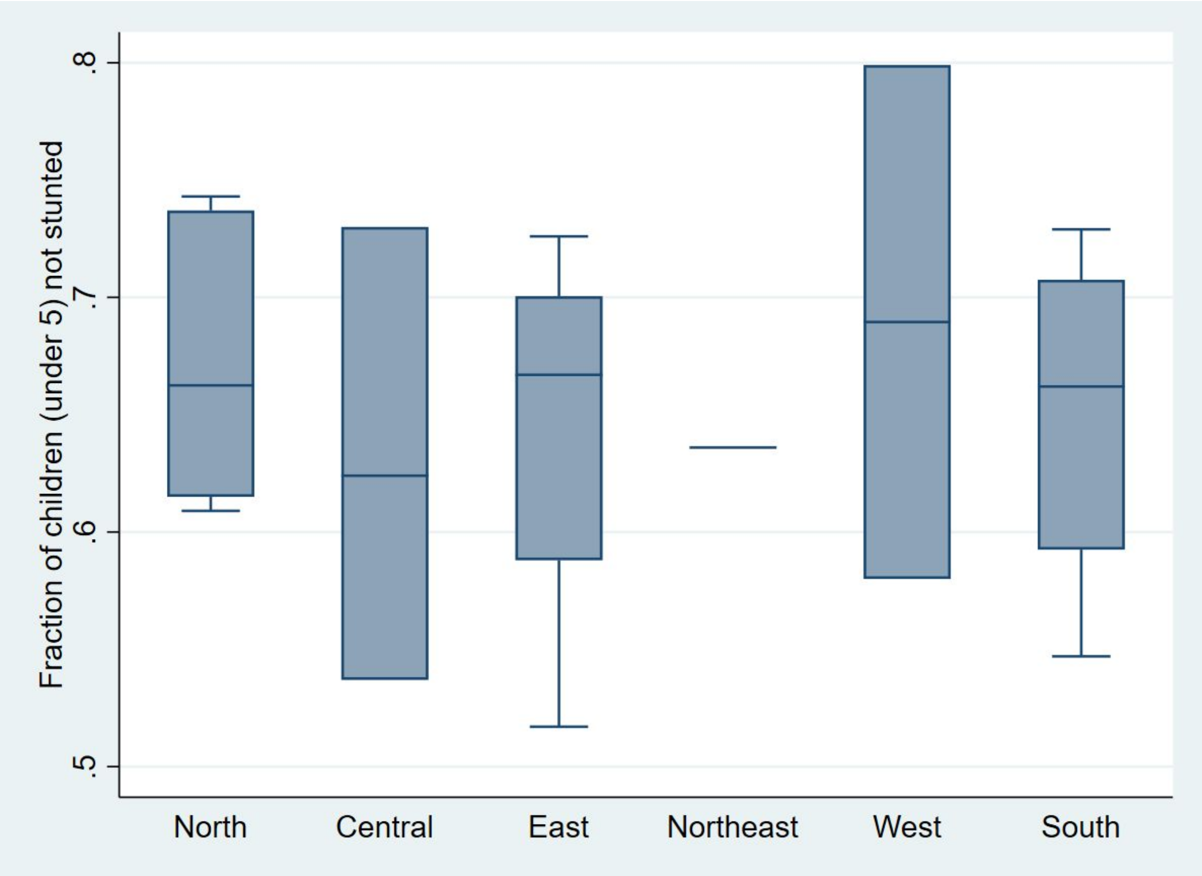

Figure A.1: Region-wise distribution of stunting component of HCI

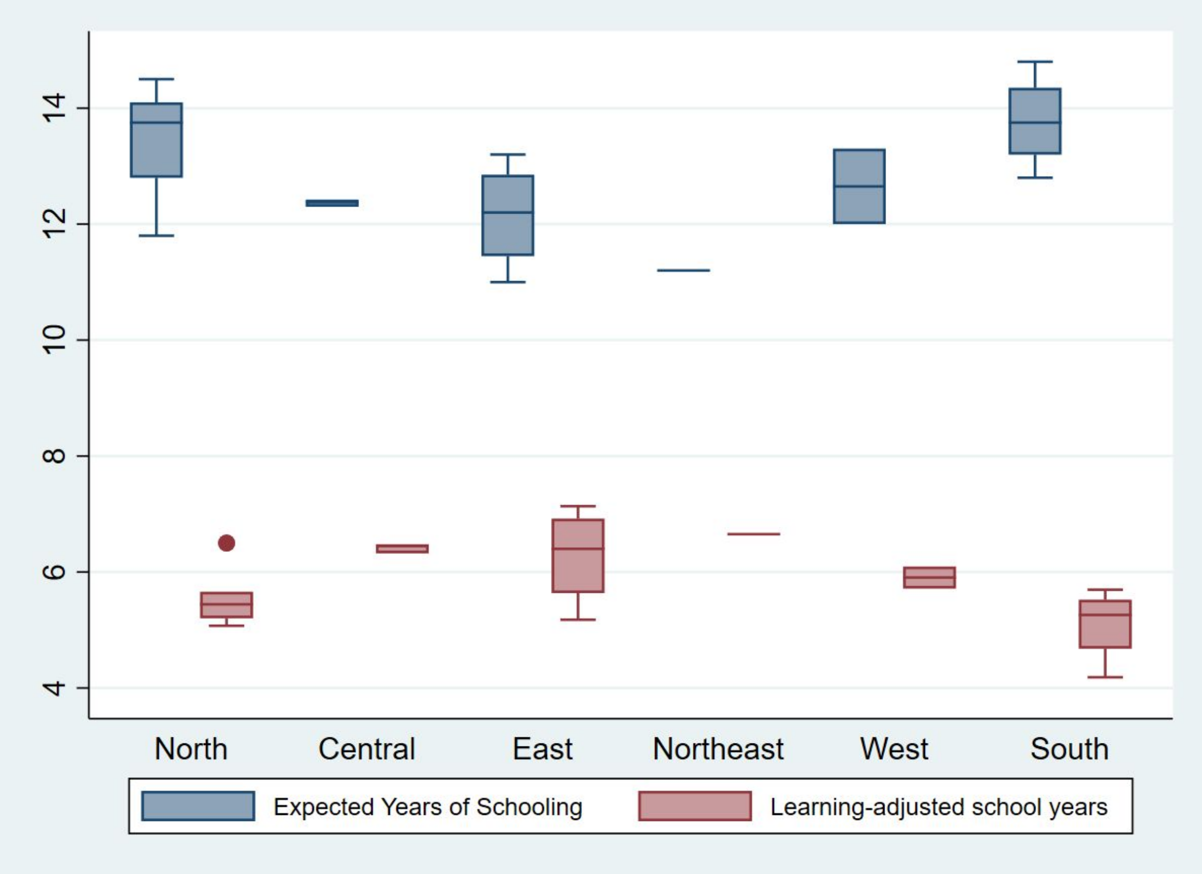

Figure A.2: Region-wise distribution of school component of HCI

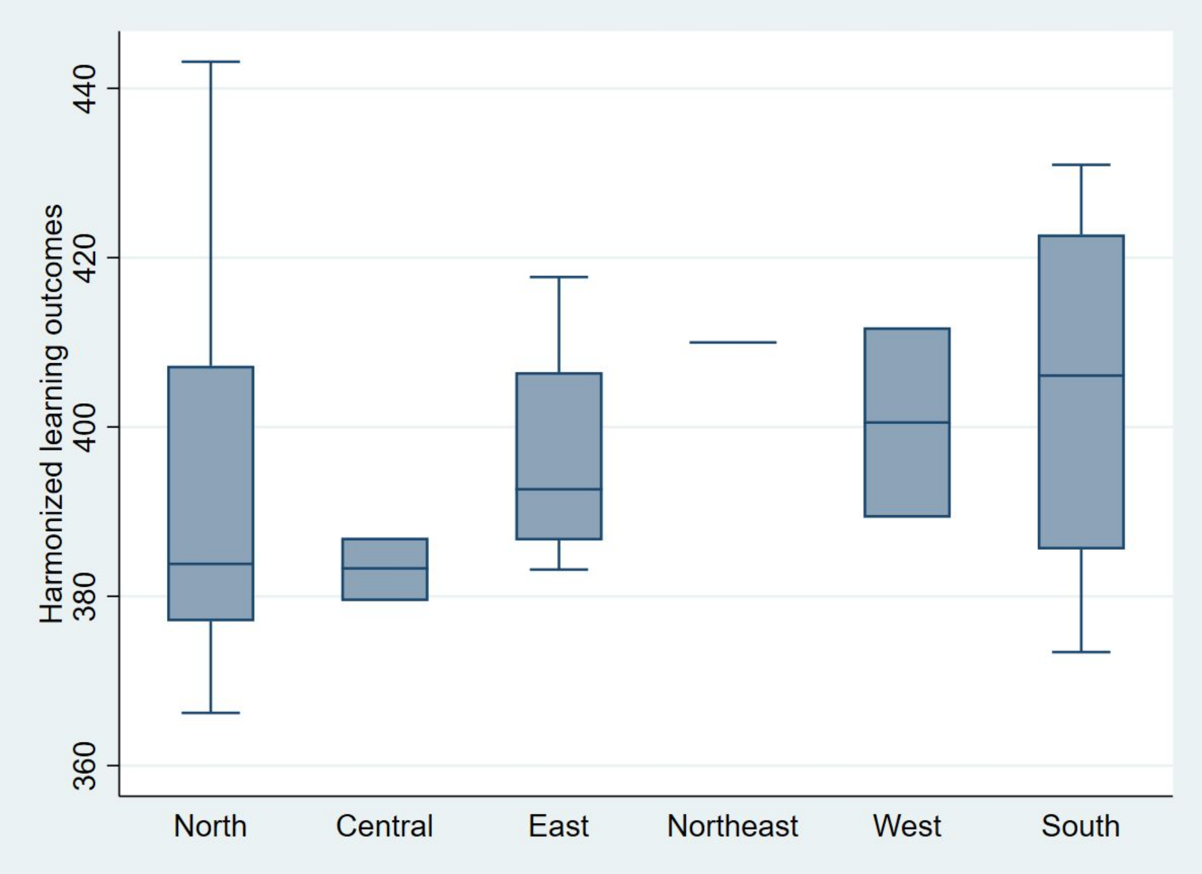

Figure A.3: Region-wise distribution of learning outcomes component of HCI

Figure A.4: Region-wise distribution of survival component of HCI