Demographic Dividend and Economic Growth: Evidence from India

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Abstract: India is going through a phase of demographic transition. A higher share of people in working age group provides India with an opportunity to realize a potential demographic dividend. However, there is no clear consensus on defining the demographic window which have important implications for economic growth. In literature, the discussion on pace of demographic transition and duration of demographic window based on different approaches is missing. India's States have historically exhibited wide difference in population growth as well as composition. There is a scarcity of studies focussing on age structure transition across States. In this paper we estimate demographic dividend using an extended Solow-Swann framework for 15 States for the period 1981 to 2018. Our findings indicate that contribution of working age share towards growth over 1981 to 2018 is comparatively lower as compared to 1981 to 2010 phase. Employment figures indicate that the absorption of youth into the labour force is far below expectations during this decade. The paper provides some useful recommendations for deriving higher economic growth.

Introduction

India experienced dramatic population growth in the second half of the twentieth century, with the population increasing from 361 million in 1951 to 1 billion in 2001. India added 180 million people to its population between 2001 and 2011. As of today18 per cent of the world population resides in India. While a cause of concern, population of a country is characterized by different age structures at different points of time. India is in the midst of a demographic transition which is a shift from a young population to an aged population. A window of opportunity opens up during demographic transition when the share of working age people is higher as compared to dependents. The net addition to growth due to a favorable age structure is termed as demographic dividend.

It is well documented that age structure can have positive effects on economic growth (Bloom and Williamson, 1998; Bloom, Canning and Malaney, 2000; Kelley and Schmidt, 2005). Bloom and Williamson (1998) in their seminal paper report that one-third of growth observed in East Asia during the high growth phase can be explained on account of demographic changes. While, Africa's dismal economic performance is partially explained by a high dependency ratios and low life expectancy (Bloom, Canning,

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and Sevilla, 2003). During the phase of demographic transition, growth in share of working age population can add 1-2 per cent per annum to economic growth (Bloom, 2011).

Numerous studies exist which examine the implication of age structure for India's economic growth (Table S1). Acharya (2004) and Chandrasekhar et. al. (2006), although acknowledging the importance of age structure, were skeptical of the policy environment which did not focus enough on human capital formation. Studies prior to 2010 did not focus on quantifying the demographic dividend for India, notable exception is James (2008). Although, the studies on India (Table S1) document a positive effect of age structure on growth however the inconsistency in findings with respect to magnitude of age structure related variables have prompted us to comprehensively analyze the effect of working age share for different periods.

The motivation for this study mainly comes from the pessimism surrounding India's future growth prospects. India has witnessed lower growth in decade starting from 2010. A number of structural factors (rigid labor laws) and cyclical factors such as roll out of GST, NBFC crises, poor performance of agriculture sector and demonetization are responsible for the growth debacle (Subramanian, 2019). The labor force participation rate has declined among both males and females.

Most of the existing studies on India have analyzed the data for the period 1961 to 2011. We extend the analysis by covering the period 2011 to 2018 which is considered as low growth phase. We ignore the period prior to 1981 because during those two decades from 1960-1980, the Indian economy was primarily dependent on agriculture and frequent shocks to agriculture led to too much variability in growth. The economy stagnated between 1950 to 1980 and India's economic growth picked up post 1990 with the introduction of reforms.

Furthermore, there is no consensus about defining the demographic window. As per National Transfer Account framework, the demographic window for India will be from 1980 to 2035 (Ladusingh & Narayana, 2011). As per UNDP's definition the phase will be from 2010 to 2050. We estimate the demographic dividend based on both these definition with a focus on contribution of age structure towards growth over 2011 to 2018.

The remainder of the paper is structured as follows. In the next section we discuss the source of data and econometric specification. Next, the results based on standard neo-classical growth model are presented. In the concluding section, the key findings have been summarized along with possible policy implications.

Material and Methods

Method

To establish the association between growth in per capita income and demographic variables, we use the standard conditional convergence model discussed in Barro and Sala-I-Martin (1995). The specification is given as:

$$\dot{z} = \lambda (z^* - z_0) \qquad \qquad \dots (1)$$

Where, growth in income per worker is a function of steady state level of income per worker and initial income per worker. The steady state level of income per worker is itself determined by a number of dynamic as well as time invariant factors such as human capital, health status, life expectancy, stock of capital, savings, geography, culture and climate (Bloom and Williamson, 1998). Here, λ is the speed of convergence which is dependent on labor productivity which in turn is determined by above mentioned factors which are assumed to be fixed at the beginning of the period.

To incorporate demographic variables in equation (1) we use the accounting identity given by Bloom et. al. (2010) in their seminal paper which links the growth of per capita income with growth in working age as:

$$Y/N = Y/L \times L/WA \times WA/N \qquad \qquad \dots (2)$$

Here, Y denotes gross domestic product, L denotes the total labor force (does not include those who are not looking for work in 15-59 group), WA is the working age population (15-59 years) and N is the total population. The per capita income here could be written as product of three underlying components: first is labor productivity which is reflected in Y/L; WA/N is the share of the working age people in the total population and L/WA represents the share of labor force.

A logarithmic transformation of identity

$$[g = \ln(Y/N); z = \ln(Y/L); e = \ln(L/WA) \text{ and } c = \ln(WA/N)]$$

results in:

$$g = z + e + c \qquad \qquad \dots (3)$$

A total differentiation of the equation shows that growth rate of income per capita can be written as the sum of growth of income per worker, growth of labour participation and the growth of the ratio of the working-age to the total population (Bloom et al 2010).

$$\dot{g} = \dot{z} + \dot{e} + \dot{c} \qquad \qquad \dots (4)$$

Using equations (1) and (4), growth in per capita incomes ($\dot{g}$) can be examined as:

$$\dot{g} = \lambda \, (\alpha X + e_0 + c_0 - g_0) + \dot{e} + \dot{c} \qquad \qquad \dots (5)$$

Where, X refers to determinants of labor productivity.

If we assume that labor force participation rates are constant, then equation 5 can be written as

$$\dot{g} = \lambda \, (\alpha X + e_0 + c_0 - g_0) + \dot{c}$$

Given the structure of the data, the panel data regression method has been used which allows us to control for unobserved State-specific effects. Equation 5 forms the basis of econometric estimation.

Two approaches were used to define the duration of demographic window:

- The period when the proportion of children and youth under 15 years falls below 30 per cent and the proportion of people 65 years and older is still below 15 per cent.
- A rise in the share of the working-age population as the initiation of the phase of demographic dividend

Data

In case of India, infrastructure has observed to be the main reason for difference in growth across regions in India (Dutt and Ravallion, 1998; Cain, Hasan and Mitra, 2012; Das, Ghate and Robertson, 2015). In addition, human capital is also identified as an important determinant (Nauriyal and Sahoo, 2010). Bosworth (2006) report that the contribution of education in growth is modest while saving is not the deterrent to economic growth.

The main challenge in identifying the determinants at State level is the data. For instance, at State level, information on capital is not available. While Adabar (2004) has treated credit extended by banks and financial institutions and capital expenditure by government as the investment. Ahluwalia (2000) has used capital expenditure from CMIE as proxy for investment. Notably, the neo-classicals have focused exclusively on capital, saving and investment and initial level of per capita income. Following the literature,

we have considered literacy rate, urbanization rate, capital expenditure (proxy for infrastructure/investment) as important correlates of economic growth.

The data was collected for India and 17 major states: Andhra Pradesh, Bihar, Delhi, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Maharashtra, Madhya Pradesh, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. Data was collected for the period 1971- 2018. The Census data for 2001 and 2011 was adjusted to consider the creation of three new states Jharkhand, Chhattisgarh and Uttarakhand. The availability of data for new as well as old states allowed us to consolidate the data of Jharkhand with Bihar, Chhattisgarh with MP, Uttarakhand with UP and Telangana with Andhra Pradesh to maintain consistency as well as comparability with old undivided states. Similar adjustments were made for other indicators such as State Domestic Product and Literacy Rate.

Notably, Census data is available till 2011 and projected population figures are available till 2036 based on 2011 data. The data on State Domestic Product and Sectoral share was obtained from Ministry of Statistics and Programme Implementation, Government of India. The data for NSDP is available at 1970-71, 1980-81, 1993-94, 1999-00, 2004-05 and 2011-12 prices. To ensure uniformity, figures were converted to 2004-05 prices.

The "working age" population here refers to those in 15-59 years age group. The share of dependents, "workers" in total population, urban population and literacy rate was calculated using Census data. Census categorizes workers in two groups main and marginal workers. The data on work force participation rate for 2018-19 was obtained from Periodic Labor Force Survey (2018) and was applied on population figures to obtain the number of workers. PLFS also provides the sectoral share of workers employed. The WPR and LFPR from Census and NSSO are comparable. Data on capital expenditure was obtained from handbook of Reserve Bank of India for previous years. For econometric analyses data for period 1981 to 2018 have been used for 15 States except Haryana and Jammu and Kashmir for which State level information on indicators was missing.

Results

Figures below portray the age structure transition for India and States. The changes in fertility and mortality rates have led to marked changes in the age composition of India's population over the last 4 decades. In the first two panels in the figure below the pyramid has a wide base indicating a higher share of 0-14 population but for 2001 and 2011, the base of pyramid is narrow, the population in age group 14 years and above is increasing. In the future it is expected that the pyramid will become more uniform with respect to share of the population.

Figure 2 below presents the age composition of population of India and States for 1971 to 2036. For India, the share of 0-14 population is expected to decrease to 19.8 % by 2036. As of 2021, the share of elderly and children in India's total population is 10.1 and 25.5 per cent respectively. The share of elderly population is higher in Kerala, Tamil Nadu and Himachal Pradesh. It is worth noting here that 30 to 40 per cent of population across States is in 25-49 age group and is expected to rise until 2031.

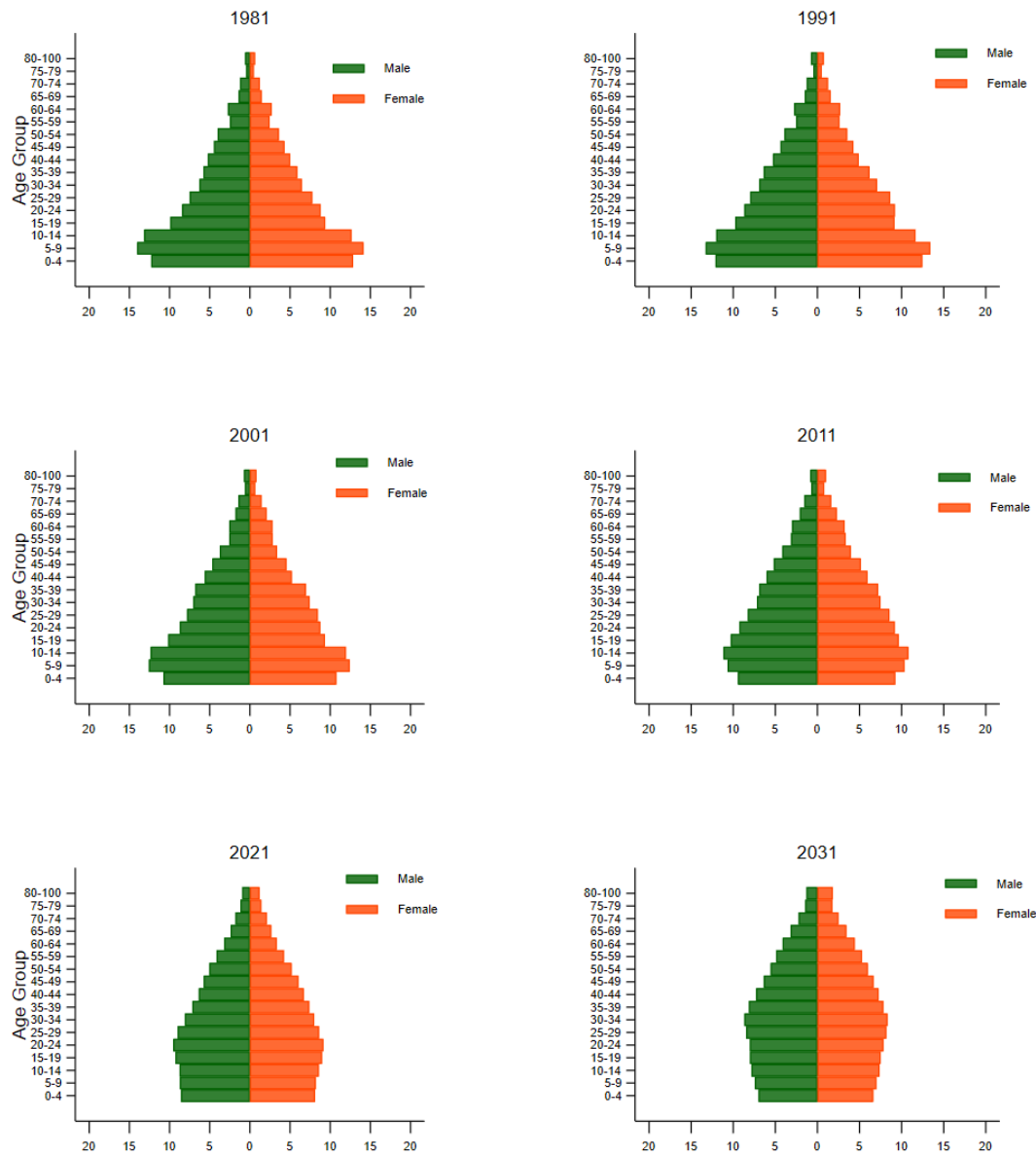Figure 1: Population pyramid, India, 1981 to 2031

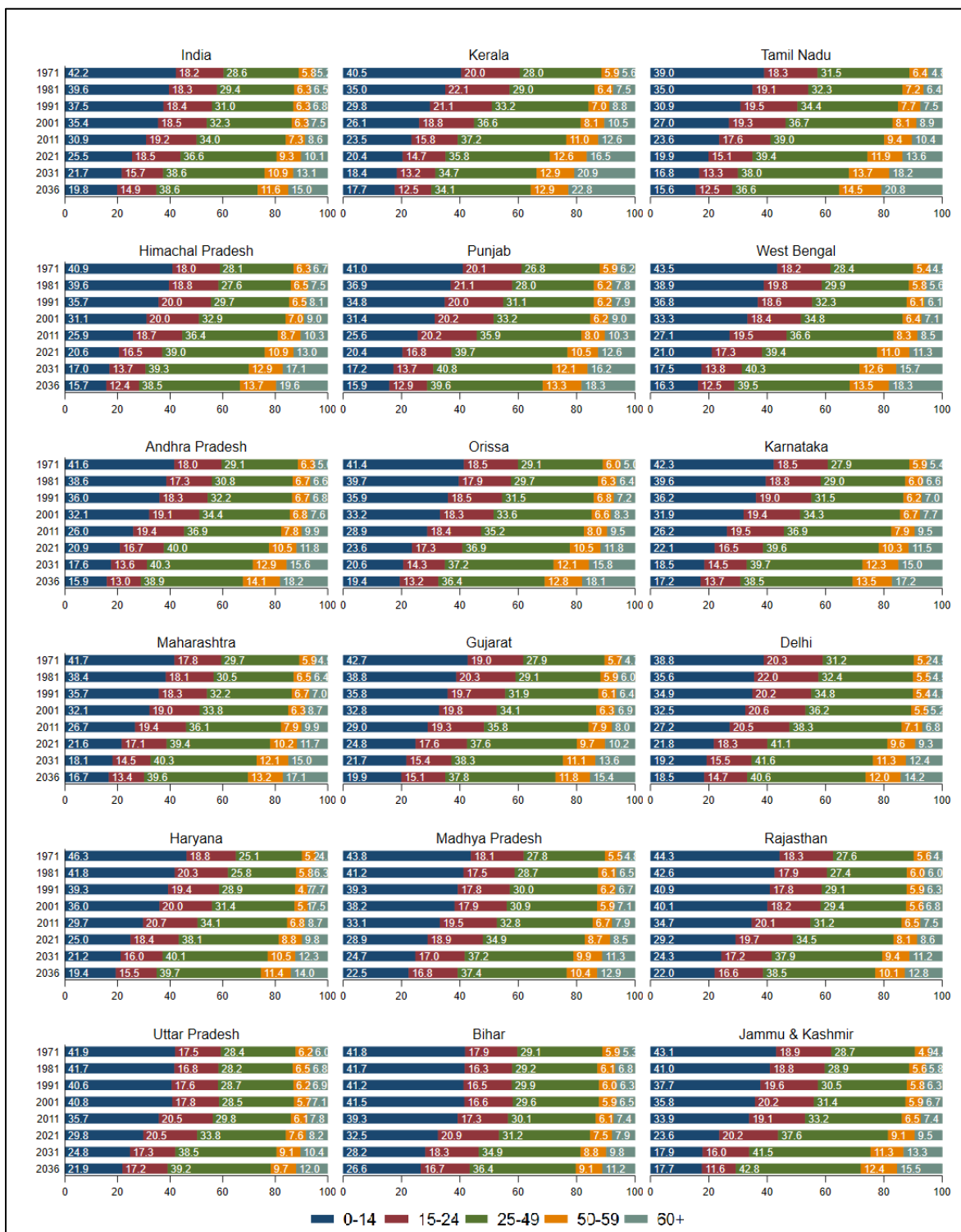Figure 2: Distribution of age structure, India and States, 1971 to 2036

Table 1 below presents the duration of demographic window based on UNDP's definition as period when proportion of children and youth under 15 years falls below 30 per cent and the proportion of people

65 years and older is still below 15 per cent. India will experience a favourable age structure for 22 years (2013 to 2035). As per this definition, demographic window is now closed for Kerala and Tamil Nadu. The window was open for Kerala for 26 years (1991 to 2017) and for Tamil Nadu for 30 years (1994 to 2024). For Rajasthan, Uttar Pradesh, Madhya Pradesh and Bihar, the favourable period will start post 2020 and will exist till 2040. Notably for most of the States the window opened in 2000's and the duration have been around 20 to 25 years.

Table 1: Duration of demographic window based on UNDP definition

	Start	end	1991	2001	2011	2016	2021	2026	2031	2036	Duration
India	2013	2035									22
Himachal Pradesh	2003	2026									23
Punjab	2004	2027									23
Haryana	2011	2036									25
Delhi	2006	2036									30
Rajasthan	2020	2036									16
Uttar Pradesh	2021	2036									15
Bihar	2026	2036									10
West Bengal	2007	2029									22
Orissa	2009	2029									20
Madhya Pradesh	2019	2036									17
Gujarat	2009	2034									25
Maharashtra	2005	2031									26
Andhra Pradesh	2005	2029									24
Karnataka	2005	2031									26
Kerala	1991	2017									26
Tamil Nadu	1994	2024									30
Jammu and Kashmir	2015	2034									19

Note: Duration of demographic window defined as period when proportion of children and youth under 15 years falls below 30 per cent and the proportion of people 65 years and older is still below 15 per cent.
*demographic window phase to continue for few more years

Figure 3 below provide the duration of demographic window based on the difference between growth of working age population which is 15-59 age group and the total population. Based on this definition the demographic window for India opened around 1970 and will close in 2030's. The States which enjoyed a window of larger duration on account of high difference in working age share and population include Haryana, Himachal Pradesh, Jammu and Kashmir, Kerala, Punjab and West Bengal. The difference in case of these States is greater than 0.7 percentage points. The favourable demographic period for Bihar, Rajasthan and Uttar Pradesh has started from 2001 onwards and will continue to exist much longer than rest of the States. Interestingly for Madhya Pradesh which is also one of the most populated and have high share of working age population, the window will cease to exist soon.

Figure 3: Duration of Demographic window computed as difference in growth rate of 15-59 age group and total population, India and States, 1971 to 2036
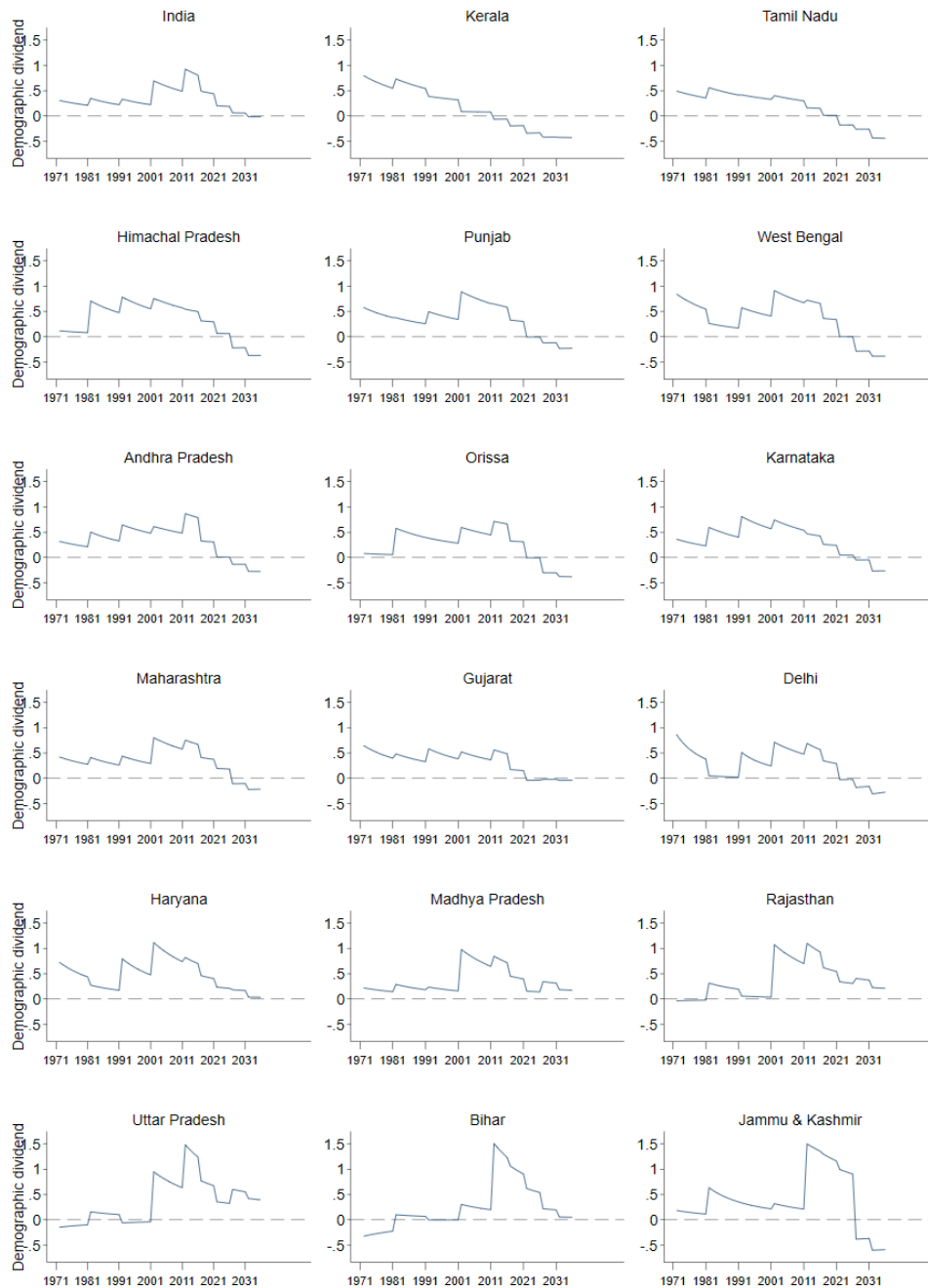

Table 2 presents the growth rate of income per capita which can be written as the sum of growth of income per worker, growth of labour participation and the growth of the ratio of the working-age to the total population. Between 1981-82 and 2018-19, the average growth in income per capita was 4.3 per cent.

While growth in income per worker is 4.5 per cent, the contribution of growth of labour participation and the growth of the ratio of the working-age to the total population is actually negative for the entire period.

Table-2: Annual average growth rates for India and selected states: 1981–2018

States	1981-2018				1981-1990				1991-2000				2001-2010				2011-2018			
	g(Y/ N)	g(Y/ L)	g(L/ WA)	g(WA /N)	g(Y/ N)	g(Y/ L)	g(L/ WA)	g(WA /N)	g(Y/ N)	g(Y/ L)	g(L/ WA)	g(WA /N)	g(Y/ N)	g(Y/ L)	g(L/ WA)	g(WA /N)	g(Y/ N)	g(Y/ L)	g(L/ WA)	g(WA /N)
Andhra Pradesh	5.3	5.3	-0.8	0.5	4.3	3.4	-0.6	0.4	4.1	3.9	-0.4	0.5	6.7	5.8	0.3	0.5	6.3	8.6	-2.8	0.7
Bihar	2.8	3.5	-0.9	0.3	2.9	2.8	-0.1	0.1	0.0	-0.7	0.7	0.0	4.5	2.4	1.7	0.2	4.4	11.0	-6.9	1.1
Gujarat	5.9	5.8	-0.3	0.4	3.9	2.7	0.4	0.4	3.9	3.4	0.0	0.5	8.4	8.2	-0.2	0.4	7.9	9.4	-1.7	0.4
Himachal Pradesh	4.8	4.4	-0.1	0.6	3.0	2.7	-0.5	0.5	4.4	3.1	0.6	0.6	5.4	3.3	1.4	0.6	6.8	9.1	-2.6	0.5
Karnataka	5.1	5.3	-0.7	0.5	3.0	2.5	-0.1	0.5	5.0	4.4	-0.1	0.7	5.4	4.8	0.0	0.6	7.2	10.1	-2.9	0.4
Kerala	4.8	4.5	0.2	0.3	1.9	2.2	-0.3	0.6	4.5	4.2	-0.1	0.4	7.1	5.5	1.4	0.1	5.9	6.5	-0.5	-0.1
Madhya Pradesh	3.3	4.6	-1.5	0.4	2.4	2.7	-0.3	0.2	1.3	1.1	0.0	0.2	4.8	3.3	0.7	0.7	5.1	13.0	-7.5	0.7
Maharashtra	5.0	5.3	-0.7	0.5	3.7	4.0	-0.2	0.3	3.7	3.8	-0.5	0.3	7.3	6.5	0.1	0.6	5.4	7.2	-2.3	0.6
NCT of Delhi	4.8	4.7	-0.2	0.4	3.2	3.2	-0.2	0.1	4.2	3.8	0.0	0.3	6.8	6.5	-0.2	0.5	5.2	5.3	-0.6	0.5
Odisha	3.8	4.2	-0.6	0.5	1.1	1.6	-0.6	0.4	2.5	2.3	-0.1	0.3	5.9	3.2	2.1	0.5	6.2	10.8	-4.5	0.6
Punjab	3.7	3.3	-0.2	0.5	3.4	3.2	-0.5	0.3	2.5	0.8	1.3	0.4	4.3	3.9	-0.4	0.7	4.7	6.0	-1.7	0.5
Rajasthan	4.6	4.7	-0.5	0.5	5.6	5.0	0.3	0.2	2.0	1.3	0.7	0.1	6.0	4.5	0.7	0.8	4.9	8.9	-4.5	0.9
Tamil Nadu	5.5	5.4	-0.4	0.3	4.2	3.2	-0.1	0.5	4.8	4.5	-0.1	0.4	6.7	6.0	0.3	0.3	6.3	8.2	-1.9	0.1
Uttar Pradesh	3.1	3.4	-0.6	0.4	2.7	2.4	0.4	0.1	0.9	0.7	0.2	0.0	4.3	2.9	0.7	0.7	4.9	8.5	-4.3	1.1
West Bengal	3.9	3.4	0.2	0.5	2.0	2.0	0.4	0.2	4.7	3.4	0.8	0.5	4.9	2.9	1.2	0.7	3.9	5.7	-2.2	0.6
India	4.3	4.5	-0.5	0.4	2.9	2.7	-0.1	0.3	3.5	3.1	0.1	0.3	5.8	4.5	0.7	0.5	5.4	8.3	-3.4	0.7

The results of the decomposition exercise are also presented for the different phases which cover the census years. Notably, the growth in income per capita over these time periods but was lower over the period 2011-12 to 2018-19, the average growth rates in per capita income were 2.9 per cent over 1981 to 1991, 3.5 per cent over 1981 to 1991, 5.8 per cent over 1981 to 1991 and 5.4 per cent over 1981 to 1991. The share of working age in total population and labour force participation rate contributed approximately 11 per cent between 1991-2000 and 20 per cent between 2001 to 2010. But the contribution is negative between 2011-2018 although working age share alone contributed to 11 per cent of overall growth in per capita income over this period.

In both table 3 and table 4, the increment to per capita income growth is slightly higher for the period 1991-2010. On average, more than 1 per cent addition to per capita income growth is observed during this phase for every 1% increase in initial share of working age population. Rather than the rate of growth in share of working population, it is the level of share of working age population which matters more for economic growth. Among other covariates, the role of capital expenditure in augmenting growth is significant in the fully adjusted models. The share of literacy rate and urban population appears to be significant for 1991-2018 phase only.

Table 3: Estimates of demographic dividend based on simple regression adjusted for fixed/random effects model and other covariate

	1981-2018	2001-2018	1991-2018	1991-2010	2001-2018	1991-2018	1991-2010
Log (initial per capita income)	-0.046	-0.037*	-0.004	-0.106	-0.075**	-0.046***	-0.224**
	0.023	0.016	0.005	0.061	0.021	0.012	0.075
Log (initial % working-age population)	0.673**	0.454**	0.213***	1.337*	0.136	0.174**	1.153*
	0.198	0.118	0.044	0.53	0.178	0.055	0.456
Growth in the ratio of working-age to population	-0.565	-1.212	1.159*	0.821	-2.733	-0.709	-3.467
	0.861	0.758	0.48	1.35	1.377	0.619	2.148
Log (Literacy rate)					0.147	0.042*	0.126
					0.111	0.018	0.07
Log (Share of Urban population					-0.012	0.014*	0.113
					0.018	0.006	0.081
Log (Capital expenditure)					0.025**	0.019***	0.032**
					0.007	0.004	0.008
Constant	-2.232**	-1.419***	-0.787***	-4.338*	-0.496	-0.553***	-3.501*
	0.583	0.34	0.133	1.566	0.449	0.161	1.391
N	555	270	420	300	270	420	300
Dummy for State	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dummy for Time	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Model Type	FE	FE	RE	FE	FE	RE	FE
Hausman test: chi2	14.15	7.99	4.65	14.81	14.64	9.49	17.25
(p-value)	0.0027	0.0463	0.199	0.002	0.0233	0.1479	0.0084

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

Discussion

The contribution of age structure in India's economic growth remains an under researched area. This study comments on the changing age structure distribution across major Indian States. Also, an attempt has been made to establish the association between age structure and economic growth using a panel data

for 15 States for the period 1981 to 2018. Following are the salient findings: huge variation in age composition is observed across the States with Kerala and Tamil Nadu already have passed through the second stage of the demographic transition. But opportunity awaits for some of the largest States such as Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh where the share of working age population will continue to increase. Second, the economic performance of Indian economy in the period 2011-2018 is relatively poor as compared to 2001-2010 period. The economies of some of the most populous States where the share of working age population is bound to increase such as Andhra Pradesh, Bihar, Maharashtra, Rajasthan and West Bengal have grown at a slower pace this decade.

Coming to the impact of favorable age structure, our results confirm the positive association between share of working age population and economic growth in context of India. The findings are in line with previous studies which have attempted to estimate the demographic dividend for India (James, 2008; Aiyar & Mody, 2011; Kumar, 2014; Ghosh, 2016; Joe et al, 2018). We observe that 1 per cent increase in share of working age was associated with more than 1 per cent increase in annual per capita income growth over the period 1991-2010. In fact, a recent study found that the contribution of India's demographic dividend is estimated to be around 1.9 percentage points out of 12% average annual growth rate in per capita income during 1981–2015 (Jain and Goli, 2021). Our results are more comprehensive since we provide estimates for various growth phases which allows us to test the contribution of favorable demographic structure towards economic growth controlling for other covariates.

An interesting result which emerge from our study is the relatively higher importance of the level of share of working age population as compared to growth in share. Once we adjust the model for other important correlates such as literacy, share of urban population and capital expenditure then the estimates for growth in share of working population is attenuated as well as rendered insignificant and this is largely due to the inclusion of capital expenditure. As compared to earlier studies, capital expenditure has been included as a proxy for government expenditure as well as infrastructure as it has stronger implications for economic growth as compared to revenue expenditure which is dictated by populist policies (Goyal and Sharma, 2018). Notably, the data on capital expenditure is not available for the period prior to 1990. Literacy and share of urban population appear to be positively associated with economic growth. This is broadly in consensus with the human capital theory which states that educated population is likely to be more productive (Mankiw, Romer, and Weil 1992).

At this stage, it is clear that a lack of conducive environment could be a deterrent to achieve a large dividend. To elaborate, economic growth remained moderate during the 2011-2018 phase. Results from regression models indicate a weaker association of share of working age with economic growth for the period 1991-2018 as compared to 1991-2010. A number of economic events such as demonetization in

2016 and roll out of GST in 2017 had unintended consequences which resulted in loss of job opportunities and smooth functioning of the economy. Although these reforms will be beneficial for the economy in the long run but India seems to have lost the crucial phase when share of working age people was increasing for some of the most populated States. The economic recovery has been further marred by the outbreak of the COVID-19 pandemic which has increased the economic insecurity.

A major constraint to achieve higher economic growth has been the inability to absorb labor and deploy them in productive activities. Employment generation has not been commensurate with the number of workers entering the labor force. As pointed out earlier, a huge amount of workers are engaged in primary sector which does not contribute much towards overall gross domestic product. Low level of skills and literacy levels have resulted in India losing the competitive advantage in manufacturing to other countries such as Vietnam and Bangladesh. Clearly, there is a need to skill workers as per the industry needs. The economies of Bihar, Rajasthan and Uttar Pradesh where a higher number of younger people will be entering the labor force has a golden opportunity. Another worrying concern is the low employment rates among females as compared to males which could wipe off additional economic gains. The reason for the low participation of women in economic force is determined by social structure as well as high fertility rates. This holds for Bihar and Uttar Pradesh where not only the fertility rates are higher but education among women is low. The major reason for the decline in work force participation in spite of increasing education levels is also the lack of appropriate jobs especially in rural areas for women with moderate level of education (Chatterjee, Desai and Vanneman, 2018; Afridi, Dinkelman and Mahajan, 2018). In addition, educated women are married off as per cultural norms which lead to engagement in household activities and consequently they have to drop off from the labor force (Chatterjee, Desai and Vanneman, 2018). Focus on women education and family planning programs and employment generation could be instrumental in preparing the future workforce. To conclude, India has at most one decade left before the old age dependency ratio starts increasing. The extent of the dividend in the coming years will depend on the ability of the State to create conducive environment today.

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Table-S1: List of India specific studies on quantification of demographic dividend using regression-based approach

Authors	Title	Time frame	N	Econometric Method	Dependent variables	Independent variables	Variable of interest	Coefficient of working age population
KS James 2008	Glorifying Malthus: Current Debate on 'Demographic Dividend' in India	1961-2001	60 (14 States)	OLS,2SLS	Growth rate of per capita income	Initial per capita income, growth in share of working age population, Literacy rate, Life expectancy, labour force transition rate and dummy for age structure transition	Growth in total population	-2.28
							Growth rate of the working-age population	-0.35
Shekhar Aiyar and Ashoka Mody, 2011	The Demographic Dividend: Evidence from the Indian States	1961-2001	76 (22 States)	Instrument variable	Annual per capita income growth	Initial per capita income, initial Working age population share, growth in share of working age population, Literacy rate, Sex ratio, hospital beds, social, economic, development expenditure, bank credit, land reform, labor reform index	Log (Initial share of working-age population)	0.14-0.30
							Growth rate of the working-age population	2.2-4.98
Vasundra Thakur 2012	The Demographic Dividend in India: Gift or curse? A State level analysis on differing age structure and its implications for India's economic growth prospects	1981-2011	51 (17 States)	OLS,2SLS	Annual per capita income growth	Initial per capita income, initial working age population share, growth in share of working age population, Literacy rate, Infant mortality rate, fertility rate	Log (initial % working-age population)	1.6-2.9
							Growth in the share of the working-age population	negative .43 to .03
Utsav Kumar 2013	India's Demographic Transition: Boon or Bane?	1971-2001	51 (17 States)	OLS,2SLS	Annual per capita income growth	Initial per capita income, initial working age population share, growth in share of working age population, initial overall physical, social infrastructure index	Growth in the share of the working-age population	2.3-2.8
							Log (Initial share of working-age population)	0.37-0.66
Gargi Bhattacharya & Sushil Haldar, 2015	Does demographic dividend yield economic dividend? India, a case study	1971-2011	60 (15 States)	OLS,2SLS	Growth rate of per capita income	Initial per capita income, initial Working age population share, growth in share of working age population, social sector expenditure, bank credit deposit ratio	Log (Initial share of working-age population)	10.54
							Growth rate of the working-age population	0.88
Saibal Ghosh 2015	Estimating the demographic dividend: Evidence from Indian states	1961-2011	70 (13 States)	2SLS	Log of Per capita NSDP	Working age population share, growth in share of working age population, Literacy rate, Sex ratio, road, PHC, crime, Bank office	Log (% working-age population)	2.07-2.35
							Growth in the share of the working-age population	.24-.36
William Joe et. al. 2018	Swimming against the tide: economic growth and demographic dividend in India	1980-2010	465 (15 States)	OLS,2SLS, ARDL	Annual per capita income growth	Initial per capita income, initial working age population share, growth in share of working age population, Literacy rate, Infant mortality rate	Log (initial % working-age population)	1 -1.5 (panel data model) and 4 (ARDL model)
							Growth in the share of the working-age population	negative 4.4 to 1.7
Jain and Goli (2021)	Demographic Change and Economic Growth in India	1980-2015	100(25 States) OLS,2SLS, FE,RE		Growth rate of per capita income	Urbanisation, social sector expenditure, governance index, gender development index, gender empowerment measure, education institutional resources, share of agriculture to non-agriculture, export openness index, infrastructure index, IMR, graduate share and workforce participation rate	Log Working-age ratio	0.55 to 4.8 (FE RE) 4.9 to 7.8 (OLS) 3 to 5.8 (2SLS) 12 to 18 (barro specification)