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Multidimensional Poverty and Inclusive Growth in India: An Analysis Using Growth Elasticities and Semi-Elasticities

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Abstract
Post reform India has generated high economic growth, yet progress in income poverty and many other key development outcomes has been modest. This paper primarily examines how inclusive economic growth has been in India between 2005-06 and 2015-16 in reducing multidimensional poverty captured by the global Multidimensional Poverty Index (MPI). We employ a constellation of elasticity and semi-elasticity measures to examine vertical, horizontal as well as dimensional inclusiveness of economic growth. Nationally, we estimate that a one percent annual economic growth in India during our study period is associated with an annual reduction in MPI of 1.34 percent. The association of the national growth to state poverty reduction (horizontal inclusiveness) is however not uniform. Some states have been successful in reducing poverty faster than the national average despite slower economic growth between 2005-05 and 2015-16; whereas, other states have been less successful to do so despite faster economic growth during the same period. Our analyses and findings show how these tools may be used in practical applications to measure inclusive growth and inform policy.

Keywords: Multidimensional poverty, MPI, economic growth, poverty in India, growth elasticity, inclusive growth

JEL classification: I3, I32, O1, O5, O53

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The Oxford Poverty and Human Development Initiative (OPHI) is a research centre within the Oxford Department of International Development, Queen Elizabeth House, at the University of Oxford. Led by Sabina Alkire, OPHI aspires to build and advance a more systematic methodological and economic framework for reducing multidimensional poverty, grounded in people's experiences and values.

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1. Introduction

Despite intermittent slowdowns, India has maintained a record of strong economic growth since the 1980s, with the average growth rate reaching at least five percent for every subsequent five-year plan.[1] Although growth in India's Gross National Income (GNI) has been much higher than the average of South Asian countries, the inclusiveness of this growth – either in terms of income poverty reduction or improvements in key social indicators – has not been relatively high. For example, in some periods including 2011-17, the reduction in the share of people living in income poverty, according to the $1.90-a-day international poverty line, has been much slower than that in Bhutan, Pakistan and Nepal (Table 1.).[2] India's performance in key social indicators has fallen short of her neighbours. Although in 2017-18 India had high rates of literacy than most other South Asian countries, in 2017 both the DPT immunisation rates among children aged 12–23 months, and access to improved sanitation facilities in rural areas were not as satisfactory as several neighbouring countries.[3]

Evaluating improvements in social indicators separately, or for a dashboard of indicators, however, does not allow conclusions to be drawn about multidimensional poverty. One may wonder how inclusive Indian economic growth would be if a multidimensional conception of poverty were adopted. For this purpose, we use the global Multidemensional Poverty Index (MPI), an international index of poverty introduced by Alkire and Santos (2010, 2014) in collaboration with the United Nations Development Program (UNDP), and revised in 2018 to align with the Sustainable Development Goals (SDGs) (Alkire, Kanagaratnam and Suppa 2020). The MPI is an implementation of the Adjusted Headcount Ratio proposed by Alkire and Foster (2011), which identifies as poor those persons who are multiply deprived, and then measures poverty by incorporating both the incidence of multiple deprivations as well as the average breadth of deprivations among the poor.

India is a large and diverse country, and consequently an analysis of inclusive growth in India should consider the variability across its states (horizontal inclusiveness) as well as the differential impact across dimensions (dimensional inclusiveness). The MPI and a form of growth elasticity we will introduce shortly are amenable to this form of analysis, as they can be broken down by population subgroups and by dimensions/indicators. Intertemporal analyses of MPI have already been undertaken in the Indian context. Alkire and Seth (2015), for instance, apply an adaptation of the global MPI using the Demographic Health

1 See Government of India (2011–12), Table A4.

2 See Government of India (2009, 2012), Deaton and Drèze (2002), Chen and Ravallion (2010), and Table 1 below.

3 See Drèze and Sen (2011, 2013) and also Table 1 below.

Survey (DHS) datasets for 1998-99 and 2005-06 to analyse the evolution of multidimensional poverty in India by state and social groups (caste, religion, age cohort).[4] They find that although the absolute reduction in the incidence of MPI was faster than that of monetary poverty, the reduction in national multidimensional poverty has not been uniformly shared by all subnational groups in India during this period. In particular, the states with initially higher multidimensional poverty tended to reduce poverty more slowly, in absolute terms, over the seven-year study period.

A more recent study by Alkire, Oldiges and Kanagaratnam (2021), using DHS datasets for 2005-06 and 2015-16, find, in contrast, that overall multidimensional poverty reduction during that period was faster and that poorer states, castes or religious or age groups, registered a faster absolute reduction in their MPIs, on average, than less poor states. India's best-performing state (Jharkhand) reduced MPI faster than any other South Asian country; indeed, only four African countries have reduced MPI faster in absolute terms. Looking across subnational regions in South Asia, nevertheless, Jharkhand was outperformed by regions in Bangladesh (Sylhet), Nepal (Far-Western) and Afghanistan (South East, North).[5]

The present paper builds on Alkire *et al.* (2021) to explore the inclusiveness of Indian economic growth between 2005-06 and 2015-16. The main tools are elasticities and semi-elasticities, that are introduced using an array of formulas below.[6] Intuitively, elasticity measures a *percentage change* in an "ends variable" due to a one percent change in a "means variable" (Foster 2014); whereas, a growth semi-elasticity measures an *absolute change* in an "ends variable" due to a one percent change in a "means variable" (Klasen and Misselhorn 2008). Thus, both elasticity and semi-elasticity formulas assess *responsiveness* (relative and absolute, respectively) of an "ends variable" to a "means variable". Following Foster (2014), we classify our responsiveness measures into three cateogories and study the vertical inclusiveness, horizontal inclusiveness, and dimensional inclusiveness of economic growth.

We study vertical inclusiveness by looking at how the national economic growth is associated with a reduction in the national MPI and its two partical indices: the incidence and the intensity of multidimensional poverty. As a part of this exercise, we further examine how each state's economic growth (gauged by the per capita net national product) is related to multidimensional poverty reduction within

4 Jayaraj and Subramanian (2009) provided an illustration of their counting-based measures of social exclusion using the first round (1992-93) and third round (2005-06) of the DHS.

5 See Alkire et al. (2020b).

6 Our approach to assessing growth elasticity of poverty is the point elasticity approach (Ravallion and Huppi 1990; Datt and Ravallion 1992; Kakwani 1993), which is different from the usual regression-based estimation of growth elasticity of poverty (see, e.g., Ravallion and Chen 1997; Adams 2004; Santos et al. 2017). The objective of the regression-based studies is to estimate cross-country growth elasticities, but we are interested in estimating the responsiveness of the "ends variables" nationally as well as for each subnational region and thus he point elasticity approach appears to be more suitable for our purpose.

that state. In order to explore horizontal inclusiveness of economic growth, we explore how the national growth is linked to a reduction in each state's multidimensional poverty by breaking down the link into two components: the responsiveness of per capita state income to the per capita national income and then the responsiveness of each state's MPI to its own per capita income. This breakdown helps identify whether a state's horizontal inclusiveness is due to the state's share in the national growth or due to the state's poverty reduction in response to its own economic growth. Finally, we analyse dimensional inclusiveness by focusing on the responsiveness of economic growth to different components of the MPI. The key components here are the uncensored headcount ratio, which is the deprivation rate in a dimension, and the censored headcount ratio, which is the proportion of the population that is multidimensionally poor as well as deprived in that dimension. Examining dimensional inclusiveness allows us to understand which indicators have responded to growth overall and whether these indicators have translated to reduction in deprivations among the poor.

Our findings on vertical inclusiveness show that for the period in question, the national growth semi-elasticity of MPI in India is 0.0027, indicating that every one percent increase in per capita income nationally is related to an annual absolute MPI reduction of 0.0027 units. Relatively speaking, the national growth elasticity of MPI is 1.34, which implies every one percent increase in per capita income nationally is associated with a 1.34 percent annual reduction in the national MPI. Growth responsiveness, however, vary widely across states. The state of Meghalaya, for example, reflects high growth elasticity and high growth semi-elasticity; whereas Uttarakhand reflects low growth elasticity as well as low growth semi-elasticity. The state of Kerala, on the other hand, shows very low level of semi-elasticity (due to very low level of initial poverty) but the highest level of growth elasticity. Further examining the state growth elasticities, we observe that the two poorest states, Bihar and Jharkhand, have reduced multidimensional poverty by reducing their intensities of poverty relatively faster than their incidences of poverty.

Examining horizontal inclusiveness, assessed by the change in state MPIs due to a one percent change in national income, we observe a wide variation across states. For every one percent change in per capita national income, in the poorest north-Indian state of Bihar, for example, the MPI fell only by 0.96 percent but in the least poor south-Indian state of Kerala, the MPI fell by 3.79 percent. By decomposing horizontal inclusiveness into the responsiveness of state growth to national growth and the responsiveness of state growth to the state MPI, we observe that some states, such as West Bengal and Meghalaya, have witnessed much slower economic growth than the national average, but their multidimensional poverty reductions have been much faster than the national poverty reduction. In contrast, Gujarat and Uttarakhand have grown much faster than the national average, yet their poverty reduction – in both absolute and relative terms – have been slower than the national average. Finally, looking at the responsiveness of the dimensional deprivations to the MPI, we find a mixed result. Nationally, some indicators such as school attendance, electricity, drinking water and assets improved faster than the MPI, while the rest grew slower, but wide variation was visible across states. Our findings provide a nuanced picture of inclusive growth in India from the perspective of multidimensional poverty.

The paper proceeds as follows. Section 2 briefly discusses India's performance in various monetary and non-monetary indicators. Section 3 outlines the methodology for the international MPI and a battery of elasticity and semi-elasticity formulations. Section 4 presents the data for our analysis. We present and analyse results in Section 5 and Section 6 concludes.

2. India's performance in various social indicators

Between 2000 and 2017, India's GNI per capita in current international dollars grew at a rate of 6.6% per annum, which is not as high as Bangladesh, Bhutan, Sri Lanka or China's growth rate, but is higher than the South Asian average over the same period. Table 1 reports the performance of India and its neighbouring countries in GNI per capita and other key social indicators in the spirit of Drèze and Sen (2011, 2013). Has India's growth rate been inclusive – or, as inclusive as her neighbours' – in terms of reducing income poverty and improving other social indicators?

Looking at the income poverty figures measured by the World Bank's \$1.90/day Headcount Ratio for India, we find that it has fallen from 38.2% to 21.2% since early 2000: a decrease of 8.1% per annum in relative terms. This laudatory improvement, however, has been considerably slower than some of her neighbours, such as Nepal and Pakistan, who have much lower growth in GNI per capita but reduced the \$1.90/day poverty rate annually by 13.3% to 14.0% in relative terms (Bhutan and Sri Lanka also outperformed India as did China). Drèze and Sen (2013) powerfully demonstrate that India's progress in some of the other key indicators was slower than her neighbours until around 2010. Although the more recent data show better performance than previous decades, India is still lagging in several social indicators. For example, despite sufficient progress during 2000-2017, India's performance in fertility rate, life expectancy, Under-5 mortality rate and DTP immunisation rate is behind Bangladesh Bhutan and Nepal, and significantly behind China and Sri Lanka. Table 1 also includes some key indicators on education and access to services, showing similar pattern.

Thus, India's performance in key social indicators is yet to be satisfactory if we compare her performance within South Asia. India's GNI per capita is nearly 41% larger than that of Bangladesh (and 51% higher than Nepal's); yet her recent \$1.90-a-day income poverty rate is nearly 6.4 percentage-points higher than Bangladesh and 6.2 percentage points higher than Nepal. Moreover, Bangladesh continues to outshine India in most key social indicators, as it had according to Drèze and Sen (2013). Another important observation from Table 1 is that in early 2000, China's GNI per capita was only around 40% higher and \$1.90/day headcount poverty was 6.5 percentage points lower than India's, but in all other social indicators (except access to safe drinking water in rural areas) China's performance was significantly better than that of India. Along with growth in income, China has also improved many social indicators much further.

These results suggest that GNI per capita and income poverty are not sufficient for understanding progress in India. Other dimensions of development are important and can help ascertain whether rising national income and lower income poverty translates into other social gains. While discussing the prospects and policy challenges for the 12th five-year plan 2012–2017, Ahluwalia (2011) acknowledged the need for Indian growth to be more inclusive in terms of improving child and maternal health, quality of education through access to basic services, and reducing disparity across social groups and states. In order to capture

Table 1: India's performance in income and other social indicators

Indicators	Year	India	Bangladesh	Bhutan	China	Nepal	Pakistan	Sri Lanka	South Asia
Gross national income per capita (in international \$)	2000	2070	1370	2690	2890	1110	2420	3440	2062
	2017	6120	4340	10170	14330	3140	4820	12250	5763
	Growth p. a.	*6.6%*	*7.0%*	*8.1%*	*9.9%*	*6.3%*	*4.1%*	*7.8%*	*6.2%*
\$1.90 a day headcount ratio (%)	2000-04	38.2	34.8	17.6	31.7	49.9	28.6	8.3	38.5
	2011-17	21.2	14.8	1.5	0.5	15.0	3.9	0.8	16.1
	Change p. a.	*-8.1%*	*-5.2%*	*-16.1%*	*-25.7%*	*-14.0%*	*-13.3%*	*-15.4%*	*-7.6%*
Fertility rate (births per woman)	2000	3.3	3.2	3.5	1.6	4.0	5.0	2.2	3.5
	2017	2.2	2.1	2.0	1.7	2.0	3.6	2.2	2.4
	Change p. a.	*-2.4%*	*-2.4%*	*-3.2%*	*0.4%*	*-4.0%*	*-1.9%*	*0.0%*	*-2.2%*
Life expectancy at birth (in years)	2000	63	65	61	71	62	63	71	63
	2017	69	72	71	76	70	67	77	69
	Change p. a.	*0.5%*	*0.6%*	*0.9%*	*0.4%*	*0.7%*	*0.4%*	*0.5%*	*0.5%*
Under-5 mortality rate (per 1000)	2000	92	87	78	37	81	112	17	94
	2017	39	32	31	9	33	72	8	44
	Change p. a.	*-4.9%*	*-5.7%*	*-5.3%*	*-8.0%*	*-5.1%*	*-2.6%*	*-4.3%*	*-4.4%*
DPT immunization rate (12-23 Months)	2000	58	82	92	85	74	59	99	60
	2017	89	98	98	99	90	75	99	87
	Change p. a.	*2.6%*	*1.1%*	*0.4%*	*0.9%*	*1.2%*	*1.4%*	*0.0%*	*2.2%*
Literacy rate (% of people ages 15 and above)	1998-01	61	47	..	91	49	43	91	58
	2017-18	74	74	67	97	68	59	92	72
	Change p. a.	*1.1%*	*2.7%*	..	*0.4%*	*1.9%*	*1.9%*	*0.1%*	*1.3%*
Rural population with access to at least basic sanitation facility (%)	2000	4	20	41	44	12	14	85	..
	2017	53	47	67	76	61	50	96	..
	Change p. a.	*16.4%*	*5.2%*	*2.9%*	*3.3%*	*10.0%*	*7.8%*	*0.7%*	..
Rural population with access to at least basic water source (%)	2000	74	94	78	70	78	81	76	..
	2017	91	97	97	86	89	90	88	..
	Change p. a.	*1.2%*	*0.2%*	*1.3%*	*1.2%*	*0.8%*	*0.6%*	*0.9%*	..

Source: Figures are based on World Bank Data Online accessed on July 3, 2020 at https://data.worldbank.org/indicator/ and the UNICEF website, for water and sanitation data, accessed on July 3, 2020 at https://data.unicef.org/topic/water-and-sanitation/sanitation/.

Note: The table is inspired by Drèze and Sen (2011, 2013). The \$1.90 a day poverty headcount ratio data were available for different range of time periods: India (2004-2011), Bangladesh (2000-2016), Bhutan (2003-2017), China (2002-2016), Nepal (2002-2010), Pakistan (2001-2015), and Sri Lanka (2002-2016) and South Asia (2002-2013). The range of years for literaty rates for all countries except Bhutan and Pakistan is 2001-2018; the range is 1998-2017 for Pakistan and the year for Bhutan is 2017.

these other important ends, distinct measures are required, because a number of studies have shown that neither levels nor reductions in monetary poverty necessarily coincide with levels and reductions in deprivations in other social indicators (Franko *et al.* 2002; Ruggeri Laderchi *et al.* 2003; Bourguignon et al. 2009, Bag and Seth 2018; Evans *et al.* 2020).

Analysing multiple dimensions of poverty requires the selection of an appropriate index. Various multidimensional indices of poverty or deprivation have been proposed in the past ten years or so.[7] However, given that almost all indicators of social deprivations are either binary or categorical, a counting approach is more suitable (World Bank 2017, Atkinson 2019). Jayaraj and Subramanian (2009) offer one class of indices related to counting measures of social exclusion presented by Chakravarty and D'Ambrosio (2006) and apply them to data from the first and third round of India's NFHS datasets. They examine how multidimensional deprivation across eight dimensions fell between 1992/93 and 2005/06 and observe that the already better-performing states had larger reductions in deprivation, which supported related findings of Deaton and Drèze (2002). Their study was extended by Mishra and Ray (2013), who estimate multidimensional deprivation using the NFHS and NSS datasets. Among other results, they conclude that the reduction in multidimensional deprivation has been due to a major and steady reduction in rural areas, and also provide estimates of growth elasticities for their deprivation measure.[8] This approach presents a useful picture of aggregate deprivation in a given society; however, as a multidimensional measure of poverty, it can be critiqued for its reliance on a union-based identification that defines as poor anyone who has even a single deprivation. In particular, it typically means that the percentage of persons considered to be poor - which has great salience for policy - will be unreasonably large.

Alkire and Foster (2011) propose an intermediate "dual-cutoff" approach to identifying the multidimensionally poor that leads to more reasonable headcount ratios and sets of the poor. First, a deprivation cutoff in each dimension determines who is deprived, and then a second poverty cutoff identifies the poor as those who are sufficiently multiply deprived. Multidimensional poverty is measured using an "adjusted headcount ratio" that is the product of the headcount ratio and the average "breadth" of deprivation among the poor. This counting approach admits the possibility that different deprivations have different values in measuring the average breadth of deprivation - a feature that has been used in the construction of the Multidimensional Poverty Index in the UNDP's *Human Development Report* 2010 (UNDP 2010). According to the report, 53.7% of Indian people were living in households that were multidimensionally

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7 See for example Chakravarty et al. (1998), Tsui (2002), Bourguignon and Chakravarty (2003), Chakravarty and D'Ambrosio (2006), Kakwani and Silber (2008), Asselin (2009), Jayaraj and Subramanian (2009), and Alkire and Foster (2011). See Atkinson (2003, 2019) for a discussion of counting measures.

8 For an application of the same method comparing multidimensional poverty between China and India, see Mishra and Ray (2012).

poor in 2005–06, their intensity or average breadth of deprivation was 52.7%, hence India's overall MPI value was 0.283. Several studies used that global MPI or an adaptation to evaluate Indian poverty. For example, Alkire and Seth (2015) find that using MPI instead of income poverty trends 1998-99 – 2005-06 to rank the progress of Indian states leads to rather different conclusions. Recently, Alkire et al. (2021) examined trends in the Indian MPI between 2005-06 and 2015-16 and found a significant acceleration. In what follows, we will use the revised version of the MPI used by Alkire et al. (2021) to assess the inclusiveness of growth within and across Indian states. But first we outline the multidimensional poverty methodology and key properties in the next section.

3. Methodology

The global multidimensional poverty index (MPI) is an implementation of the adjusted headcount ratio methodology proposed by Alkire and Foster (2011), using a particular choice of indicators, deprivation cutoffs and relative weights, and a poverty cutoff. It is based on ten indicators grouped into three dimensions: health, education and standard of living. Each dimension is equally weighted and indicators within each dimension are also equally weighted (see Table 2). The deprivation cutoffs are applied at the

Table 2: Dimensions, indicators, deprivation cutoffs and weights of the Indian MPI

Dimension (Weight)	**Indicator (Weight)**	**Deprivation Cutoff**
Education (1/3)	Schooling (1/6)	No household member aged 10 years or older has completed six years of schooling
	Attendance (1/6)	Any school-aged child 6-14 years is not attending school up to the age at which he/she would complete class 8
Health (1/3)	Nutrition (1/6)	Any person 0-54 years of age for whom there is nutritional information in the dataset is undernourished
	Mortality (1/6)	A child under 18 has died in the household in the five-year period preceding the survey
Standard of Living (1/3)	Electricity (1/18)	The household has no electricity
	Sanitation (1/18)	The household's sanitation facility is not improved (according to SDG guidelines) or it is improved but shared with other households
	Water (1/18)	The household's source of drinking water is not safe or safe drinking water is at least a 30-minute walk from home, roundtrip
	Housing (1/18)	The household has inadequate housing: the floor is of natural materials or the roof or wall are of natural or rudimentary materials
	Cooking fuel (1/18)	A household cooks using solid fuel, such as dung, agricultural crop, shrubs, wood, charcoal or coal
	Assets (1/18)	The household does not own more than one of these assets: radio, TV, telephone, computer, animal cart, bicycle, motorbike, or refrigerator, and does not own a car or truck

Source: Alkire et al. (2021).

household level and thus refer to all members within the household. A household is identified as MPI poor if its deprivation score is equal to or larger than one-third. Thus the MPI uses an intermediate approach to the identification of the poor as discussed above.[9]

The MPI can be decomposed in several ways (Alkire and Foster 2011; Alkire et al. 2015). First, the MPI can be expressed as a product of two partial indices – *incidence* of multidimensional poverty (H) and *intensity* of multidimensional poverty (A) as:

$$\text{MPI} = H \times A. \tag{3.1}$$

The *incidence* refers to the proportion of multidimensionally poor population; whereas, the *intensity* refers to the average of all weighted deprivation scores of those that are identified as multidimensionally poor.[10] This property has interesting policy implication in evaluating changes over time. A certain reduction in the MPI occurs if any deprivation of any poor person is reduced. Any reduction will in turn reduce either H or A. If a reduction in the MPI occurs only by reducing the number of poor (as the deprivation reduction lowers their deprivation score to be less than the poverty cutoff), then H decreases but A may not. On the other hand, if a reduction in the MPI occurs by reducing the deprivations among those who stay poor, then A decreases (because the deprivation score of those persons decreases, but does not fall below the poverty cutoff), but H may not.

Second, whenever the total population is divided into M mutually exclusive and collectively exhaustive subgroups, then the overall MPI, as well as its consistent sub- and partial indices, can be expressed as a population-weighted average of the MPI values of these M subgroups. Let us denote the population share and the MPI of the m^{th} subgroup by λ_m and MPI_m, respectively. Then the overall MPI (for example) can be expressed as:

$$\text{MPI} = \sum_{m=1}^{M} \lambda_m \text{MPI}_m. \tag{3.2}$$

Third, the MPI can be equivalently expressed as a weighted average of censored headcount ratios, where the weights correspond to those in the second column of Table 2. A *censored headcount ratio* (CH) of an

9 For further details on the MPI methodology, see Alkire et al. (2020a). The MPI is an implementation of the Adjusted Headcount Ratio within the counting approach framework proposed by Alkire and Foster (2011). Further methodological details on the counting approach and the Adjusted Headcount Ratio may be found in Chapters 4 and 5 of Alkire et al. (2015).

10 This expression is analogous to the expression HI for the poverty gap ratio, where H is the income headcount ratio and I is the income gap ratio (or average gap among the poor).

indicator denotes the proportion of population that are identified as multidimensionally poor as well as deprived in that indicator. The third decomposition is expressed as:

$$\mathrm{MPI} = \sum_{d=1}^{10} w_d \mathrm{CH}_d, \tag{3.3}$$

where w_d and CH_d are the relative weight assigned to and the censored headcount ratio of the d^{th} indicator, respectively. It will prove useful in the later discussion to here define an *uncensored headcount ratio* (UH) of an indicator as simply the proportion of population that are deprived in that indicator, irrespective of deprivaitons in other indicators.

Elasticities and semi-elasticities

The MPI and its partial indices can be used to track and analyse changes in poverty over time. Let us denote any two time periods by t_1 and t_2 such that $t_1 < t_2$. The *annualised absolute change* in any variable x between periods t_1 and t_2 is defined as:

$$\Delta x = \frac{x_{t_2} - x_{t_1}}{t_2 - t_1}. \tag{3.4}$$

Similarly, the *annualised relative change* in any variable x between periods t_1 and t_2 is defined as:

$$\delta x = 100 \times \left[\left(\frac{x_{t_2}}{x_{t_1}} \right)^{\frac{1}{t_2 - t_1}} - 1 \right]. \tag{3.5}$$

In this paper, variable x may be the per capita income for a population, the MPI, the incidence (H), the intensity (A), the censored headcount ratio (CH) or the uncensored headcount ratio (UH).

The primary objective of this paper is to measure the inclusiveness of economic growth. As noted in Foster (2014), this is usually gauged using an elasticity that indicates the responsiveness of an "ends variable" x with respect to a "means variable" y (usually the income per capita). The 'y elasticity of x', denoted by $e(x;y)$, is defined as:

$$e(x;y) = \frac{\delta x}{\delta y}. \tag{3.6}$$

The advantage of this elasticity term $e(x;y)$ is that its interpretation is straightforward: it provides *the percentage change in x associated with a one percent increase in y.*

The elasticity formulation in (3.6) measures only relative change in poverty and its partial indices, which are relevant because both the poverty measure and its partial indices are bounded and cannot improve indefinitely. However it may be equally important to understand the association between economic growth and absolute improvements using the concept of semi-elasticity (Klasen and Misselhorn, 2008). We define the 'y semi-elasticity of x', denoted by $s(x;y)$, as:

$$s(x;y) = \frac{\Delta x}{\delta y}. \tag{3.7}$$

Unlike the elasticity term, the semi-elasticity term $s(x;y)$ computes *the absolute change in* x *associated with a one percent increase in* y.

Table 3: Different formulations for elasticities and semi-elasticities

Elasticities and Semi-elasticities	**Formulation**
Elasticity	
National growth elasticity of national MPI	$e(\text{MPI};Y) = \frac{\delta\text{MPI}}{\delta Y}$
National growth elasticity of national incidence (H)	$e(H;Y) = \frac{\delta H}{\delta Y}$
National growth elasticity of national intensity (A)	$e(A;Y) = \frac{\delta A}{\delta Y}$
National growth elasticity of dth national censored headcount ratio	$e(\text{CH}_d;Y) = \frac{\delta\text{CH}_d}{\delta Y}$
National growth elasticity of dth national uncensored headcount ratio	$e(\text{UH}_d;Y) = \frac{\delta\text{UH}_d}{\delta Y}$
National MPI elasticity of dth national censored headcount ratio	$e(\text{CH}_d;\text{MPI}) = \frac{\delta\text{CH}_d}{\delta\text{MPI}}$
National dth uncensored elasticity of dth national censored headcount ratio	$e(\text{CH}_d;\text{UH}_d) = \frac{\delta\text{CH}_d}{\delta\text{UH}_d}$
National growth elasticity of subgroup (m) growth	$e(Y_m;Y) = \frac{\delta Y_m}{\delta Y}$
National growth elasticity of subgroup (m) MPI	$e(\text{MPI}_m;Y) = \frac{\delta\text{MPI}_m}{\delta Y}$
Subgroup (m) growth elasticity of subgroup (m) MPI	$e(\text{MPI}_m;Y_m) = \frac{\delta\text{MPI}_m}{\delta Y_m}$
Subgroup (m) growth elasticity of subgroup (m) incidence	$e(H_m;Y_m) = \frac{\delta H_m}{\delta Y_m}$
Subgroup (m) growth elasticity of subgroup (m) intensity	$e(A_m;Y_m) = \frac{\delta A_m}{\delta Y_m}$
Semi-elasticity	
National growth semi-elasticity of national MPI	$s(\text{MPI};Y) = \frac{\Delta\text{MPI}}{\delta Y}$
National growth semi-elasticity of subgroup (m) MPI	$s(\text{MPI}_m;Y) = \frac{\Delta\text{MPI}_m}{\delta Y}$
Subgroup (m) growth semi-elasticity of subgroup (m) MPI	$s(\text{MPI}_m;Y_m) = \frac{\Delta\text{MPI}_m}{\delta Y_m}$
National growth semi-elasticity of national incidence	$s(H;Y) = \frac{\Delta H}{\delta Y}$
National growth semi-elasticity of subgroup (m) incidence	$s(H_m;Y) = \frac{\Delta H_m}{\delta Y}$
Subgroup (m) growth semi-elasticity of subgroup (m) incidence	$s(H_m;Y_m) = \frac{\Delta H_m}{\delta Y_m}$

Table 3 summarises the formulations for elasticies and semi-elasticities employed in this paper. When the 'means' variable is the national per capita income Y, then, for any variable x, $e(x;Y)$ is referred to as *national growth elasticity* and $s(x;Y)$ is referred to as *national growth semi-elasticity*. For ease of interpretation, we define the elasticities and semi-elasticities so that a positive number indicates an improvement in the 'ends' variables. As evident from Table 3, we multiply the formulations by a negative sign whenever it is natural for the 'end' variable x and the 'means' variable to move in different directions to reflect improvements.

Vertical inclusiveness

The key growth elasticity and semi-elasticity formulations used as measures of national inclusive growth are $e(\text{MPI}; Y)$ and $s(\text{MPI}; Y)$, where both take the MPI as the 'ends' variable and indicate the absolute and relative reductions in the national MPI, respectively, associated with a one percent increase in national income.[11] Whenever they are positive, multidimensional poverty is understood to have fallen owing to an increase in per capita income. Whenever they are equal to zero, there is no change in multidimensional poverty. Finally, whenever they are negative, multidimensional poverty has risen during an increase in income. As the MPI measures poverty, the associated elasticities can be viewed as measures of vertical inclusive growth.[12]

A number of other elasticity formulations in Table 3 are also helpful in analysing inclusive growth. The national elasticities $e(H; Y)$ and $e(A; Y)$, for instance, help identify which of the two components is driving reductions in the overall MPI. Indeed, the overall elasticity $e(\text{MPI}; Y)$ can be usefully broken down into $e(\text{MPI}; H)$ and $e(H; Y)$, such that $e(\text{MPI}; Y) = e(\text{MPI}; H) \times e(H; Y)$, where the first term (the incidence elasticity of MPI) indicates how a reduction in national incidence translates into a reduction in the national MPI while the second term is the national growth elasticity of the national incidence.

Horizontal inclusiveness

One may also be interested in knowing how poverty has been reduced across all population subgroups, which can be interpreted as a concern for horizontal inclusive growth. For any population subgroup m as defined above, $e(\text{MPI}_m; Y)$ and $s(\text{MPI}_m; Y)$ in Table 3 are national growth elasticities of subgroup poverty. Owing to additive decomposability in Equation (3.2), $s(\text{MPI}; Y)$ can be expressed as a population-weighted average of the subgroup elasticities $s(\text{MPI}_m; Y)$, and hence it can be used as a benchmarking inclusive growth in the subgroups. Each of $e(\text{MPI}_m; Y)$ and $s(\text{MPI}_m; Y)$ can be conveniently broken down into two elements:

$$e(\text{MPI}_m; Y) = e(\text{MPI}_m; Y_m) \times e(Y_m; Y). \tag{3.8}$$

$$s(\text{MPI}_m; Y) = s(\text{MPI}_m; Y_m) \times e(Y_m; Y). \tag{3.9}$$

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11 In this paper, we restrict attention to cases where income growth is positive.

12 See Foster (2014) for discussions of the forms of inclusive growth.

In Equation (3.8), the first term denotes the percentage annual reduction in poverty in subgroup m associated with a one percent increase in auual per capita income within that subgroup; whereas, in Equation (3.9), the first term denotes the annual absolute reduction in poverty in subgroup m associated with a one percent increase in annual per capita income within that subgroup. The second term in both decompositions denotes the percentage increase in the income of subgroup m associated with a one percent increase in national income and thus measures the extent of the subgroup's share in the national economic growth.

Dimensional inclusiveness

Recall from Equation (3.3) that the overall MPI is a weighted average of the censored headcount ratios of the component indicators and it is also important to understand which of them are changing in line with the MPI associated with economic growth. Note that an improvement in the censored headcount ratio of an indicator may depend on the improvement of its own uncensored headcount ratio, which we refer to as an aggregate effect, as well as on the improvement in the entire joint distribution of deprivations, which we refer to as a distributional effect. The improvement in the censored headcount ratio of an indicator may depend on the interplay of the aggregate effect and the distributional effect. The overall improvement of the uncensored headcount ratio of an indicator may be or may not be shared by the poor. If the overall reduction of the uncensored headcount ratio of an indicator is not accompanied by a faster reduction in the censored headcount ratio of that indicator, then the aggregate effect is considered to be weak for that indicator.

Alkire et al. (2021) visually examined both absolute and relative improvements in censored headcount ratios between 2005-06 and 2015-16 and compared the changes with the respective uncensored headcount ratios. We strengthen this analysis by using some explicit elasticity and semi-elasticity measures and relevant decompositions to examine the reductions in deprivations in different indicators among the poor. The first obvious tool that we use for this purpose is the MPI elasticity of censored headcount ratio $e(\mathrm{CH}_d;\mathrm{MPI})$, which shows whether the d^{th} indicator of the MPI has increased faster or slower than the MPI itself in relative terms. Then, we examine the interplay of aggregate and distribution effects by looking at both absolute and relative changes in censored headcount ratios.

To analyse absolute changes, we use the growth semi-elasticity of censored headcount ratio of each indicator $s(\mathrm{CH}_d;\mathrm{Y})$ and decompose it into two components: the ratio of absolute changes in the censored headcount ratio and the uncensored headcount ratio $d(\mathrm{CH}_d;\mathrm{UH}_d) = \Delta\mathrm{CH}_d/\Delta\mathrm{UH}_d$; and the growth semi-elasticity of uncensored headcount ratio $s(\mathrm{UH}_d;\mathrm{Y})$. Similarly, the relative changes may be analysed by using the growth elasticity of censored headcount ratio of each indicator $e(\text{CH}_d; \text{Y})$ and decomposing it into the uncensored elasticity of censored headcount ratio $e(\text{CH}_d; \text{UH}_d)$ and the growth elasticity of uncensored headcount ratio $e(\text{UH}_d; \text{Y})$. The two decomposition formulations may be expressed as:

$$s(\text{CH}_d; Y) = d(\text{CH}_d; \text{UH}_d) \times s(\text{UH}_d; Y). \quad (3.10)$$

$$e(\text{CH}_d; Y) = e(\text{CH}_d; \text{UH}_d) \times e(\text{UH}_d; Y). \quad (3.11)$$

The decompositions in (3.10) and (3.11) are quite interesting in analysing the interplay between aggregate and distributional effects. For example, if the responsiveness of the uncensored headcount ratio of an indicator to growth (i.e., $s(\text{UH}_d; Y)$ or $e(\text{UH}_d; Y)$) is low but the responsiveness of the censored headcount ratio of the indicator to growth (i.e., $s(\text{CH}_d; Y)$ or $e(\text{CH}_d; Y)$) is relatively high, then there is evidence of stronger distributional effect than aggregate effect. In this case, $e(\text{CH}_d; \text{UH}_d) > 1$ and the distributional effect is supporting the aggregate effect ensuring that the reduction in the overall deprivation of the d^{th} indicator is translating into even more reduction among the poor. On the other hand, whenever $d(\text{CH}_d; \text{UH}_d)$ and $e(\text{CH}_d; \text{UH}_d)$ are positive and low, it means that the overall reduction in deprivations in indicator d is not sufficiently shared by the poor. Finally, if the responsivenesses of both uncensored and censored head count ratios of an indicator are high and proportional (i.e., $e(\text{CH}_d; \text{UH}_d)$ is close to 1), then there is evidence of strong aggregate effect and the overall reduction is approximately proportional to the reduction among the poor.

4. Data

We apply the above methodology to Indian data to analyse the inclusiveness of its growth, starting with the growth-elasticity of the adjusted headcount ratio and continuing with elasticities linking various partial indices and other variables of interest. An Indian version of the MPI is estimated using the third (NFHS3) and the fourth (NFHS4) rounds of National Family Health Survey (NFHS) datasets for years 2005/06 and 2015/16, respectively. The NFHS3 and the NFHS4 are Demographic and Health Surveys (DHS) that are nationally representative, covering all states and the union territory of Delhi. The samples were collected through a multi-stage, stratified sampling procedure. The NFHS3 and the NFHS4 datasets contain information for 109,041 and 601,137 sample households, respectively.

These two datasets are similar in many aspects, but there are certain differences that require adjusting four of the ten MPI indicators: nutrition, mortality, school attendance, and flooring material. All indicators and their deprivation cutoffs are outlined in Table 2. Differences in these four indicators cause the MPI figures that are harmonised (national and sub-national) to be lower than the global MPI figures. For a detailed explanation on how the adjustments in the indicators have been made, see Alkire et al. (2021).

To measure economic growth in India, we use information on national and state per capita domestic product available from the *2014-15* and *2018-19 Handbooks of Statistics on the India Economy* published by the Reserve Bank of India.[13] For state level data we use per capita net state domestic product (PC-NSDP) at factor cost at constant prices, and for the national level we use the accompanying figures on per capita net national product (PC-NNP).[14] Compound annual growth rates are calculated for the period 1999 to 2006 using formula (3.9). For simplicity, we will refer to both the per capita state domestic product and the per capita net national product as *per capita income*.

5. Results

This section presents the inclusiveness of growth and responsiveness of different partial indices to each other, both at the national level and across sub-national regions. Table 4 reports the MPI, its partial indices, incidence (H) and intensity (A), and their absolute and relative changes. The national MPI fell from 0.283 to 0.123 by 0.016 units or 8% per annum between 2005/06 and 2015-16. Nationally, this reduction was accompanied by a 2.7 percentage points or 6.6% per annum reduction in incidence and a 0.7 percentage point or 1.5% per annum reduction in intensity. The per annum pace of relative reduction in the national incidence is no faster than the pace of relative reduction in the national $1.90-a-day poverty rate between 2004 and 2011. During the same period, the national income, reported in the final row of the final column in Table 4, grew by 6% per annum.

When we look at the performance across 28 states[15] and the union capital territory of Delhi, MPIs appear to have fallen, certainly to different extents, in all states. None of the large states which had more than 55% of the poor in 2005-06 (Bihar, Madhya Pradesh, Rajasthan, Uttar Pradesh and West Bengal), had reduced poverty steeply by more than 10% per annum. West Bengal, the least poor among them in 2005-16, had the largest relative reduction (9.6%) in MPI. Note that the relative reductions in MPIs of these states (except West Bengal) were not larger than the national growth rate. In contrast, the four South

[13] The per capita state domestic products and the per capita net national products are preseted in the appendix in Table A1.

[14] Net domestic (national) product is gross domestic (national) product minus depreciation. The data for years 2005-06 to 2010-11 are available at 2004-05 base prices.

[15] We have combined Andhra Pradesh with Telangana because Telengana was not partitioned in 2005-06. Andhra Pradesh's 2015-16 per capita NSDP values are computed by using population weighted averages of Andhra Pradesh and Telangana.

Indian states – Andhra Pradesh, Karnataka, Kerala, and Tamil Nadu – had much faster relative reductions in their MPIs over the same period.

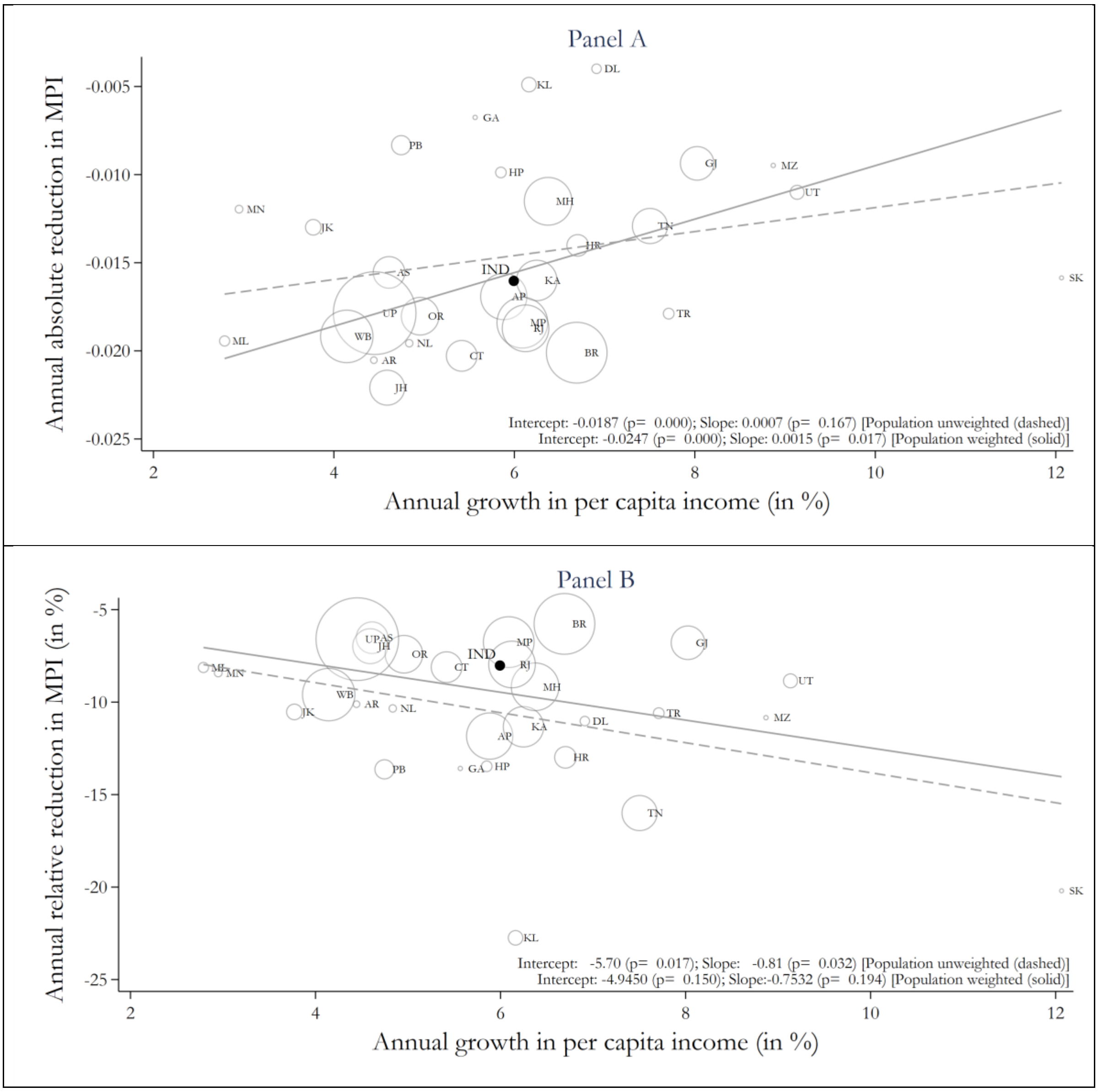
Table 4: Annualized Growth in MPI, incidence, intensity and per capita income

	2005-06			2015-16			Absolute Change			Growth Rates			
State	MPI	H (%)	A (%)	MPI	H (%)	A (%)	ΔMPI	ΔH (%pt)	ΔA (%pt)	δMPI (%)	δH (%)	δA (%)	δY (%)
AP	0.236	50.0	47.2	0.067	16.4	40.8	-0.017	-3.4	-0.6	-11.8	-10.5	-1.4	5.9
AR	0.313	60.0	52.2	0.108	24.4	44.2	-0.021	-3.6	-0.8	-10.1	-8.6	-1.6	4.4
AS	0.317	61.7	51.4	0.162	36.2	44.7	-0.016	-2.5	-0.7	-6.5	-5.2	-1.4	4.6
BR	0.449	77.4	58.0	0.248	52.5	47.2	-0.020	-2.5	-1.1	-5.8	-3.8	-2.0	6.7
CT	0.355	70.0	50.8	0.153	36.8	41.5	-0.020	-3.3	-0.9	-8.1	-6.2	-2.0	5.4
DL	0.058	12.9	45.0	0.018	4.3	42.1	-0.004	-0.9	-0.3	-11.0	-10.4	-0.7	6.9
GA	0.088	20.7	42.6	0.020	5.5	37.2	-0.007	-1.5	-0.5	-13.6	-12.4	-1.3	5.6
GJ	0.185	38.3	48.4	0.092	21.7	42.2	-0.009	-1.7	-0.6	-6.8	-5.5	-1.3	8.0
HR	0.187	39.1	47.7	0.046	10.9	42.5	-0.014	-2.8	-0.5	-13.0	-12.0	-1.2	6.7
HP	0.129	31.1	41.6	0.030	8.1	37.4	-0.010	-2.3	-0.4	-13.5	-12.5	-1.1	5.9
JK	0.193	41.8	46.3	0.064	15.2	41.7	-0.013	-2.7	-0.5	-10.5	-9.6	-1.0	3.8
JH	0.429	74.9	57.3	0.208	46.5	44.7	-0.022	-2.8	-1.3	-7.0	-4.6	-2.4	4.6
KA	0.229	48.9	46.8	0.069	17.3	39.8	-0.016	-3.2	-0.7	-11.3	-9.9	-1.6	6.2
KL	0.053	13.3	39.7	0.004	1.1	37.3	-0.005	-1.2	-0.2	-22.7	-22.3	-0.6	6.2
MP	0.366	68.7	53.2	0.182	41.1	44.3	-0.018	-2.8	-0.9	-6.8	-5.0	-1.8	6.1
MH	0.186	40.1	46.4	0.071	17.3	41.3	-0.012	-2.3	-0.5	-9.2	-8.1	-1.2	6.4
MN	0.204	44.4	46.0	0.085	21.0	40.3	-0.012	-2.3	-0.6	-8.4	-7.2	-1.3	2.9
ML	0.340	61.4	55.4	0.146	32.8	44.5	-0.019	-2.9	-1.1	-8.1	-6.1	-2.2	2.8
MZ	0.139	30.8	45.1	0.044	9.8	45.2	-0.009	-2.1	0.0	-10.8	-10.9	0.0	8.9
NL	0.295	57.0	51.7	0.099	23.7	41.7	-0.020	-3.3	-1.0	-10.3	-8.4	-2.1	4.8
OR	0.336	64.2	52.3	0.156	35.9	43.4	-0.018	-2.8	-0.9	-7.4	-5.6	-1.9	5.0
PB	0.108	24.0	45.0	0.025	6.1	41.3	-0.008	-1.8	-0.4	-13.6	-12.9	-0.9	4.7
RJ	0.332	62.2	53.4	0.145	32.0	45.3	-0.019	-3.0	-0.8	-8.0	-6.4	-1.6	6.1
SK	0.177	37.5	47.3	0.019	4.9	38.1	-0.016	-3.3	-0.9	-20.2	-18.5	-2.1	12.1
TN	0.157	37.4	41.9	0.027	7.3	37.5	-0.013	-3.0	-0.4	-16.0	-15.1	-1.1	7.5
TR	0.265	54.6	48.6	0.087	20.3	42.7	-0.018	-3.4	-0.6	-10.6	-9.4	-1.3	7.7
UP	0.361	68.8	52.5	0.183	40.8	44.7	-0.018	-2.8	-0.8	-6.6	-5.1	-1.6	4.5
UT	0.182	39.3	46.3	0.072	17.3	41.8	-0.011	-2.2	-0.5	-8.8	-7.9	-1.0	9.1
WB	0.302	58.0	52.1	0.110	26.3	41.9	-0.019	-3.2	-1.0	-9.6	-7.6	-2.1	4.1
IND	0.283	55.1	51.3	0.123	27.9	43.9	-0.016	-2.7	-0.7	-8.0	-6.6	-1.5	6.0

Source: Figures on MPI, H, and A have been obtained from Alkire et al. (2020a,b).
Notes: δY refers to per capita economic growth between 2005-06 and 2015-16 adjusting for different bases of 2004-05 and 2015-16. For states, Y is per capita state domestic product and Y is the net national product. The values of per capita incomes are reported in the Appendix Table A1. The abbreviation %pt stands for percentage point.
Abbreviations: AP: Andhra Pradesh; AR: Arunachal Pradesh; AS: Assam; BR: Bihar; CT: Chhattisgarh; DL: Delhi; GA: Goa; GJ: Gujarat; HR: Haryana; HP: Himachal Pradesh; JK: Jammu and Kashmir; JH: Jharkhand; KA: Karnataka; KL: Kerala; MP: Madhya Pradesh; MH: Maharashtra; MN: Manipur; ML: Meghalaya; MZ: Mizoram; NL: Nagaland; OR: Odisha; PB: Punjab; RJ: Rajasthan; SK: Sikkim; TN: Tamil Nadu; TR: Tripura; UP: Uttar Pradesh; UT: Uttarakhand; WB: West Bengal.

Did states with larger economic growth rates reduce MPI faster? In order to visualise the relationship between per capita income growth rates and changes in MPI, we plot the relationships between economic growth and both the absolute and relative reductions in MPIs across states in Panels A and B of Figure 1. On the horizontal axes of both panels, we present annual growth of per capita incomes. On the vertical axis of Panel A, we present the annual absolute reduction in MPIs; whereas, on the vertical axis of Panel B, we present the annual relative reduction in MPIs.

Figure 1: Income Growth and Reduction in MPI across States of India
2005-06 and 2015-16



Source: Author's own computation using the values in Table 4.
Abbreviations: AP: Andhra Pradesh; AR: Arunachal Pradesh; AS: Assam; BR: Bihar; CT: Chhattisgarh; DL: Delhi; GA: Goa; GJ: Gujarat; HR: Haryana; HP: Himachal Pradesh; JK: Jammu and Kashmir; JH: Jharkhand; KA: Karnataka; KL: Kerala; MP: Madhya Pradesh; MH: Maharashtra; MN: Manipur; ML: Meghalaya; MZ: Mizoram; NL: Nagaland; OR: Odisha; PB: Punjab; RJ: Rajasthan; SK: Sikkim; TN: Tamil Nadu; TR: Tripura; UP: Uttar Pradesh; UT: Uttarakhand; WB: West Bengal.
Notes: Circles are proportional to the number of poor in 2005-06.

The trend line in Panel A, which can be obtained by regressing the absolute changes in MPIs on the growth rates of incomes, shows that there exists a weak positive relationship. In other words, the states with faster economic growth between 2005-06 and 2015-16 did not necessarily reduce MPI faster in absolute terms.

The trendline in Panel B, however, shows a statistically significant negative relationship between the relative change in MPIs and growth in per capita incomes across states. The highest growth in income has been achieved by Sikkim and the lowest growth rate has been achieved by Meghalaya. The largest absolute reduction in MPI has been obtained by Jharkhand; whereas, the largest relative reduction in MPI has been obtained by Kerala. There are other exceptions as well. For example, Uttarakhand's income growth rate is higher than all states except Sikkim, but both its absolute and relative reductions in MPI have been lower than many other states. Madhya Pradesh and Kerala have very similar per annum growth in per capita incomes of around 6%, but Madhya Pradesh has reduced MPI by 7% per year; whereas, Kerala has reduced it by around 23% per year.[16]

5.1.1 Growth Elasticities

In the previous subsection, we graphically explored the relationship between economic growth rates and reductions in MPI across states. We now use various elasticity formulations defined in Table 3. We first explore the vertical inclusiveness of national economic growth in reducing the national MPI using the figures presented in Table 4. We find from the final row of the table that ΔMPI = -0.016, δMPI = -8.0 and δY = 6.0. Therefore, the national semi-growth elasticity of MPI is $s(\text{MPI};Y)$ = -(-0.016)/6.0 = 0.0027, which means that a one percent per annum growth in national per capita income is associated with reducing the national MPI by 0.0027 units per annum on 0-1 scale. Similarly, the national growth elasticity of MPI, $e(\text{MPI};Y)$ = -(-8.0)/6.0 = 1.34, which means that a one percent per annum increase in per capita national income is associated with reducing the MPI by 1.34 percent per annum between 2005-16 and 2015-16. From the final row of Table 4, we also observe that ΔH = -2.7 and thus the national semi-growth elasticity of incidence is $s(H;Y)$ = -2.7/6.0 = -0.045, which means that a one percent increase in national per capita income has been associated with 0.45 percentage points per annum reduction in the incidence of multidimensional poverty.

We next examine horizontal inclusiveness using various formulations of elasticities and semi-elasticities that are reported in Table 5. The second and third columns of the table report national semi-growth elasticities of state MPIs, $s(\text{MPI}_m;Y)$, and national growth semi-elasticities of state incidences, $s(H_m;Y)$. The national growth semi-elasticity of a state's MPI or incidence captures how well national growth

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16 The relationship between the percentage changes in MPIs and the growth rates of per capita income, however, become statistically insignificant when we control for the initial levels of MPI. We find statistically significantly positive relationship between the initial levels of MPIs and percentage changes in MPIs over time, which means that the larger the levels of MPI in 2005-06, the slower the magnitude of relative reductions over the ten-year period. This relationship is in slight contrast to the negative realationship observed between the initial MPI and the absolute reduction in the MPI across states by Alkire *et al.* (2020b). The relationships between the initial state-wise MPIs and incidence and their relative changes over time are available in Figure A1 in the appendix.

translates into absolute reductions in a state's multidimensional poverty. Our findings show that, in terms of absolute reductions, Jharkhand registered the highest national growth semi-elasticity of MPI. One percent of national growth in income per annum was associated with a per annum reduction in the state's MPI of 0.0037, and 0.47 percentage points reduction in its incidence per annum. For the state of Kerala, on the other hand, a one percent of national growth in income per annum was associated with a 0.0008 points per annum reduction in its MPI. However, we should be careful about the interpretation here because Kerala had a very low level of initial MPI. We therefore also report the national growth elasticities of state MPIs, $e(MPI_m;Y)$, in the fourth column of Table 5. Unlike growth semi-elasticities, growth elasticities capture relative changes in multidimensional poverty. Kerala had the highest national growth elasticity of state MPI of -3.79, which is nearly 2.8 times as large as the all India elasticity and nearly four times as large as that of the state of Bihar, which had the lowest national growth elasticity of state MPI.

To better understand the association between a reduction in a state's MPI and national growth, we decompose the national growth elasticity and growth semi-elasticity in state MPI into the two component elasticities presented in Equations (3.8) and (3.9). The final column of Table 5 presents the national growth elasticity of state growth, which assesses the percentage change in a state's per capita income attributed to a one percent change in the national per capita income. Then columns $s(\mathrm{MPI}_m;Y_m)$ and $e(\mathrm{MPI}_m;Y_m)$ report the state growth semi-elasticity of state MPI and the state growth elasticity of state MPI, respectively. These decompositions show whether the translation of national growth to a state's poverty reduction is more closely linked to the association between national and state economic growth or to the effectiveness of the state in converting economic growth into lower poverty for the state, or both.

The national growth elasticities of state MPI vary between -0.96 and -3.79; whereas, the state growth elasticities to state MPI vary between -0.84 and -3.69. While some patterns are similar there are also cases where trajectories diverge. For example, in 2005-6, Gujarat and Haryana had similar levels of MPIs of 0.185 and 0.187, respectively, and a similar incidence of MPI at 38.3% and 39.1%, respectively. Both states also had roughly similar levels of average income of INR 36,102 and INR 40,627, respectively. The national growth elasticities of state growth of Gujarat and Haryana are -1.34 and -1.12, respectively, which mean that both states grew slightly faster than the national growth, although Harayana grew a bit slower per annum between 2005-06 and 2015-16. Yet the state growth elasticity of state MPI, $e(\mathrm{MPI}_m;Y_m)$, for Gujarat, at -0.85, is less than half of that of Haryana's elasticity of -1.94. If we look at the state growth semi-elasticities of state incidence, $s(H_m;Y_m)$, one percent of Gujarat's per capita growth per annum is associated with 0.21 percentage points per annum reduction in the incidence of MPI between 2005-06 and 2015-16, which is half as fast as the 0.42 percentage points per annum reduction of MPI incidence

Table 5: Horizontal inclusiveness: Growth elasticities and semi-elasticities of state MPI and Incidence (and state rankings)

State	$s(\text{MPI}_m; Y)$	$s(H_m; Y)$	$e(MPI_m; Y)$	$s(\text{MPI}_m; Y_m)$	$s(H_m; Y_m)$	$e(\text{MPI}_m; Y_m)$	$e(Y_m; Y)$
AP	-0.0028 (13)	-0.56 (3)	-1.97 (8)	-0.0029 (15)	-0.57 (10)	-2.01 (12)	0.98 (15)
AR	-0.0034 (2)	-0.59 (1)	-1.69 (15)	-0.0046 (4)	-0.8 (2)	-2.28 (9)	0.74 (25)
AS	-0.0026 (16)	-0.43 (18)	-1.09 (28)	-0.0034 (11)	-0.55 (12)	-1.41 (22)	0.77 (22)
BR	-0.0034 (4)	-0.42 (19)	-0.96 (29)	-0.003 (14)	-0.37 (21)	-0.86 (28)	1.12 (9)
CT	-0.0034 (3)	-0.55 (5)	-1.35 (21)	-0.0037 (8)	-0.61 (9)	-1.5 (18)	0.9 (18)
DL	-0.0007 (29)	-0.14 (29)	-1.84 (10)	-0.0006 (29)	-0.12 (29)	-1.6 (16)	1.15 (7)
GA	-0.0011 (27)	-0.25 (27)	-2.27 (5)	-0.0012 (24)	-0.27 (23)	-2.44 (6)	0.93 (17)
GJ	-0.0016 (25)	-0.28 (26)	-1.13 (25)	-0.0012 (26)	-0.21 (27)	-0.85 (29)	1.34 (4)
HR	-0.0023 (17)	-0.47 (14)	-2.17 (7)	-0.0021 (18)	-0.42 (17)	-1.94 (13)	1.12 (8)
HP	-0.0016 (23)	-0.38 (21)	-2.25 (6)	-0.0017 (22)	-0.39 (19)	-2.3 (8)	0.98 (16)
JK	-0.0022 (18)	-0.44 (17)	-1.76 (13)	-0.0034 (10)	-0.7 (5)	-2.79 (5)	0.63 (27)
JH	-0.0037 (1)	-0.47 (12)	-1.16 (24)	-0.0048 (2)	-0.62 (8)	-1.52 (17)	0.77 (23)
KA	-0.0027 (14)	-0.53 (8)	-1.89 (9)	-0.0026 (16)	-0.51 (13)	-1.81 (14)	1.04 (11)
KL	-0.0008 (28)	-0.2 (28)	-3.79 (1)	-0.0008 (28)	-0.2 (28)	-3.69 (1)	1.03 (12)
MP	-0.0031 (9)	-0.46 (16)	-1.13 (26)	-0.003 (13)	-0.45 (15)	-1.11 (26)	1.02 (14)
MH	-0.0019 (21)	-0.38 (22)	-1.53 (17)	-0.0018 (19)	-0.36 (22)	-1.44 (21)	1.06 (10)
MN	-0.002 (20)	-0.39 (20)	-1.41 (19)	-0.0041 (5)	-0.79 (3)	-2.86 (4)	0.49 (28)
ML	-0.0032 (6)	-0.48 (11)	-1.36 (20)	-0.007 (1)	-1.03 (1)	-2.91 (2)	0.47 (29)
MZ	-0.0016 (24)	-0.35 (24)	-1.81 (11)	-0.0011 (27)	-0.24 (26)	-1.22 (25)	1.48 (3)
NL	-0.0033 (5)	-0.56 (4)	-1.73 (14)	-0.004 (6)	-0.69 (6)	-2.14 (10)	0.81 (20)
OR	-0.003 (10)	-0.47 (13)	-1.24 (23)	-0.0036 (9)	-0.57 (11)	-1.49 (19)	0.83 (19)
PB	-0.0014 (26)	-0.3 (25)	-2.27 (4)	-0.0018 (20)	-0.38 (20)	-2.87 (3)	0.79 (21)
RJ	-0.0031 (8)	-0.5 (9)	-1.33 (22)	-0.0031 (12)	-0.49 (14)	-1.3 (24)	1.02 (13)
SK	-0.0026 (15)	-0.54 (6)	-3.37 (2)	-0.0013 (23)	-0.27 (24)	-1.67 (15)	2.01 (1)
TN	-0.0022 (19)	-0.5 (10)	-2.67 (3)	-0.0017 (21)	-0.4 (18)	-2.13 (11)	1.25 (6)
TR	-0.003 (11)	-0.57 (2)	-1.77 (12)	-0.0023 (17)	-0.44 (16)	-1.37 (23)	1.29 (5)
UP	-0.003 (12)	-0.47 (15)	-1.1 (27)	-0.004 (7)	-0.63 (7)	-1.48 (20)	0.74 (24)
UT	-0.0018 (22)	-0.37 (23)	-1.48 (18)	-0.0012 (25)	-0.24 (25)	-0.97 (27)	1.52 (2)
WB	-0.0032 (7)	-0.53 (7)	-1.6 (16)	-0.0046 (3)	-0.77 (4)	-2.32 (7)	0.69 (26)

Source: Authors' own computations based on the PC-NSDP values and the data obtained from Alkire et al. (2020a,b). *Note:* State ranks are reported in the parentheses. *Abbreviations*: AP: Andhra Pradesh; AR: Arunachal Pradesh; AS: Assam; BR: Bihar; CT: Chhattisgarh; DL: Delhi; GA: Goa; GJ: Gujarat; HR: Haryana; HP: Himachal Pradesh; JK: Jammu and Kashmir; JH: Jharkhand; KA: Karnataka; KL: Kerala; MP: Madhya Pradesh; MH: Maharashtra; MN: Manipur; ML: Meghalaya; MZ: Mizoram; NL: Nagaland; OR: Odisha; PB: Punjab; RJ: Rajasthan; SK: Sikkim; TN: Tamil Nadu; TR: Tripura; UP: Uttar Pradesh; UT: Uttarakhand; WB: West Bengal.

associated with 1% per annum growth in per capita income for Harayana during this period.

Next, we estimate the growth elasticities of two partial indices, H and A, in Table 6 in order to understand how each of these components has contributed to the reduction in the MPIs at the state and national levels. From the figures in the final row of Table 4, we observe that, nationally, δH = -6.6 and δA = -1.5. Therefore, the national growth elasticity of national incidence is $e(H; Y)$ = -6.6/6.0 = -1.1; whereas, the national growth elasticity of national intensity is $e(A; Y)$ = -1.5/6.0 = 0.26. These elasticities indicate that nationally a one percent increase in per capita income per annum is associated with a per annum reduction of 1.1% in incidence and 0.26% in intensity.

Table 6: State growth elasticities of MPI, incidence and intensity

State	$e(\text{MPI}_m;Y_m)$	$e(H_m;Y_m)$	$e(A_m;Y_m)$	$e(\text{MPI}_m;H_m)$
AP	-2.01 (12)	-1.79 (11)	-0.25 (16)	1.12 (18)
AR	-2.28 (9)	-1.94 (9)	-0.37 (8)	1.17 (13)
AS	-1.41 (22)	-1.13 (23)	-0.3 (11)	1.26 (9)
BR	-0.86 (28)	-0.57 (29)	-0.3 (10)	1.51 (1)
CT	-1.5 (18)	-1.15 (20)	-0.37 (7)	1.3 (6)
DL	-1.6 (16)	-1.51 (16)	-0.1 (28)	1.06 (27)
GA	-2.44 (6)	-2.23 (5)	-0.24 (17)	1.09 (21)
GJ	-0.85 (29)	-0.69 (28)	-0.17 (24)	1.23 (11)
HR	-1.94 (13)	-1.78 (12)	-0.17 (22)	1.09 (23)
HP	-2.3 (8)	-2.14 (7)	-0.18 (20)	1.07 (24)
JK	-2.79 (5)	-2.54 (3)	-0.28 (13)	1.1 (20)
JH	-1.52 (17)	-1.01 (25)	-0.53 (2)	1.5 (2)
KA	-1.81 (14)	-1.58 (14)	-0.26 (15)	1.15 (15)
KL	-3.69 (1)	-3.61 (1)	-0.1 (27)	1.02 (28)
MP	-1.11 (26)	-0.82 (27)	-0.3 (12)	1.35 (3)
MH	-1.44 (21)	-1.27 (17)	-0.18 (18)	1.13 (16)
MN	-2.86 (4)	-2.44 (4)	-0.45 (4)	1.17 (14)
ML	-2.91 (2)	-2.18 (6)	-0.78 (1)	1.33 (4)
MZ	-1.22 (25)	-1.22 (18)	0 (29)	1 (29)
NL	-2.14 (10)	-1.74 (13)	-0.44 (5)	1.23 (12)
OR	-1.49 (19)	-1.14 (22)	-0.38 (6)	1.31 (5)
PB	-2.87 (3)	-2.72 (2)	-0.18 (19)	1.06 (26)
RJ	-1.3 (24)	-1.05 (24)	-0.27 (14)	1.24 (10)
SK	-1.67 (15)	-1.53 (15)	-0.18 (21)	1.09 (22)
TN	-2.13 (11)	-2.01 (8)	-0.15 (25)	1.06 (25)
TR	-1.37 (23)	-1.22 (19)	-0.17 (23)	1.13 (17)
UP	-1.48 (20)	-1.14 (21)	-0.36 (9)	1.29 (7)
UT	-0.97 (27)	-0.87 (26)	-0.11 (26)	1.12 (19)
WB	-2.32 (7)	-1.84 (10)	-0.52 (3)	1.26 (8)

Source: Authors' own computations based on data obtained from Alkire et al. (2020a,b).
Notes: State ranks are reported in the parentheses. *Abbreviations*: AP: Andhra Pradesh; AR: Arunachal Pradesh; AS: Assam; BR: Bihar; CT: Chhattisgarh; DL: Delhi; GA: Goa; GJ: Gujarat; HR: Haryana; HP: Himachal Pradesh; JK: Jammu and Kashmir; JH: Jharkhand; KA: Karnataka; KL: Kerala; MP: Madhya Pradesh; MH: Maharashtra; MN: Manipur; ML: Meghalaya; MZ: Mizoram; NL: Nagaland; OR: Odisha; PB: Punjab; RJ: Rajasthan; SK: Sikkim; TN: Tamil Nadu; TR: Tripura; UP: Uttar Pradesh; UT: Uttarakhand; WB: West Bengal.

Table 6 presents the state growth elasticities. The second column reports the state growth elasticity of state MPI, $e(\text{MPI}_m;Y_m)$; whereas the third and fourth columns of report the state growth elasticity of state incidence, $e(H_m;Y_m)$, and the state growth elasticity of state intensity, $e(A_m;Y_m)$, respectively. To understand the practicality of such decomposition, let us consider the cases of Rajasthan and Mizoram. The state growth elasticities of state MPI in Rajasthan and Mizoram are -1.3 and -1.22, respectively. However, for Rajasthan, the state growth elasticity of state incidence is -1.05 while for Mizoram it is exactly the same as the state growth elasticity of state MPI. The state growth elasticity of state intensity for Mizoram is zero, suggesting that unlike in Rajasthan, Mizoram's decline in MPI entailed almost no impact on intensity.

Dividing column $e(\text{MPI}_m; Y_m)$ by column $e(H_m; Y_m)$ in Table 6 yields the final column containing $e(\text{MPI}_m; H_m)$, which is the state incidence elasticity of state MPI or the per annum percentage change in the state MPI arising from a one percent change in the state incidence per annum. Across states, the incidence elasticity of MPI is larger than one nationally and for all states except for Mizoram. Recall that a value of $e(\text{MPI}_m; H_m) > 1$ represents a situation where there has been a relatively larger reduction in the MPI than that in the corresponding state incidence, which is obtained whenever the change in the state intensity supports the change in the state incidence. The largest state incidence elasticities of state MPI are observed for three poorest states of Madhya Pradesh, Jharkhand and Bihar. This is expected as in the poorest states, a larger share of persons might experience a lower deprivation score while remaining poor.

Finally, in this section, we examine dimensional inclusiveness associated with growth and poverty reduction. Recall that the MPI is composed of ten indicators and is the weighted average of their censored headcount ratios as per Equation (3.3). It may be interesting to probe how the rates of change in dimensional deprivations among the poor compare to the rates of change in MPI. The first two columns of data in Table 7 report the censored and uncensored headcount ratios in 2005–06.

The next set of five columns in the table analyses absolute changes in censored headcount ratios. The largest annual absolute reduction took place for the assets indicator and the smallest in the mortality indicator. Let us analyse the nutrition indicator and the housing indicator. Both censored and uncensored headcount ratios fell fastest for the nutrition indicator, with $s(\text{CH}_d; Y) < s(\text{UH}_d; Y)$. For nutrition, $d(\text{CH}_d; \text{UH}_d)$ = 1.17 > 1, which means that the absolute reduction in the deprivation rate among the poor in the nutrition indicator is greater than the reduction in the uncensored headcount ratio. Therefore, the overall improvement in the nutrition indicator was shared proportionally with the multidimensionally poor. The housing indicator narrates a slightly different story. For this indicator $s(\text{UH}_d; Y)$= 0.17, which means a one percent annual economic growth is associated with a 0.17 percentage point absolute annual reduction in the indicator's deprivation rate. The reduction is much slower compared to what we observed in nutrition where it is 0.33. However, for the housing indicator, $d(\text{CH}_d; \text{UH}_d)$ = 2.08, which means that the annual absolute reduction in the censored headcount ratio is more than twice as fast as the annual absolute reduction in the uncensored headcount ratio. In this case, the improvement in the joint distribution may have resulted in a more drastic reduction in deprivations among the poor, reflecting a stronger distributional effect: people may have become non-poor due to improvements in indicators other than housing, so although their housing condition was still deprived, their deprivation score is less than one-third.

Let us next turn to the final set of six columns analysing relative changes in censored headcount ratios. Relative reductions vary from 6.2% for housing to 12.8% for assets, with some falling at a faster rate than the overall rate of 8% for the MPI while others are decidedly slower. Looking at the national MPI elasticies of censored headcount ratios, $e(\mathrm{CH}_d;\mathrm{MPI})$, we observe that for four of the ten indicators—attendance, electricity, drinking water and assets—the MPI elasticities of censored headcount ratios are larger than 1, whereas for the rest of the indicators they are less than one.

Relative reductions in all censored headcount ratios are faster than the corresponding reductions in uncensored headcount ratios, most likely owing to the smaller initial levels of the former. We break down the growth elasticity of censored headcount ratios using the decomposition formulation in (3.11). Let us first look at the 'cooking fuel' and 'housing' indicators. For both, the growth elasticities of uncensored headcount ratios are less than 0.4, which means that a one percent annual economic growth is associated with less than 0.4 percent reduction in deprivation rates of each indicator. However, the uncensored elasticies of censored headcount ratios are nearly three for both indicators, which means that the percentage reduction in censored headcount ratios are nearly three times larger than the corresponding uncensored headcount ratios. Thus, the reductions in the censored headcount ratios in the 'housing' and 'cooking fuel' indicators have been driven by the improvements in the joint distribution and reflect strong distributional effect. Next, let us look at the schooling and sanitation indicators. Both indicators had similar growth elasticies of censored headcount ratios of around 1.15. However, they reflect very different kinds of decompositions. The uncensored elasticity of censored headcount ratio for schooling is close to one, which means there were proportional improvement amont the poor; whereas, the uncensored elasticity of censored headcount ratio for sanitation is 2.26 with growth elascitiy of the corresponding uncensored headcount ratio being merely 0.51. Therefore, the reduction in schooling deprivation among the poor is due to strong aggregate effect; whereas, the reduction in sanitation deprivation among the poor is owing mainly to distributional effect.[17]

[17] We report the MPI elasticities and uncensored elasticities of censored headcount ratios across rural/urban areas and across states in Table A2 and Table A3. The national pattern of reduction in the censored headcount ratio was not necessarily replicated in all states. In some states, reductions in censored headcount ratios are relatively faster than the national reduction.

Table 7: Elasticities, semi-elasticities and dimensional inclusiveness at the national level

Indicator	Initial CH_d (%)	Initial UH_d (%)	Absolute change and semi-elasticity: $\Delta\mathrm{CH}_d$ (p.p.)	$\Delta\mathrm{UH}_d$ (p.p.)	$s(\mathrm{CH}_d; Y)$	$d(\mathrm{CH}_d; \mathrm{UH}_d)$	$s(\mathrm{UH}_d; Y)$	Relative change and elasticity: $\delta\mathrm{CH}_d$ (%)	$\delta\mathrm{UH}_d$ (%)	$e(\mathrm{CH}_d; MPI)$	$e(\mathrm{CH}_d; Y)$	$e(\mathrm{CH}_d; \mathrm{UH}_d)$	$e(\mathrm{UH}_d; Y)$
Assets	37.6	46.9	-2.8	-3.3	-0.47	0.85	-0.55	-12.8	-11.4	1.60	-2.14	1.12	-1.90
Attendance	19.8	21.3	-1.4	-1.5	-0.24	0.96	-0.25	-12.0	-11.3	1.49	-1.99	1.06	-1.89
Electricity	29.1	33.0	-2.0	-2.1	-0.34	0.98	-0.35	-11.4	-9.5	1.42	-1.91	1.20	-1.58
Water	16.6	21.9	-1.0	-0.7	-0.17	1.42	-0.12	-9.3	-4.0	1.17	-1.56	2.36	-0.66
Nutrition	44.3	57.3	-2.3	-2.0	-0.39	1.17	-0.33	-7.1	-4.1	0.89	-1.19	1.72	-0.69
Schooling	24.0	24.9	-1.2	-1.1	-0.21	1.11	-0.19	-7.0	-5.7	0.87	-1.16	1.22	-0.95
Sanitation	50.4	70.8	-2.6	-1.9	-0.43	1.37	-0.32	-6.9	-3.1	0.86	-1.15	2.26	-0.51
Mortality	4.5	4.8	-0.2	-0.2	-0.04	1.09	-0.04	-6.8	-5.6	0.85	-1.14	1.21	-0.94
Cooking Fuel	52.9	74.6	-2.7	-1.6	-0.45	1.68	-0.27	-6.8	-2.4	0.85	-1.13	2.87	-0.39
Housing	44.9	55.7	-2.1	-1.0	-0.35	2.08	-0.17	-6.2	-2.0	0.77	-1.04	3.11	-0.33

Source: Authors' own computations based on data obtained from Alkire et al. (2020a, b).

6. Concluding Remarks

Although India's economy grew faster over the past two decades than the average South-Asian economic growth, progress in income poverty and other key social indicators has been relatively modest. This paper asks whether this lack of responsiveness extends to multidimensional poverty and, if so, which states and dimensions are most affected. Following Alkire *et al.* (2021), we note that the annual reduction in MPI from 2005-06 to 2015-16 was 8%, while the annual per capita national income growth rate over the same period was 6%. The growth elasticity of the MPI was only 1.34, with the national growth elasticity of the national incidence being 1.1. Growth in India has been modestly "multidimensionally inclusive".

To better understand the situation in India, the national growth elasticity was decomposed by state to obtain the national growth elasticity of the MPI for each state. There is great heterogeneity across states, with some, like Kerala and Sikkim reaching 3.3 or above, while others such as Assam, Bihar, Gujarat, Jharkhand, Madhya Pradesh and Uttar Pradesh lying between 0.96 and 1.16. This is partially due to variation in the ability of states to participate in economic growth: Jharkhand, for example, falls below the national growth elasticity, while Sikkim far exceeds it. The state growth elasticity of state MPI nets out this effect to see how economic growth in each state translates into reduction in the MPI. The state of Nagaland, for example, is not a strong participant in national economic growth, and yet reduced the MPI by 2.14% for each 1% of state growth, above the national level. The state growth elasticities can be further decomposed to see whether the main impact is through the headcount ratio or the breadth of deprivation. For example, Mizoram's state growth elasticity of state MPI is about -1.22 while its state growth elasticity of state incidence is also -1.22, which means that the average intensity has not changed over this time period. The state-wise analysis provides information on the extent and nature of horizontal inclusive growth in India.

A further decomposition focuses on the dimensions that make up multidimensional poverty. The MPI breaks down by dimension into a weighted sum of censored headcount ratios – which provide the percentage of the populations who are poor and deprived in a given indicator. We examined the growth elasticities of the overall censored headcount ratios to identify the dimensions in which the reduction among the poor has been most rapid. We calculated the growth elasticities of the uncensored headcount ratios, and then found the uncensored elasticities of censored headcount ratios to see how the change in overall dimensional deprivations translated into changes in deprivations among the poor for each dimension. The dimension-wise analysis offers a nuanced understanding of dimensional inclusive growth in India. Additional analysis of both state and dimension simultaneously helps to identify population and dimension pairs that are experiencing rapid reductions in deprivations and those that are not. Combined with information on levels of deprivations, this is a helpful diagnostic tool for locating populations that might benefit from policies and programs to address particular deprivations.

This analysis has made use of the decomposition properties of the adjusted headcount ratio to understand several forms of inclusive growth in India. However, its focus on the poor means that it does not emphasize variations up the distribution (among the near-poor and non-poor) and hence overlooks certain aspects of inequality. This requires alternative tools such as the general mean approach of Foster and Székely (2008) or some other measure of vertical inclusive growth that emphasizes inequality.[18] It also does not emphasize inequality within the poor population, which as noted by Alkire and Foster (2019) is a necessary cost if we want a multidimensional poverty measure that can be broken down by dimension. Seth and Alkire (2017) provide an alternative approach to accounting for inequality among the poor that might be fruitful. The kind of analysis conducted in this paper can be replicated in other countries to explore the strength and nature of the connections between economic growth and changes in multidimensional poverty nationally, across different population subgroups, and within dimensions. We hope that the paper provides a starting point for such analyses to build upon.

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18 See the discussion in Foster (2014).

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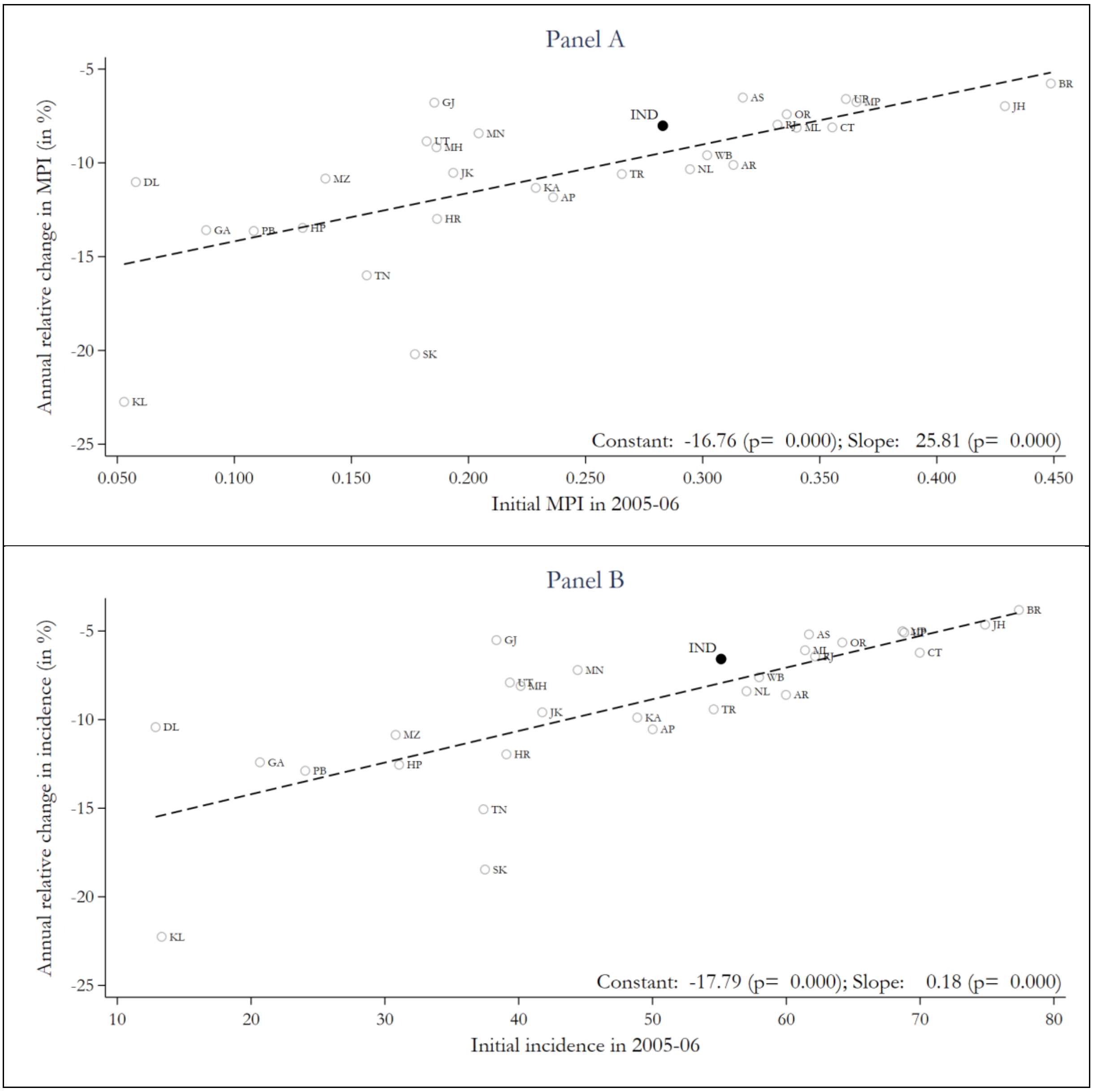
Appendices

Figure A1: Relative changes in state-wise MPIs and incidences between 2005-06 and 2015-16



Source: Authors' own computations based on the data in Alkire et al. (2020).

Note: Trend lines are population unweighted. *Abbreviations*: AP: Andhra Pradesh; AR: Arunachal Pradesh; AS: Assam; BR: Bihar; CT: Chhattisgarh; DL: Delhi; GA: Goa; GJ: Gujarat; HR: Haryana; HP: Himachal Pradesh; JK: Jammu and Kashmir; JH: Jharkhand; KA: Karnataka; KL: Kerala; MP: Madhya Pradesh; MH: Maharashtra; MN: Manipur; ML: Meghalaya; MZ: Mizoram; NL: Nagaland; OR: Odisha; PB: Punjab; RJ: Rajasthan; SK: Sikkim; TN: Tamil Nadu; TR: Tripura; UP: Uttar Pradesh; UT: Uttarakhand; WB: West Bengal.

Table A1: Per capita state domestic product and net national product at constant prices between 2005-06 and 2015-16

	Base 2004-05							Base 2011-12				
State	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2011-12	2012-13	2013-14	2014-15	2015-16
AP	27,179	29,797	33,217	33,733	35,677	37,708	38,556	78,205	78,796	82,151	88,432	97,640
AR	26,870	27,675	30,287	32,028	33,893	34,548	35,527	73,068	72,820	77,044	87,965	85,356
AS	17,050	17,579	18,089	18,922	20,406	21,146	21,741	41,142	41,609	43,002	44,809	50,642
BR	7,588	8,759	9,070	10,297	10,635	12,090	13,149	21,750	22,201	22,776	23,223	23,987
CT	18,530	21,580	22,929	23,926	24,189	25,991	27,163	55,177	56,777	61,409	61,146	63,791
DL	69,128	76,243	83,243	91,845	97,525	103,619	106,677	185,361	193,175	202,216	216,029	234,328
GA	80,844	86,257	87,085	90,409	95,320	110,306	129,397	259,444	220,019	188,358	241,081	278,601
GJ	36,102	38,568	42,498	43,685	49,168	53,813	56,634	87,481	96,683	102,589	111,370	120,683
HR	40,627	44,423	47,046	49,780	55,044	57,797	61,716	106,085	111,648	119,522	124,302	133,591
HP	35,806	38,195	40,143	41,666	43,492	46,682	49,203	87,721	92,672	98,816	105,241	112,723
JK	22,406	23,375	24,470	25,641	26,518	27,666	28,790	53,173	52,406	54,088	50,724	59,924
JH	17,406	17,427	20,996	19,867	21,534	24,330	25,265	41,254	44,176	43,779	48,781	44,524
KA	29,295	31,967	35,574	37,687	37,294	40,699	41,492	90,263	94,417	101,919	105,697	116,832
KL	35,492	38,113	41,315	43,644	47,360	50,146	52,808	97,912	103,551	107,846	112,444	119,665
MP	15,927	17,073	17,572	19,462	20,959	21,706	23,272	38,551	41,287	42,778	44,336	47,646
MH	40,671	45,582	50,138	50,183	54,246	59,587	61,276	99,564	103,904	109,398	114,750	122,588
MN	19,341	19,250	19,868	20,861	21,810	20,711	22,169	39,762	38,954	41,441	44,101	46,389
ML	24,278	25,471	25,633	28,223	29,306	31,418	34,232	60,013	59,703	58,681	55,936	56,039
MZ	25,826	26,308	28,467	31,921	34,699	40,072	37,921	57,654	60,261	67,592	85,056	91,845
NL	33,072	35,074	37,317	39,041	40,590	43,992	46,340	53,010	55,482	58,619	60,372	60,663
OR	18,194	20,194	21,640	22,963	22,846	23,968	24,542	48,370	50,714	54,109	54,211	58,165
PB	34,096	37,087	39,567	41,003	42,831	44,769	46,325	85,577	88,915	93,238	95,807	100,141
RJ	19,445	21,342	21,922	23,356	24,304	27,502	29,612	57,192	58,441	61,053	64,522	68,048
SK	29,008	30,293	31,722	35,394	60,774	66,136	73,704	158,667	160,553	168,897	180,675	195,066
TN	34,126	39,166	41,314	43,193	47,394	53,507	57,093	92,984	96,890	101,559	106,189	114,581
TR	25,688	27,558	29,022	31,711	34,544	36,718	39,608	47,079	50,366	54,429	58,033	64,173
UP	13,445	14,241	14,875	15,713	16,390	17,388	18,014	32,002	32,908	34,044	34,583	36,923
UT	27,781	30,644	35,444	38,621	44,557	48,525	52,606	100,305	106,318	112,803	118,788	126,952
WB	23,808	25,400	27,094	27,914	29,799	31,314	32,164	51,543	53,157	53,811	54,520	57,255
IND	26,015	28,067	30,332	31,754	33,901	36,202	38,048	63,462	65,538	68,572	72,805	77,659

Source: The annual per capita figures for the period between 2005-06 and 2011-12 for base year 2004-05 is obtained from Table 10 of the Handbook of Statistics on Indian Economy 2014-15. The annual per capita figures for the period between 2011-12 and 2015-16 for base year 2011-12 is obtained from Table 10 of the Handbook of Statistics on Indian Economy 2018-19.

Abbreviations: AP: Andhra Pradesh; AR: Arunachal Pradesh; AS: Assam; BR: Bihar; CT: Chhattisgarh; DL: Delhi; GA: Goa; GJ: Gujarat; HR: Haryana; HP: Himachal Pradesh; JK: Jammu and Kashmir; JH: Jharkhand; KA: Karnataka; KL: Kerala; MP: Madhya Pradesh; MH: Maharashtra; MN: Manipur; ML: Meghalaya; MZ: Mizoram; NL: Nagaland; OR: Odisha; PB: Punjab; RJ: Rajasthan; SK: Sikkim; TN: Tamil Nadu; TR: Tripura; UP: Uttar Pradesh; UT: Uttarakhand; WB: West Bengal; IND: India.

Table A2: MPI elasticity of the censored headcount ratios across states

State	Nu	Mo	Sc	At	Co	Sa	Wa	El	Ho	As
AP	1.00	0.63	0.79	1.63	1.00	0.92	0.67	1.85	1.03	1.31
AR	1.02	1.37	0.77	1.50	0.85	0.91	0.84	0.97	0.83	1.16
AS	0.83	0.98	0.79	1.43	0.78	0.89	1.31	1.73	0.78	1.60
BR	0.74	1.03	0.79	2.09	0.67	0.68	2.24	1.32	0.59	1.79
CT	0.82	0.90	1.08	1.67	0.78	0.83	1.18	2.33	0.78	1.54
DL	0.85	0.36	0.88	1.48	1.77	1.07	1.07	1.53	0.75	1.17
GA	0.88	0.29	0.66	1.48	1.04	0.92	1.93	7.36	0.99	1.51
GJ	0.87	1.00	1.08	1.13	0.81	0.91	1.15	1.53	0.89	1.57
HR	0.93	0.57	0.77	1.20	1.01	1.16	0.97	1.56	0.95	1.51
HP	0.97	0.39	0.83	1.57	0.95	1.05	1.23	1.21	0.94	1.28
JK	0.91	0.81	0.72	1.63	0.93	1.00	1.04	0.90	0.93	1.11
JH	0.68	1.20	0.92	2.00	0.68	0.69	1.27	1.83	0.65	1.56
KA	0.98	0.76	0.74	1.44	0.91	0.92	1.17	1.63	0.83	1.41
KL	1.01	1.07	0.81	0.92	1.02	0.96	1.20	1.07	0.88	1.12
MP	0.81	0.92	1.01	1.61	0.76	0.79	1.11	1.81	0.74	1.69
MH	0.96	0.79	0.86	1.29	0.93	0.97	0.60	1.40	0.98	1.32
MN	0.80	0.75	0.72	2.39	0.87	1.06	0.68	1.08	0.85	1.32
ML	0.70	0.61	0.74	2.17	0.73	0.99	0.95	1.63	0.78	1.13
MZ	1.21	0.96	0.40	1.32	0.90	0.70	1.19	0.63	1.15	1.20
NL	0.84	1.05	0.65	1.86	0.79	1.28	1.26	1.74	0.78	0.93
OR	0.82	1.08	0.93	1.59	0.77	0.81	1.17	1.94	0.73	1.55
PB	0.92	0.62	0.81	1.26	1.01	1.15	0.68	1.48	0.97	1.69
RJ	0.84	1.07	0.87	1.44	0.84	0.92	0.91	1.72	0.86	1.35
SK	0.80	0.63	0.87	1.59	0.95	1.19	1.51	1.62	0.97	1.07
TN	0.98	0.40	0.90	1.15	1.01	0.96	1.10	1.52	0.86	1.48
TR	1.00	1.02	0.84	1.60	0.93	0.69	1.07	1.47	0.91	1.14
UP	0.89	0.85	0.78	1.42	0.83	0.83	1.87	1.36	0.70	2.09
UT	0.93	0.46	0.65	1.11	0.95	1.07	1.38	2.29	1.02	1.43
WB	0.88	1.02	0.90	1.63	0.80	0.77	0.91	2.18	0.74	1.44
IND	**0.89**	**0.85**	**0.87**	**1.49**	**0.85**	**0.86**	**1.17**	**1.42**	**0.77**	**1.60**

Source: Authors' own computations based on the data in Alkire et al. (2020a,b).

Notes: National elasticities are computed using the the formulations $e(\mathrm{CH}_d;\mathrm{MPI})$ and the state elasticities are computed using the formulations $e\left(\mathrm{CH}_{d,m};\mathrm{MPI}_m\right)$.

State abbreviations: AP: Andhra Pradesh; AR: Arunachal Pradesh; AS: Assam; BR: Bihar; CT: Chhattisgarh; DL: Delhi; GA: Goa; GJ: Gujarat; HR: Haryana; HP: Himachal Pradesh; JK: Jammu and Kashmir; JH: Jharkhand; KA: Karnataka; KL: Kerala; MP: Madhya Pradesh; MH: Maharashtra; MN: Manipur; ML: Meghalaya; MZ: Mizoram; NL: Nagaland; OR: Odisha; PB: Punjab; RJ: Rajasthan; SK: Sikkim; TN: Tamil Nadu; TR: Tripura; UP: Uttar Pradesh; UT: Uttarakhand; WB: West Bengal; IND: India.

Indicator abbreviations: Nu: Nutrition; Mo: Mortality; Sc: Schooling; At: Attendance; Co: Cooking Fuel; Sa: Sanitation; Wa: Water; El: Electricity; Ho: Housing; As: Assets.

Table A3: Uncensored elasticity of the censored headcount ratios across states

State	**Nu**	**Mo**	**Sc**	**At**	**Co**	**Sa**	**Wa**	**El**	**Ho**	**As**
AP	1.93	1.47	1.72	1.13	1.91	3.01	-1.81	1.07	1.75	1.16
AR	1.51	1.21	1.30	1.10	3.87	2.16	3.56	1.42	19.51	1.29
AS	1.70	1.17	1.14	1.05	15.66	2.04	1.70	1.11	7.38	1.11
BR	1.54	1.07	1.07	1.01	4.42	3.15	1.21	1.36	5.42	1.17
CT	1.70	1.17	1.07	1.07	5.60	2.64	1.51	1.06	3.11	1.13
DL	5.82	2.17	1.98	1.27	1.40	3.87	-3.52	1.77	-1.12	1.23
GA	2.88	1.57	2.00	1.05	1.62	2.22	1.70	4.20	2.59	1.17
GJ	1.97	1.21	1.33	1.17	5.09	1.57	2.97	1.13	2.05	1.06
HR	2.93	1.60	1.38	1.09	3.72	1.43	3.03	1.08	2.49	1.11
HP	2.51	0.00	1.64	1.28	14.26	1.80	2.01	1.37	2.71	1.21
JK	2.02	1.51	1.39	1.07	2.68	2.16	1.85	1.23	1.87	1.43
JH	1.59	1.07	1.06	1.01	5.06	4.24	1.63	1.17	3.31	1.19
KA	2.10	1.09	1.35	1.11	2.59	2.40	2.13	1.17	4.28	1.15
KL	3.36	2.07	2.90	1.10	4.54	1.55	1.72	1.15	6.75	1.26
MP	1.60	1.17	1.09	1.03	3.56	2.52	1.53	1.17	3.57	1.15
MH	1.88	1.32	1.35	1.16	3.28	2.50	27.22	1.50	2.27	1.21
MN	1.28	1.33	1.09	1.03	7.27	2.65	-5.27	1.91	9.52	1.31
ML	2.27	1.51	1.17	1.02	-99.24	1.79	3.72	1.10	4.35	1.20
MZ	2.55	2.51	2.28	1.16	8.88	2.02	1.94	1.19	1.14	1.06
NL	1.54	1.22	1.21	1.06	6.64	1.72	1.93	1.12	9.13	1.54
OR	1.45	1.14	1.13	1.05	5.62	3.60	1.88	1.14	3.02	1.13
PB	2.87	1.56	1.61	1.08	2.78	1.68	8.94	1.07	2.58	1.14
RJ	2.05	1.17	1.21	1.05	4.71	1.85	2.51	1.08	1.99	1.17
SK	2.45	2.19	1.66	1.32	6.58	2.01	1.46	1.47	3.46	1.36
TN	2.81	4.17	1.59	1.31	1.83	3.21	3.08	1.17	3.73	1.07
TR	1.75	1.20	1.16	1.09	4.21	3.43	1.49	1.13	5.66	1.21
UP	1.49	1.20	1.15	1.06	2.70	2.62	1.91	1.30	8.22	1.12
UT	2.20	3.34	1.67	1.22	3.96	2.00	1.68	1.05	2.74	1.24
WB	1.74	1.22	1.21	1.08	6.23	2.50	3.27	1.09	5.32	1.14
IND	**1.72**	**1.21**	**1.22**	**1.06**	**2.87**	**2.26**	**2.36**	**1.20**	**3.11**	**1.12**

Source: Authors' own computations based on the data in Alkire et al. (2020).

Notes: National elasticities are computed using the the formulations $e(\mathrm{CH}_d; \mathrm{UH}_d)$ and the state elasticities are computed using the formulations $e\big(\mathrm{CH}_{d,m}; \mathrm{UH}_{d,m}\big)$.

State abbreviations: AP: Andhra Pradesh; AR: Arunachal Pradesh; AS: Assam; BR: Bihar; CT: Chhattisgarh; DL: Delhi; GA: Goa; GJ: Gujarat; HR: Haryana; HP: Himachal Pradesh; JK: Jammu and Kashmir; JH: Jharkhand; KA: Karnataka; KL: Kerala; MP: Madhya Pradesh; MH: Maharashtra; MN: Manipur; ML: Meghalaya; MZ: Mizoram; NL: Nagaland; OR: Odisha; PB: Punjab; RJ: Rajasthan; SK: Sikkim; TN: Tamil Nadu; TR: Tripura; UP: Uttar Pradesh; UT: Uttarakhand; WB: West Bengal; IND: India.

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