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Abstract

This paper examines the interaction between demographic change, employment absorption, and productivity growth across Indian states using a transparent accounting decomposition. Methodologically, we extend standard demographic dividend accounting by explicitly incorporating labor-market absorption, decomposing per capita Net State Domestic Product (NSDP) growth into output per employed worker, the employment-to-working-age population ratio, and the working-age share of the population. This employment-adjusted framework separates the mechanical contribution of age structure—the arithmetic demographic dividend—from labor-market dynamics and productivity performance.

Using state-level data spanning 1994–2023, we document substantial heterogeneity in demographic transitions and growth experiences across Indian states. Declining dependency ratios provided a positive mechanical contribution to per capita growth in almost all states. However, this potential dividend was frequently muted—and in several cases fully offset—by falling employment-to-working-age ratios, particularly during the high-growth period from 2004 to 2017. At the same time, several better-performing states, sustained high growth in output per working-age adult over long periods.

A three-period decomposition (1994–2004, 2004–2017, and 2017–2023) reveals a marked shift in the composition of growth. While earlier phases were characterized by strong productivity growth alongside weak employment absorption, the post-2017 period exhibits a partial recovery in employment ratios accompanied by a broad-based slowdown in productivity per employed worker. We use the historical bounds implied by these decompositions to construct counterfactual growth trajectories, highlighting the limits of demographic advantage in the absence of employment-intensive productivity growth.

JEL Codes: J11, O11, O47, J21, O53

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Introduction

Population dynamics matter for aggregate prosperity not only through the familiar channels debated by growth optimists and pessimists—scale economies, human-capital accumulation, and changes in the capital–labour ratio—but also, crucially, through shifts in age structure. In the early stages of what is termed 'the demographic transition' rising fertility or a large cohort of children increases the dependent population and reduces the share of working-age adults; this rising youth dependency can depress per-capita income growth because fewer workers and savers support each dependent. As the transition advances, however, falling youth dependency and a larger share of working-age adults create a window of faster per-capita growth: the demographic dividend. Later still, as the population ages and the elderly share rises, the favourable effect of a large working-age cohort dissipates.

One particularly illuminating way to assess the contribution of this changing structure is to calculate what has been called the *The arithmetic age-structure dividend* (Eastwood & Lipton, 2011). This can be laid out as follows.

Let Y denote aggregate output, N total population, and W the working-age population. Per-capita output is $y \equiv Y/N$ and output per worker is $y_w \equiv Y/WA$. The growth rate of output per person decomposes exactly as

$$g\left(\frac{Y}{N}\right) \;=\; g\left(\frac{Y}{W}\right) \;+\; g\left(\frac{W}{N}\right), \tag{1}$$

where $g(\cdot)$ denotes the growth rate. The first term on the right captures changes in productivity per worker (technology, capital deepening, labour quality); the second captures changes in the share of the population that is of working age.

If a demographic shift does not affect $g(Y/W)$—that is, if it leaves productivity per worker unchanged—then any change in the working-age share translates one-for-one into the growth rate of output per person. Concretely, a demographic transition that raises the working-age share W/N by 1 percentage point (for example, growing at 1% per year instead of 0%) raises the growth rate of output per person by 1 percentage point. We refer to this simple, one-for-one effect as the *arithmetic age-structure dividend*. Because $W/N = 1-D$ where D is the dependency ratio, a falling dependency ratio implies a rising working-age share and, arithmetically, a faster rate of growth of output per person.

This arithmetic identity is useful because it isolates an unambiguous accounting channel through which demographic change affects per-capita growth. But it is incomplete as a behavioural statement: the arithmetic dividend is a necessary but not sufficient condition for a demographic gift to translate into higher living standards.

Crucially, the working-age share is only part of the story: what matters for per-person output is how many of those working-age people are actually employed. And in terms of labor market policy, this is the critical variable. Define E as the employed population. We

can therefore split the demographic term further by writing

$$\frac{Y}{N} = \frac{Y}{E} \times \frac{E}{W} \times \frac{W}{N}, \tag{2}$$

so that, in growth rates,

$$g\left(\frac{Y}{N}\right) = g\left(\frac{Y}{E}\right) + g\left(\frac{E}{W}\right) + g\left(\frac{W}{N}\right). \tag{3}$$

The terms in (3) have transparent meanings. $g(Y/E)$ is growth in output per employed person (productivity of those working); $g(E/W)$ is the growth rate of the *employment-to-working-age ratio* (the extent to which the working-age cohort is absorbed into productive employment); and $g(W/N)$ is the change in the working-age share of the population. The textbook "arithmetic age-structure dividend"—the one-for-one effect of a rising working-age share on per-capita growth—obtains only if the employment-to-working-age ratio does not change (if it increases, the arithmetic age structure dividend actually is amplified). More generally the relevant demographic contribution is the growth of the *employed share of population*, E/N, which decomposes as,

$$g\left(\frac{E}{N}\right) = g\left(\frac{E}{W}\right) + g\left(\frac{W}{N}\right).$$

A larger working-age cohort becomes an economic gift only to the extent that those additional working-age people enter productive employment. If W/N rises by 1 percentage point but E/W falls (for example, because new cohorts fail to find work or withdraw from the labour force), the net effect on E/N — and hence on Y/N when Y/E is unchanged — can be small or even negative. Conversely, if E/W rises alongside W/N, the employment-adjusted age-structure dividend can exceed the simple arithmetic dividend.

Such accounting decompositions are ubiquitous in growth and development economics. Such decompositions are powerful diagnostics — they make transparent how much of observed growth is due to demographic structure ($g(\frac{W}{N})$), labour-market margins ($g(\frac{E}{W})$), or productivity ($g(\frac{Y}{E})$) — but they do not by themselves establish causal mechanisms. Fernández-Villaverde, Ventura, and Yao (2025) emphasise this distinction when they interpret cross-country differences in productivity in light of demographic change.

India offers a particularly revealing setting in which to undertake this decomposition. Indian states are large—many comparable in population to medium-sized countries—but are nevertheless at sharply different stages of the demographic transition. While some states have already completed their fertility transition and are entering demographic maturity, others continue to experience rapid growth of the working-age population. These differences coexist within a single national economy, sharing broadly common institutions, macroeconomic policies, and national shocks. Moreover, India's future economic trajectory has been tied to the so-called "demographic dividend," the expectation that a rising share of working-age adults would provide a structural tailwind to growth.

This combination of scale and heterogeneity creates a unique opportunity to exam-

ine how demographic change, employment absorption, and productivity growth interact across otherwise comparable units. Unlike cross-country analyses, which conflate demographic variation with institutional and policy differences, a state-level perspective within India allows us to isolate how age structure and labor-market outcomes shape growth when higher-level political and economic conditions are broadly shared. At the same time, the large size of Indian states ensures that the patterns we document are economically meaningful and instructive.

The remainder of this paper implements this program for India's states : we measure each component empirically, attribute recent growth accordingly, and simulate prospective contributions under alternative employment and productivity scenarios and come up with three main findings.

First,whatever age structure dividend Indian states have received in the last 3 decades has been muted because of falling employment-to-working age ratios;in some cases sharply reversing the gain from reducing dependency ratios over the entire period from 1994-2023.

Secondly, as almost a corollary, we find that in several states, especially the better performing ones, GDP growth *per working adult* has been consistently high over a long period since liberalization-even exceeding levels seen in East Asia during its long boom between the 1960s and 1990s. This was particularly so in period 2004-2017.

Third, we undertake a three part periodization of these combined effects to examine changes in gdp per capita over time. We define these periods by simple turning points in the data. From 1994-2004, employment to working age population ratio remained constant, before falling till 2017, and rising thereafter. We therefore look at the periods 1994-2004, 2004-2017 and 2017-2023 separately. We find that between in the first two period the negative employment effects more than offset the arithmetic demographic dividend. Following 2017, there has been a partial recovery in employment ratios and continuing demographic advantages. However, per capita GDP growth did not increase, suggesting a collapse of productivity per worker .

Our paper can also be seen as identifying actual quantitative historical bounds on the demographic dividend, and employment patterns in India as it has played out so far. This allows us to undertake some speculative counterfactuals. Specifically, we use these numbers to undertake some retrospective growth trajectories for each state. We put these in an appendix

The aim of these counterfactuals is not only to clarify our understanding of the past but also to inform expectations for India's future growth, given the impending rise and then potential slowdown in the growth of its working-age population. Our aim here is to obtain quantitative bounds on how much demographics may matter going forward. [1].

The rest of the paper is set out as follows. We begin with a brief literature review on both international evidence and within-India state level research on the impact of demographics on growth. In the following section we undertake a descriptive analysis, ex-

[1]In the Indian context, this is particularly salient because states such as Kerala and Tamil Nadu are already experiencing working-age population stagnation or decline, while more populous states like Bihar and Uttar Pradesh remain in an earlier phase of the demographic transition

plaining our accounting identity and how we operationalize it. We then further examine a key finding: a substantial slowdown in productivity. The following section then looks at counterfactuals. The final section concludes.

Demographic Dividends: Previous Studies

A large international literature links economic growth and demographic change, with early theoretical foundations provided by Auerbach and Kotlikoff (1990), Cutler, Poterba, Sheiner, and Summers (1990), and Weil (1997). Recent contributions that align closely with our concern include Kotschy and Bloom (2023) who highlight the link between population aging and economic growth. Similarly, Jones (2022) uses endogenous growth models to study stagnation risks from shrinking populations. Lee (2014) is an overview of the impacts of aging on growth.[2]

The *demographic dividend* refers to the temporary boost in per capita income growth that can occur when a country (or region) experiences a rising share of working-age individuals and a falling share of dependents (youth and elderly)(Bloom, Canning, & Sevilla, 2003). This shift in the dependency ratio can raise aggregate output per capita through purely mechanical means: more potential workers per person increases the economy's capacity to produce goods and services, even if output per worker remains constant.

Evidence from cross-country studies suggests that the demographic transition typically raises GDP per capita growth by a modest but significant margin. On average, increases in the working-age share have contributed around 0.3–0.6 percentage points per year to growth, with much larger effects in peak cases. In East Asia between 1965 and 1990, for example, demographic dynamics accounted for 1.4–1.9 percentage points of annual growth, or roughly one-third of the "economic miracle" (Bloom & Williamson, 1998). More recent estimates place the "arithmetic" dividend from declining dependency ratios at about 0.32 percentage points per year in Sub-Saharan Africa (1985–2025), compared with 0.52 in East Asia over 1965–2005 (Eastwood & Lipton, 2011). Model-based counterfactuals similarly suggest that fertility decline can raise income per capita by 5–12 percent over 20–50 years, consistent with growth contributions of a few tenths of a percentage point annually during the dividend window (Ashraf, Weil, & Wilde, 2013).

Conversely, countries failing to integrate their growing working-age populations into productive employment risk missing the dividend, or worse, facing social strains(Mason & Lee, 2007). In the Indian context, projections suggest that the working-age share will remain high until at least the late 2030s, but the magnitude of the dividend will depend on labour market policies, education, and skill formation (Aiyar & Mody, 2011).

[2]There are of course, many international studies that provide analytical parallels- a far from exhaustive list might include the following: Chen, Imrohoroglu, and Imrohoroglu (2007) explain Japan's savings rate in terms of aging, productivity, and fiscal policy; Maestas, Mullen, and Powell (2023) quantify GDP growth losses from U.S. aging at 0.3 percentage points per year between 1980 and 2010. Firm dynamics are also implicated: Hopenhayn, Neira, and Singhania (2022) connect aging to rising concentration and declining entrepreneurship, and Karahan, Pugsley, and Şahin (2019) link it to the long-term fall in U.S. start-up rates.

Importantly, though the demographic dividend is not automatic. It represents a potential growth bonus contingent on the economy's capacity to productively employ the additional workers. Without complementary investments in human capital, job creation, and governance, the dividend may be squandered(Bloom et al., 2003). Moreover, once the demographic transition advances and the share of elderly dependents rises, the dividend period gives way to demographic headwinds, as seen in ageing societies like Japan.

The converse of the demographic dividend–what can be termed a *demographic nightmare*, occurs when a rapidly growing working-age population outpaces the economy's capacity to generate productive employment. In such cases, the rising share of young adults may exacerbate unemployment, underemployment, and social unrest, especially when combined with poor educational outcomes and weak institutional capacity (Cincotta, Engelman, & Anastasion, 2003; Williamson, 2001).

The Demographic Transition in India

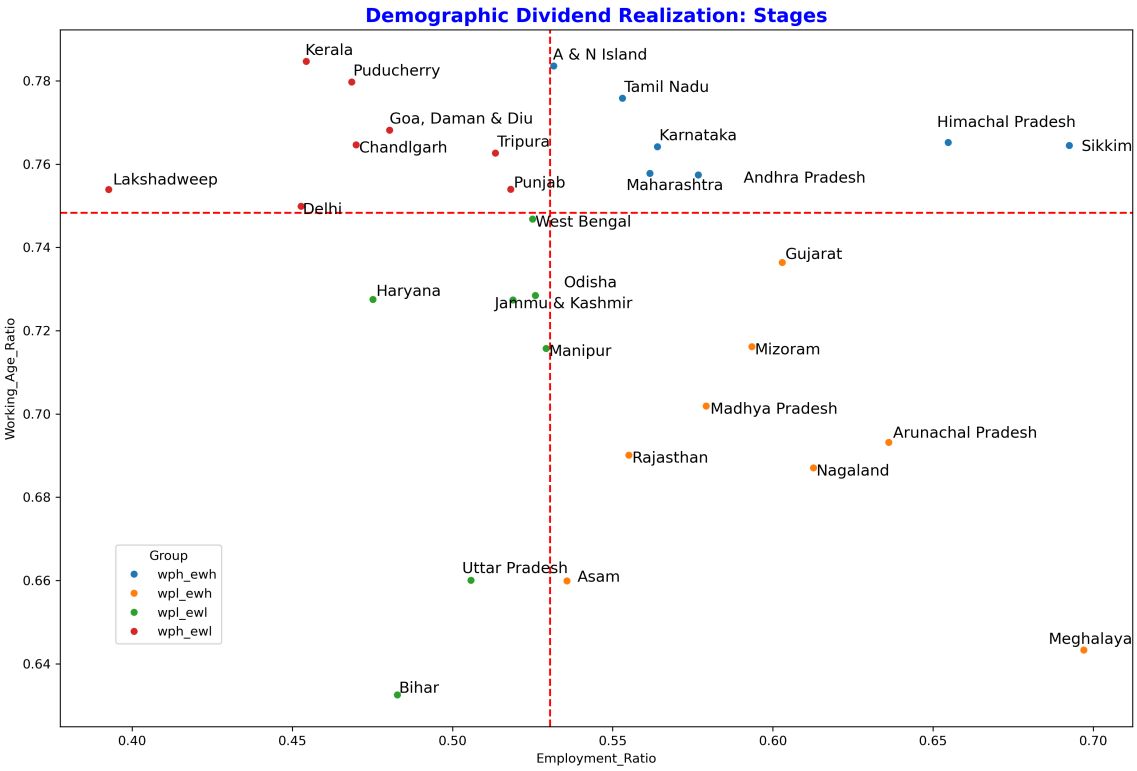
As researchers have noted, the demographic transition is unfolding unevenly across states due to wide variation in fertility rates, mortality decline, and migration patterns. States such as Kerala, Tamil Nadu, and Himachal Pradesh have already completed much of their working age transition, with fertility rates below replacement levels and a stabilising or declining share of working-age adults in the population. These states are now entering what has been described as the "second demographic dividend" phase, where the policy challenge is to sustain growth amid population ageing through higher productivity and greater capital accumulation (Bloom et al., 2003). In contrast, higher-fertility states such as Bihar, Uttar Pradesh, Madhya Pradesh, and Rajasthan are still in the early stages of reaping the first demographic dividend. Their working-age share is projected to rise for at least another two decades , offering a window of opportunity to accelerate growth by expanding productive employment and improving human capital.

In order to understand the state-level demographic transition, we derive average working-age-to-population ratio and employment rate in the working age for select states. Further, the states are classified into four groups. In group 1, states having higher than median working age-to-population ratio and higher than median employment rate are included. In group 2, states having higher than median working age to population ratio but lower than median employment rate are included. In group 3, states having lower than median working age but higher than median employment rate are included. Finally, in group 4, states having lower than median working age and lower than median employment rate included (Fig 1).

This classification is illuminating as it reveals that states like Kerala, Andhra Pradesh, Tamil Nadu, Himachal Pradesh, Maharashtra, Karnataka fall in group 1. It suggests that these states have reached the saturation point of demographic transition. Economic growth in future is likely to be driven by productivity improvements alone.

Conversely, states like Uttar Pradesh, Bihar, Haryana and to some extent West Bengal are still in the initial stage of demographic transition. In theory, their growth momemntum

Figure 1: Demographic Stages



can be generated both by increasing share of working age population and productivity growth.

Empirical work using state-level data suggests that this heterogeneity matters for aggregate growth prospects. Aiyar and Mody (2011) show that between 1981 and 2001, Indian states with larger increases in the working-age share experienced faster growth in per capita income, controlling for other factors. However, the extent to which this relationship holds going forward depends on the labour market's ability to absorb new entrants. In lagging states, where educational attainment, female labor force participation, and formal sector employment remain low, the dividend could remain latent.

Several empirical studies have examined the growth effects of changes in the working-age population share at the state level in India. Using decadal panel data for 15 major states over 1971–2001, James (2008) found a strong positive association between the working-age share and economic growth, even in the presence of gaps in education, health, and employment generation. Similarly, Aiyar and Mody (2011), analysing data for 22 states from 1961–2001, estimated that 40–50% of per capita income growth since the 1970s was attributable to the demographic dividend, after correcting for inter-state migration and endogeneity. More recently, Joe, Kumar, and Rajpal (2018) used panel data for 15 states (1980–2010) and found a significant impact of changes in the working-age share on per capita income growth.

Other studies have reached less optimistic conclusions. Thakur (2012) reported a negative impact of growth in the working-age ratio on economic growth for 17 major states between 1981 and 2011, attributing this to the absence of adequate policies and institutions in states experiencing large demographic shifts. Kumar (2014) found a favorable demographic effect for 1971–2001 but expressed scepticism about future prospects, noting that much of the increase in working-age share is concentrated in economically weaker states with poor infrastructure and weak labour absorption capacity.

Recent contributions emphasise the risks of a squandered dividend. Bisht and Pattanaik (2023) highlight the challenges posed by a younger population amid rising education levels in the post-liberalisation period, while Parida and Madheswaran (2023) argue that without smoother school-to-work transitions, India risks losing its demographic advantage.Jain, Goli, and Jana (2025) suggest that there was a substantial dividend between 1981 and 2021, but that is in question going forward.

Taken together, these studies suggest that the relationship between demographic change and economic growth in India is contingent on the economic and institutional context at the state level. While earlier periods and certain states appear to have benefited substantially from rising working-age shares, more recent evidence points to heterogeneous and sometimes negligible effects, especially in regions with weak human capital, inadequate infrastructure, and limited capacity to absorb labour into productive employment. The divergence in findings underscores that the demographic dividend is not an automatic growth driver, but rather a potential that must be actively harnessed through complementary policies in education, health, and job creation. Without such measures, states with the

largest demographic potential risk experiencing a demographic nightmare rather than a dividend.

For lagging Indian states, this risk is non-trivial: high fertility persists alongside slow structural transformation, low female labour force participation, and stagnant formal job creation. Without significant policy interventions to improve human capital and labour absorption, the demographic transition in these states could deepen income inequality, strain public finances, and trigger political instability—turning what could have been a growth opportunity into a macroeconomic liability.

Descriptive analysis

Data Sources and Measurement

The decomposition in equation (3), while conceptually straightforward, has some data related challenges. Demographic variables are slow-moving, requiring investigation of long-term trends. Long term NSDP series is affected by base and methodology changes, necessitating statistical adjustments.

We use four years (1994, 2004, 2017 and 2023) and 18 states for analysis, mainly due to the availability of reliable data. The main sources of demographic and employment related data at the state level is NSSO's quinquennial Employment, Unemployment Survey (EUS) (before 2017) and Periodic Labor Force Survey (PLFS) (2017 and after). The per capita NSDP series was obtained from RBI's Handbook of Statistics on Indian States. NSDP figures were converted to the 2011-12 base (the last available base year) by a ratio-splicing method. For those states that were bifurcated after 1994 we merging state NSDPs based on their respective population.

Basic Descriptive Statistics: Stylized facts

Basic data trends

At the outset, we begin with use the ILO labor statistics database to get a baseline understanding of India in comparative perspective.

The figure 2 compares India's employment to working age population against all countries with GDP per capita of less than $5000. India's employment ratio has always been below the average, primarily on account of its very low female labor force participation. The figure additionally shows that this ratio has also changed substantially over this period. From 1994 to 2004, the ratio remained roughly the same, before collapsing till 2017 and recovering to its initial levels since then. We use this fact to undertake a three period decomposition in following sections.

Figure 2: India has a lower employment ratio than average across developing countries

Indian State Data

Moving then to the subnational data: Table 1 summarizes the key variables by state. As we can observe, states are very differently placed in their demographic transition. As is well known, states like Bihar/UP have rising working age populations and in terms of levels of working age ratios are now where southern and higher per capita income states were decades ago.

Figure 3 depicts the relationship between the working-age ratio and constant per capita income in Bihar, Uttar Pradesh, and the two older southern states of Tamil Nadu and Kerala over the period. Together, they appear to follow the expected quadratic fit (also depicted) that a demographic dividend would produce.

As we have noted, to the extent that the demographic dividend supports economic growth, it is by increasing the supply of effective labor. There is one additional intermediate step therefore that one must take into account: the absorption of the working age population into the labor force. This can be measured either as the labor force, or more appropriately as the employed fraction of the working age population.

Most studies of the demographic dividend in India surprisingly do not measure this variable ($g_{e/w}$) directly. Aiyar and Mody (2011), for example, use labor force participation rate and assumes that to be constant.Jain et al. (2025) by contrast make the assumption that $g_{e/w}$ grows. However, our analysis is backward looking and we simply use labor force surveys to directly calculate this.

In the table below, we document the surprisingly sharp differences in the different measures of growth when one takes into account per capita and per working adult numbers.

In the first column of Table 2, we observe notable differences in yearly output growth

Table 1: Stylized Facts

Year State	Population 1994	 2023	Per capita NSDP 1994	 2023
Andhra Pradesh	67215320	91246000	29309	155847
Assam	25732940	35713000	27736	80439
Bihar	92328660	166222000	11267	39994
Delhi	10385320	21359000	77849	273687
Haryana	17261140	30209000	43042	185490
Himachal Pradesh	5328420	7468000	36208	161191
Jammu and Kashmir	5198100	13903000	31404	79059
Karnataka	47511420	67692000	38278	186038
Kerala	31345140	35776000	38305	161957
Madhya Pradesh	67828860	11675900	20880	73076
Maharashtra	78652460	126385000	40419	163819
Odisha	32987280	46276000	24442	98331
Punjab	20466300	30730000	48488	130002
Rajasthan	48053420	81025000	27315	90830
Tamil Nadu	58467160	76860000	33850	179731
Uttar Pradesh	145116900	247324000	19755	55976
West Bengal	69060920	99084000	22664	79621
Gujarat	42698540	71507000	34667	181963*

Source: Handbook of Statistics, RBI. *. Gujarat NSDP is for 2022

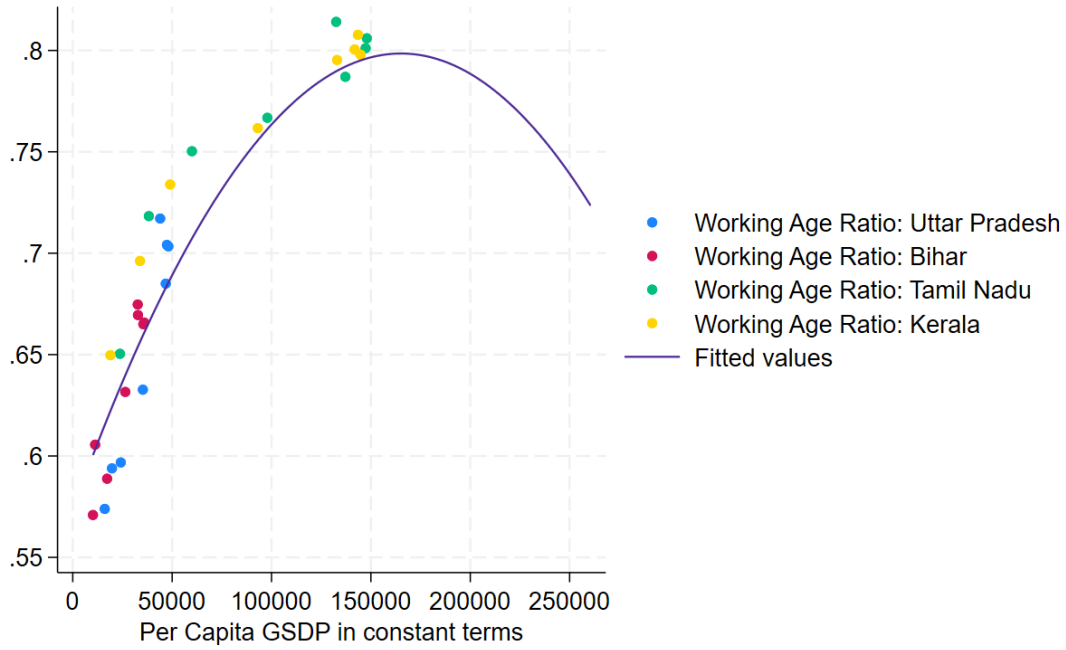


Figure 3: Working age fraction and NSDP in constant terms: selected states

Table 2: Growth Rates 1994–2003 with alternative normalizations

State	NSDP	Per Capita Output	Per Working Age person	Per Employed Person
Andhra Pradesh	6.82	5.76	5.20	5.95
Bihar	6.40	4.37	4.08	4.17
Delhi	6.82	4.34	3.92	4.39
Haryana	6.97	5.04	4.24	4.81
Himachal Pradesh	6.31	5.15	4.41	4.81
Jammu & Kashmir	6.58	3.18	2.61	2.66
Karnataka	6.67	5.45	4.76	5.35
Kerala	5.43	4.97	4.57	4.72
Madhya Pradesh	6.19	4.32	3.70	3.89
Maharashtra	6.46	4.83	4.18	4.61
Odisha	5.97	4.80	4.29	4.22
Punjab	4.80	3.40	2.81	3.07
Rajasthan	5.94	4.14	3.49	4.10
Tamil Nadu	6.70	5.76	5.27	5.92
Uttar Pradesh	5.43	3.59	2.98	3.29
West Bengal	5.58	4.33	3.65	3.41
Assam	4.80	3.67	3.22	2.59
Average	6.11	4.54	3.96	4.23

Source: Handbook of Statistics on Indian States.

across states. The southern states stand out: Andhra Pradesh, Karnataka, and Tamil Nadu have recorded output growth rates of about 6.7–6.8% annually since 1994, compared with only 5.4–6.0% in large northern states such as Uttar Pradesh, Rajasthan, and Madhya Pradesh. Even Kerala, which has a slower-growing population base, matches the long-run output growth of Uttar Pradesh (5.4%). Some states, such as Haryana and Delhi performing even better than the southern states by this metric.

When output is measured in per capita terms (column two), the differences become naturally sharper. Andhra Pradesh and Tamil Nadu have grown close to 5.8% per capita, while Kerala and Karnataka also record strong growth around 5.0–5.5%. By contrast, per capita output growth in Rajasthan, Bihar, and Madhya Pradesh has been in the 4.1–4.4% range, and Uttar Pradesh even lower at just 3.6%. This gap underscores how demographic pressures and slower improvements in living standards have constrained the northern states.

Looking at output per working-age adult (column 3), the southern advantage becomes even clearer. Tamil Nadu and Andhra Pradesh have achieved growth of more than 5.2% per working-age adult, while Kerala and Karnataka also perform strongly at 4.6–4.8%. In contrast, the lagging states show much weaker numbers: Bihar (4.1%), Madhya Pradesh (3.7%), Rajasthan (3.5%), and Uttar Pradesh (2.98%).

Finally, when we move to output per employed adult (column four), the pattern is similar. Andhra Pradesh and Tamil Nadu record nearly 6% annual growth in output per employed adult, while Karnataka and Kerala follow with gains above 5%. By comparison,

Rajasthan (4.1%), Bihar (4.2%), Madhya Pradesh (3.9%), and Uttar Pradesh (3.3%) fall well short. In other words, southern states not only grew faster overall but also generated far stronger productivity improvements for those employed.

Another point of note is the relative performance of the large eastern states. West Bengal and Assam perform poorly per working age adult, but even worse in terms of employed adult.

Taken together, this suggests a sustained divergence: the southern states have combined faster aggregate growth with stronger gains in employment and productivity, while the northern states have lagged both in output expansion and in the quality of employment generation.

Results from Decomposition

Table 3 below shows our primary accounting decomposition for the entire period under study (1994-2023). The last column gives us the pure impact of the demographic dividend. Just reducing dependency ratios and rising working age populations have, in an accounting sense added between 0.3 and 0.8 percentage points to GDP per capita annually.

The most striking finding emerging from Table 3- a declining contribution from the employment to working age ratio in the period 1994-2023. In some states the contribution of employment to working age ratio fell about half a percentage point. On average, the working age population growth added over half a percentage point to per capita output growth, but this was muted by a quarter percentage point reduction in the growth of employment to the working age. In some states in fact, this reduction has wiped out any advantage accruing from demographic growth. Relatedly, some states have had exceptionally high growth rates in output per employed person (Karnataka, Tamil Nadu, Andhra Pradesh, Gujarat).

Table 3: Decomposition of Per Capita GDP Growth: Output, Employment, and Demographics

State	Y/N	Y/E	E/W	W/N
Jammu & Kashmir	3.18	2.66	-0.06	0.58
Punjab	3.40	3.07	-0.26	0.60
Uttar Pradesh	3.59	3.29	-0.31	0.61
Assam	3.67	2.59	0.63	0.45
Rajasthan	4.14	4.10	-0.61	0.66
Madhya Pradesh	4.32	3.89	-0.19	0.62
West Bengal	4.33	3.41	0.24	0.68
Delhi	4.34	4.39	-0.48	0.42
Bihar	4.37	4.17	-0.09	0.29
Odisha	4.80	4.22	0.07	0.51
Maharashtra	4.83	4.61	-0.43	0.64
Kerala	4.97	4.72	-0.15	0.40
Haryana	5.04	4.81	-0.58	0.80
Himachal Pradesh	5.15	4.81	-0.40	0.74
Karnataka	5.45	5.35	-0.59	0.69
Tamil Nadu	5.76	5.92	-0.66	0.49
Andhra Pradesh	5.76	5.95	-0.75	0.56
Average	4.54	4.23	-0.27	0.57

Note: The decomposition shows that growth in per capita GDP can be expressed as the sum of three components: (i) growth in output per employed person, (ii) growth in the employment-to-working-age-population ratio, and (iii) growth in the working-age population share. By construction, the last three columns sum to the first column.

Divergent Growth Dynamics

The table 4 presents a detailed decomposition of growth rates for Net State Domestic Product per capita (Y/N) across different states in India over three distinct periods: 1994-2004, 2004-2017, and 2017-2023. Our choice of these periods stems from the observation of three distinct periods in the employment to working age ratios as seen in figure 2. This decomposition is further broken down into contributions from NSDP per employed person (Y/E), employment in the working-age group (E/W), and the population share in the working-age group (W/N). The data reveals several broad patterns and trends on economic growth, labor productivity, employment, and demographic changes.

Table 4: Subperiodwise Growth Decomposition

period	1994-2004				2004-2017				2017-2023			
	Y/N	Y/E	E/W	W/N	Y/N	Y/E	E/W	W/N	Y/N	Y/E	E/W	W/N
State												
AP	4.61	4.39	-0.31	0.53	6.97	7.98	-1.59	0.58	5.07	4.26	1.03	-0.21
Assam	1.35	0.63	0.66	0.07	4.61	5.29	-1.60	0.92	5.50	0.37	5.81	-0.68
Bihar	4.28	4.35	0.19	-0.27	4.93	6.93	-2.85	0.85	3.30	-2.12	5.84	-0.42
Delhi	3.53	4.06	-1.05	0.51	6.35	6.55	-0.66	0.46	1.31	0.15	1.60	-0.44
Gujarat	3.55	2.69	0.50	0.36	8.20	9.86	-2.30	0.64	4.73	0.26	4.60	-0.12
Haryana	4.16	2.60	0.34	1.22	6.71	8.51	-2.48	0.68	2.86	0.21	2.44	0.21
HP	4.96	4.98	-0.65	0.62	5.98	6.86	-1.55	0.66	3.67	0.10	3.16	0.41
JK	2.19	2.19	-1.13	1.13	3.99	4.13	-0.62	0.48	3.11	-0.09	3.42	-0.23
Karnataka	4.24	3.15	0.14	0.94	6.76	8.47	-2.04	0.34	4.65	2.48	2.22	-0.05
Kerala	4.48	4.39	-0.10	0.20	6.36	7.54	-1.17	0.00	2.77	-0.01	2.88	-0.10
MP	3.16	3.24	-0.26	0.18	5.47	5.72	-1.35	1.11	3.76	1.16	2.66	-0.07
Maharashtra	3.72	3.40	-0.17	0.49	6.57	7.58	-1.62	0.60	2.88	0.52	2.20	0.17
Odisha	3.53	3.29	-0.10	0.34	5.49	6.91	-1.99	0.57	5.42	0.32	5.26	-0.16
Punjab	2.32	1.20	0.63	0.49	4.58	6.21	-2.44	0.80	2.66	-0.44	3.31	-0.22
Rajasthan	2.72	3.19	-0.53	0.06	5.52	7.44	-2.79	0.87	3.52	-1.21	4.08	0.65
TN	3.70	3.07	0.19	0.44	7.68	9.41	-2.04	0.32	5.02	3.39	1.68	-0.06
UP	2.02	1.84	0.10	0.07	5.08	6.67	-2.60	1.01	2.98	-1.70	4.03	0.65
WB	4.71	4.27	-0.28	0.72	4.36	4.35	-0.80	0.81	3.64	0.08	3.83	-0.26

Note: (i) AP: Andhra Pradesh; HP: Himachal Pradesh; JK: Jammu and Kashmir; MP: Madhya Pradesh; TN: Tamil Nadu; UP: Uttar Pradesh; WB: West Bengal. (ii) Figures for Gujarat pertain to the subperiod 2017-2022 instead of 2017-2023.

Decomposition of State-Level Growth: Productivity, Employment, and Demography

1994–2004: Productivity-Driven Growth amid Limited Employment Expansion

During the decade from 1994 to 2004, most Indian states recorded moderate to robust increases in Net State Domestic Product (NSDP) per capita. This expansion was primarily powered by a strong rise in NSDP per employed person (Y/E), pointing to significant gains in labor productivity rather than extensive employment growth. The period coincides with the early phases of liberalization, when market-oriented reforms, improvements in infrastructure, and agricultural diversification began to yield productivity dividends.

States such as Andhra Pradesh (AP), Himachal Pradesh (HP), and Kerala exemplify this pattern: each experienced marked improvements in Y/E. These productivity gains translated directly into higher per capita incomes, underscoring that output growth was largely driven by "working more productively not "working more."

However, the contribution from employment within the working-age population (E/W) was negative or negligible in several states, including Delhi and Jammu & Kashmir (JK). This suggests that while output per worker increased, the number of employed individuals did not rise proportionately with the working-age population. In other words, economic growth was not accompanied by commensurate job creation—a pattern consistent with the broader national phenomenon of "jobless growth" during the 1990s.

By contrast, the contribution from the share of the working-age population in the total population (W/N) was generally positive. This reflected India's emerging demographic dividend: as fertility rates declined and more individuals entered the labor-force age bracket, the potential labor supply expanded. However, the failure to translate this demographic advantage into employment gains foreshadowed future structural challenges in linking productivity improvements with inclusive growth.

2004–2017: Accelerated Growth, but Employment Crisis

The period from 2004 to 2017 witnessed a phase of accelerated and broad-based growth across nearly all major states. States like Gujarat, Tamil Nadu (TN), and Maharashtra experienced sharp increases in NSDP per capita, driven predominantly by large gains in productivity (Y/E). This era coincided with a national investment boom- what has been called "India's Dream Run"(Nagaraj, 2013), expanding industrial capacity, and deepening integration into global and domestic value chains.

The surge in productivity during this period likely reflects both sectoral and technological shifts. The structural transformation of state economies—particularly the expansion of manufacturing and high-value services—raised overall efficiency levels. Yet, this very transformation also had uneven social and labor-market implications. The data indicate a marked decline in the contribution of employment within the working-age group (E/W) in most states. Despite rapid output growth, employment generation lagged significantly,

and in states such as Bihar and Rajasthan, the E/W contribution turned distinctly negative. In fact, the choice of this periodization is to reflect this decline. In many states, high productivity coexisted with stagnating or even declining employment rates—signaling the deepening of a structural dualism between high-productivity, capital-intensive sectors and low-productivity, labor-surplus ones.

The demographic contribution (W/N) continued to be positive during this phase, reflecting the tailwinds of India's youthful population. In states such as Kerala—where fertility rates had already fallen sharply—this contribution began to plateau. This early stagnation hinted at the demographic transition toward an aging population, where the growth of the working-age cohort would no longer provide a sustained economic boost.

Overall, while 2004–2017 was India's most dynamic period of state-level growth since liberalization, its underlying composition revealed an imbalance: soaring productivity per worker without commensurate employment expansion- a fact that raised questions about the sustainability and inclusiveness of the growth model.

2017–2023: Divergent Outcomes and Emerging Structural Headwinds

The post-2017 period presents a more complex and uneven trajectory across Indian states. While some states, such as Assam and Odisha, continued to exhibit robust per capita NSDP growth, others—including Delhi, Punjab, and parts of northern India—experienced a visible deceleration. This period overlaps with multiple shocks and transitions: the slowdown in private investment after 2016, the twin disruptions of demonetization and the GST rollout, and later, the economic dislocations caused by the COVID-19 pandemic.

A key feature of this period is the weakening of productivity-driven growth. The contribution from NSDP per employed person (Y/E) declines sharply in many states, indicating a loss of momentum in productivity enhancement. This may reflect both cyclical downturns and structural stagnation—reduced investment in manufacturing, declining total factor productivity, and limited diffusion of new technologies beyond a few leading sectors.

In contrast, there is a notable and somewhat counterintuitive positive shift in employment within the working-age group (E/W) for many states, particularly in Assam, Bihar, and Madhya Pradesh. This improvement suggests a modest recovery in employment generation, possibly supported by the expansion of rural non-farm activities, construction, and labor-intensive services. Policy efforts—such as rural employment schemes, state-level investment promotion, and post-pandemic job recovery programs—may have contributed to this shift. However, the quality of employment remains uncertain, with indications that much of the increase may be in informal or low-wage segments rather than in secure, high-productivity sectors(Jayadev, Tripathi, & Shravan, 2025).

At the same time, the demographic contribution (W/N) turns negative or diminishes in a growing number of states. This reversal reflects the beginning of a demographic inflection point: slowing population growth and early signs of population aging. States like Kerala and Delhi already exhibit a waning demographic dividend, where the share of the

working-age population either stabilizes or declines. This shift marks a transition from a period when demographics supported growth to one where demographic headwinds may constrain it.

In sum, the 2017–2023 phase underscores the fragility of India's growth architecture at the state level. The earlier productivity-led growth has slowed, employment gains remain fragile, and the demographic advantage that once buoyed growth is beginning to erode. These emerging trends highlight the need for a new development strategy—one that revives productivity while ensuring broad-based employment creation before demographic tailwinds turn into headwinds.

Synthesis: From Productivity-Led Expansion to Demographic Headwinds

Taken together, the three phases—1994–2004, 2004–2017, and 2017–2023—trace a clear arc in the evolution of India's state-level economic dynamics. They reveal both the strength and the structural fragility of India's growth trajectory since liberalization. Across these three decades, per capita NSDP growth was, for the most part, impressive by historical standards. Yet, its composition and underlying drivers evolved in ways that expose the tensions between productivity, employment, and demography.

The first decade (1994–2004) marked the consolidation of post-reform growth. This was an era of rising efficiency—states reaped the early gains of market liberalization, privatization, and trade openness. However, these gains were not accompanied by broad-based employment growth. Instead, growth occurred largely through productivity improvements among the already employed, while many entering the labor force failed to find stable work. Employment-to-working-age ratios (E/W) stagnated or fell, particularly in urbanized and service-dominant states. The demographic contribution (W/N), though positive, functioned more as potential energy than realized power: India was accumulating a vast working-age population, but not yet putting it fully to work.

The second phase (2004–2017) represented India's most dynamic growth period—a time of accelerated expansion and deeper structural change. Most states experienced rapid gains in productivity, driven by industrial diversification, infrastructure investment, and the scaling up of modern services. The state-level data reveal a decisive shift: productivity (Y/E) became the central driver of growth everywhere, from Gujarat's industrial surge to Tamil Nadu's manufacturing and services mix. However, this expansion came with an intensification of the "productivity–employment paradox." Job creation lagged persistently behind output growth, and in some cases, employment actually declined in proportion to the working-age population. The dualism of India's growth—where modern, capital-intensive sectors coexisted with a vast informal economy—became more entrenched.

The demographic contribution (W/N) remained positive, but its role was subtly changing. India's working-age population continued to grow, but the dividends of this demographic expansion were increasingly contingent on job creation and productivity absorption. Some southern and western states—especially Kerala and Tamil Nadu—began to show signs of demographic maturation, with slowing growth in their working-age cohorts.

The challenge was shifting: from managing an expanding youth population to sustaining employment in a gradually aging society.

The third phase (2017–2023) represents a turning point. Aggregate per capita growth slowed, and state trajectories began to diverge more sharply. Some states—particularly in the east and northeast, such as Assam and Odisha—continued to grow at healthy rates, suggesting a partial diffusion of industrial and service activities beyond traditional growth poles. Yet, the major urbanized states, including Delhi and Punjab, saw deceleration. The underlying composition of growth also changed. The contribution of productivity (Y/E) weakened, indicating saturation effects and perhaps reduced efficiency gains from existing economic structures.

At the same time, employment ratios (E/W) improved modestly in several states, reflecting both recovery from earlier job losses and a partial expansion of low- to medium-skill employment. But this was likely driven by a mix of formal and informal job creation, much of it precarious. The persistence of informal employment, underemployment, and weak wage growth suggests that the quality of new jobs remains a central constraint on inclusive development.

More structurally, the demographic engine that powered India's growth for three decades began to lose steam. The contribution from the working-age population share (W/N) turned flat or negative in many states, signaling a demographic inflection. Kerala, and to a lesser extent Delhi and Tamil Nadu, illustrate the new demographic reality: a slowing or shrinking workforce and a rising dependency ratio. Other states, such as Bihar and Uttar Pradesh, remain demographically young but face the converse problem—large cohorts of potential workers without sufficient productive employment.

What emerges, therefore, is a composite picture of India's growth trajectory characterized by three overlapping transformations:

1. **A shift from extensive to intensive growth:** Early post-reform expansion relied increasingly on productivity gains rather than on the absorption of new workers. Growth was intensive—output per worker rose, but total employment lagged.

2. **A structural imbalance between sectors:** States moved toward higher-productivity sectors that were less employment-intensive, particularly manufacturing and modern services. The dual economy persisted, with the informal sector absorbing surplus labor without raising overall productivity.

3. **An impending demographic transition:** The once-favorable age structure that supported growth is now stabilizing or reversing in several regions. Without robust employment creation, the demographic dividend risks turning into a demographic burden.

Excluding those in Higher Education

An additional conceptual issue concerns the definition of the workforce and, in particular, the treatment of individuals enrolled in higher education.In India, with various states

passing through different stages of their demographic dividend, this can have a significant impact on our measures. Consider two states, one relatively young, with a demographic bulge passing through tertiary education while the other is relatively older where the majority of the population have already exited college. Simply taking an age cut off as a demarcation may overstate the actual population that may be part of the labor force in the first case.

In order to examine the implications of this, we undertake a further exercise. In our extension, individuals enrolled in higher education are retained in the population N but are removed from the workforce W, reflecting the view that their primary activity is schooling rather than work. In addition, individuals who report being both enrolled in higher education and also employed are also removed from employment E. This ensures internal consistency: students are excluded from both the numerator and denominator of labour-market ratios, rather than being counted as workers while being treated as outside the labour force.

These adjustments have direct implications for the decomposition

$$\Delta \ln \left(\frac{Y}{N}\right) = \Delta \ln \left(\frac{Y}{E}\right) + \Delta \ln \left(\frac{E}{W}\right) + \Delta \ln \left(\frac{W}{N}\right).$$

Removing students from the workforce mechanically lowers the participation rate W/N by reducing the size of W while leaving N unchanged. At the same time, removing student-workers from employment lowers E, which dampens the mechanical increase in the employment rate E/W that would otherwise arise from a smaller workforce. For example, if $N = 100$, W falls from 50 to 40 due to educational enrolment, and E falls from 30 to 26 because some students were employed, then W/N falls from 0.50 t.o 0.40 (20%) while E/W rises only from 0.60 to 0.65 (8.3%)

The findings are reported in the table 5. It can be seen that excluding those attending educational institutions from working age population changes our findings for some states. While the general pattern of a collapse in productivity holds, the effect is accentuated in some states. Consider Andhra Pradesh. Excluding those in education between 2004-2017 suggests that labor productivity growth was about .5% higher over the period. This is likely because a large population were undergoing higher education at that point. In the second period (2017-2023) that population may have become part of the genuine workforce, and as a result, there is greater growth in both W/N and E/W rise, while Y/E growth is even lower once we take this adjustment into account.

Table 5: Subperiod-wise Growth Composition: Working Age Population excluding Those Attending Educational Institutions

period	2004–2017				2017–2023			
	Y/N	Y/E	E/W	W/N	Y/N	Y/E	E/W	W/N
State								
Andhra Pradesh	6.97	8.41	-1.41	-0.03	5.07	3.32	1.56	0.19
Assam	4.61	5.30	-1.14	0.45	5.50	0.31	5.08	0.12
Bihar	4.93	6.85	-1.54	-0.38	3.30	-1.82	4.63	0.49
Delhi	6.35	6.44	-0.23	0.14	1.31	0.44	1.14	-0.27
Gujarat	8.20	9.56	-1.69	0.33	3.95	0.49	3.35	0.11
Haryana	6.71	8.33	-1.98	0.36	2.86	0.50	2.13	0.23
Himachal Pradesh	5.98	6.29	-0.92	0.61	3.67	1.24	1.51	0.92
Jammu Kashmir	3.99	3.58	0.06	0.35	3.11	1.00	2.46	-0.35
Karnataka	6.76	8.46	-1.61	-0.09	4.65	2.53	2.40	-0.28
Kerala	6.36	6.78	-0.25	-0.16	2.77	1.59	1.29	-0.11
Madhya Pradesh	5.47	6.32	-1.22	0.37	3.76	0.03	2.89	0.84
Maharashtra	6.57	7.69	-1.32	0.20	2.88	0.19	2.30	0.39
Odisha	5.49	6.87	-1.28	-0.11	5.42	0.49	4.51	0.42
Punjab	4.58	6.10	-1.95	0.43	2.66	-0.26	2.46	0.45
Rajasthan	5.52	7.22	-1.62	-0.08	3.52	-0.72	2.69	1.55
Tamil Nadu	7.68	9.22	-1.32	-0.22	5.02	3.83	0.94	0.24
Uttar Pradesh	5.08	6.73	-1.95	0.30	2.98	-1.68	3.56	1.11
West Bengal	4.36	4.31	-0.32	0.38	3.64	0.28	3.16	0.19

Note: (i) AP: Andhra Pradesh; HP: Himachal Pradesh; JK: Jammu and Kashmir; MP: Madhya Pradesh; TN: Tamil Nadu; UP: Uttar Pradesh; WB: West Bengal. (ii) Figures for Gujarat pertain to the subperiod 2017-2022 instead of 2017-2023.

Conclusion

This paper set out to separate arithmetic demography from labour-market absorption and productivity, using a transparent accounting decomposition of per capita output into three terms: output per employed worker (Y/E), the employment-to-working-age ratio (E/W), and the working-age share (W/N). Applying this lens to Indian states since the mid-1990s yields three central findings. First, the demographic transition mechanically supported growth almost everywhere, with W/N adding a non-trivial increment to per capita NSDP. Second, this potential dividend was frequently muted—and at times offset—by falling E/W, especially through the 1990s and 2000s, when "jobless" or "job-light" growth prevailed. Third, after 2017, the growth model pivoted in a problematic direction: modest improvements in E/W appeared in many states, but they coincided with a broad-based collapse in Y/E, leaving aggregate per capita gains weaker and more uneven.

Two policy lessons follow directly from the arithmetic. *Demography is not destiny*: the dividend materialises only when employment rises with the working-age share, and it is sustained only when productivity per worker also improves. India's recent pattern—a partial rebound in E/W alongside weakening Y/E—is arithmetically fragile. Where employ-

ment creation is concentrated in low-productivity segments, the employment-adjusted age-structure dividend shrinks, and the growth premium from W/N is quickly exhausted. Conversely, the states that have historically posted the strongest outcomes—Tamil Nadu, Andhra Pradesh, and to a degree Karnataka and Maharashtra—combined sustained Y/E gains with relatively stable E/W, translating demographic tailwinds into durable growth per working-age adult.

Our counterfactual exercises underscore the scale of the missed opportunity and the bounds on what is feasible. On the upside, convergence to the best observed state-level Y/E trajectories would have raised long-run per capita output paths materially; on the downside, slippage in W/N as ageing advances, when coupled with stagnant E/W, can push growth toward the lower bound even without an outright productivity shock. These historical bounds provide disciplined expectations for the coming decades: as several states (Kerala, Tamil Nadu, Himachal Pradesh) enter demographic maturity and others (Bihar, Uttar Pradesh, Madhya Pradesh) retain youthful profiles, the composition of growth—not merely its rate—will determine welfare gains.

With demographic tailwinds fading in some states and still to be harnessed in others, the central challenge going forward is to engineer *employment-intensive productivity growth*. The accounting decomposition used here does not explain behaviour, but it does pin down the margins that must move for a more inclusive growth pattern, lifting Y/E without sacrificing E/W, even as we might expect W/N to slowly diminish over time, as today's dividend into tomorrow's headwind.

Appendix:Counterfactuals

Besides providing a granular view of the growth process, accounting decomposition allows us to simulate alternative 'what if' scenarios. Since any growth episode, as a matter of arithmetical necessity, must be accounted for by three variables under study–namely, increase in working age population, fraction of employed in the working age population and NSDP per employed person, modeling these variables is one way of understanding the plausible growth trajectories of different Indian states. In this section, we undertake this exercise.

Specifically, we construct two counter-factuals. The first counterfactual–what we call demographic dividend realization–shows the scenario where all states had been able to achieve convergence with the state having fastest productivity growth rate. The second counterfactual, what we call–demographic collapse–simulates the scenario where working age population ratio to population ratio growth slows down due to declining fertility. This is the pessimistic scenario in which the state gets old before becoming rich.

For constructing counterfactuals, we generate counterfactual annual growth rates for the variables under investigation. Second we derive cumulative growth rate of the said variables over the entire period. Next, we combine cumulative growth rate over the entire period with initial levels to derive the entire trajectory of variables under study. For select states, the counterfactual level variables are plotted.

Demographic Dividend Realization

First, we investigate an optimistic counterfactual. In this scenario, all states are able to absorb the working-age population growth in a high-productivity sectors. To translate this intuition into a realistic growth path, we assume that the per worker NSDP growth in every state converges to the highest NSDP per worker growth state.

As seen in the table 6, actual growth rate was substantially less than counterfactual 1–between 2 to 4 percentage points–for most states, demonstrating the gap between actual and potential performance.

Demographic Collapse

The second investigated scenario shows slowing working age to population ratio–mainly due to fertility related reasons–together with low employment absorption. As one can see in the table, the actual performance is quite close to the lower bound in this case, suggesting that demographic dividend has not been exploited efficiently.

Finally, we plot the trajectory of actual vs simulated NSDP for four states in the figure 4. These four states are chosen from the four demographic stages as shown in the figure 1. These plots provide the visual confirmation of the point being made earlier that states' growth was closer to the lower bound of our simulation exercise.

Table 6: Actual vs Counterfactual NSDP

State	1994-2011			2011-2023		
	CF1	CF2	Per capita Y	CF1	CF2	Per capita Y
Andhra Pradesh	6.73	5.32	5.77	8.28	5.54	5.75
Assam	6.52	2.08	2.32	8.34	5.31	5.59
Bihar	6.34	4.96	5.02	8.36	3.15	3.45
Delhi	6.45	4.93	5.09	8.42	2.91	3.26
Gujarat	6.54	5.18	5.44	NA	NA	NA
Haryana	7.34	4.24	5.31	8.31	4.42	4.66
Himachal Pradesh	6.79	4.69	5.21	8.66	4.48	5.07
Jammu & Kashmir	7.00	2.22	2.94	8.28	3.32	3.53
Karnataka	6.85	4.48	5.05	8.27	5.82	6.03
Kerala	6.28	5.52	5.52	8.07	4.19	4.19
Madhya Pradesh	6.59	3.88	4.19	8.83	3.74	4.50
Maharashtra	6.72	4.87	5.30	8.48	3.73	4.15
Odisha	6.49	3.81	4.02	8.48	5.50	5.91
Punjab	6.74	2.88	3.34	8.47	3.08	3.48
Rajasthan	6.63	3.99	4.35	8.77	3.15	3.85
Tamil Nadu	6.52	5.72	5.95	8.30	5.25	5.48
Uttar Pradesh	6.48	3.21	3.41	9.14	2.77	3.85
West Bengal	6.75	4.36	4.83	8.63	3.06	3.62

Note: CF1 and CF2 refer to counterfactual 1 and counterfactual 2 NSDP growth figures respectively.

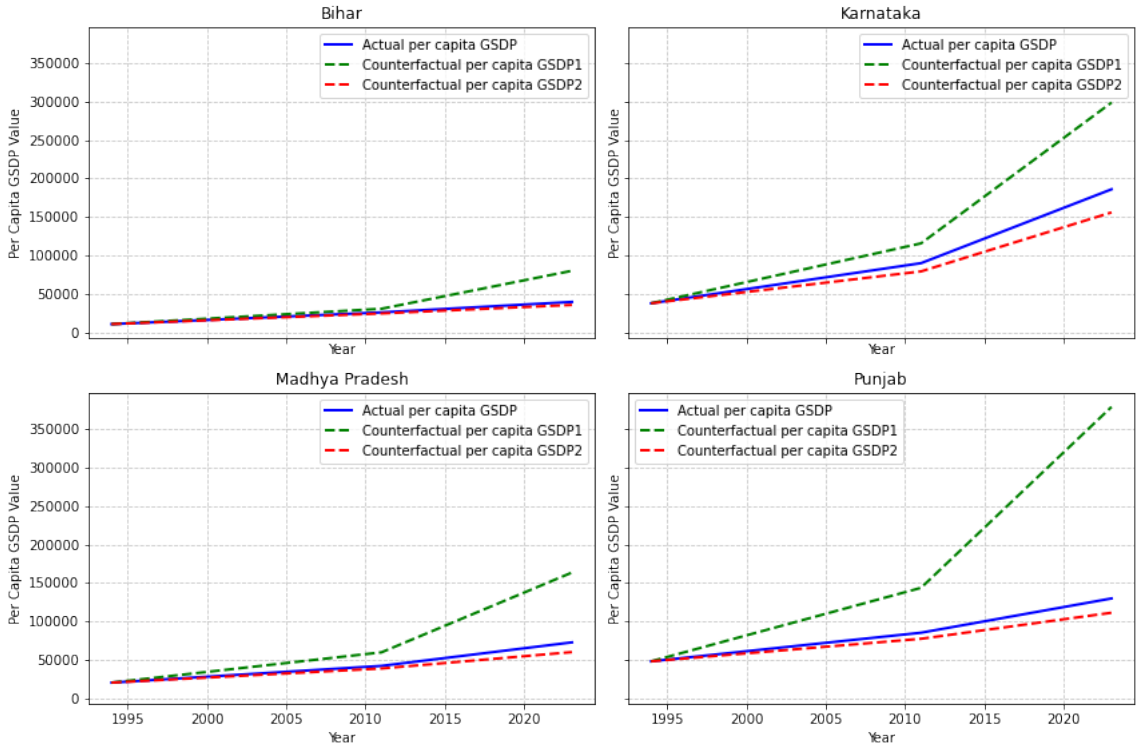


Figure 4

Note: Counterfactual trajectories vs actual trajectory of SDP per capita.

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