Demographic Change and Economic Growth in India

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Abstract

This paper assesses the economic benefits of demographic changes in India by using panel data and employing robust econometric models. The analysis highlights three key points: First, the dividend effect is estimated to be around one percentage points per annum for the period 1981 – 2015 after controlling for core policy variables. Second, the significance of interaction effects and instrumental variable results strengthen the argument that the working age population can promote economic growth only if they are equipped with good health, quality education, and decent employment opportunities. And third, the working age population explains the maximum portion of the inequality in per capita income across states. Thus, India needs to work towards enhancing the quality of education and health care along with employment opportunities for the growing working age population. Job generation and spending on health and education is the key for reaping maximum dividend from demographic windows of opportunity.

Keywords: Demographic Dividend, Economic Growth, Population Growth, Working Age Population, Health, Education, Employment

JEL Classification Numbers: J10, J11

1. Introduction

The impact of demographic factors, mainly population size and its growth, on economic development has long been represented by three major contesting views in the literature – the pessimistic theory, the optimistic theory and the neutralist theory (Coale & Hoover, 1958; Birdsall, Kelly, & Sinding, 2003). But these growth debates have ignored the effect of changes in age structure (due to variable population growth) on economic performance. It is only after the late eighties and particularly the late nineties, the significance of age structure and the resulting emergence of "Demographic Dividend" got acknowledged in the growth literature (Bloom & Freeman, 1988; Bloom & Sachs, 1998; Bloom & Williamson, 1998; Bloom, Canning & Sevilla, 2001; Higgins & Williamson, 1997; Mason, 2001).

The concept of 'Demographic Dividend'[1] emanates when an economy moves from the second stage to the third stage of demographic transition process in which the birth rates begin to fall, coupled with a falling death rate and leads to subsequent shift in the age structure of the population towards working age group (15-59) relative to the population of dependents (0-14 and 60+). Among the dependents, the child population falls dramatically while that of the old age population grows only moderately thereby creating opportunities for growth (Bloom, 2011).

The rising share of working age population creates a potential for many benefits: first, an increase in the labor force who produce more than they consume. Second, lower fertility rate induces greater participation of females in the labor market. Third, greater investment in health, education, and skills of the population as lower resources are needed to be diverted for child caring and rearing. Fourth, household savings increase as working age people are more capable of saving than the dependents and accord capital for investment purposes. The fifth argument follows from the Life-Cycle Hypothesis which states that people in the working age save more for their retirement due to improvements in life expectancy (Bloom, Canning, & Sevilla, 2003; Bloom, 2011; James, 2008; Kumar, 2013). However, the realization of DD is conditional on the existing policy environment such as better education, skills, and health, and disability outcomes, growing employment

[1] From now onwards, Demographic Dividend is abbreviated as DD throughout the paper.

opportunities for a rapidly growing young population, trade openness, etc. Also, this dividend is transitory in nature and vanishes over time with further demographic changes.

It is in this context, the focus of this paper is to estimate the impact of demographic factors on economic growth in India, which has emerged as both a demographic and an economic giant in the world. Its population is around 18 percent of the world's population and its Gross Domestic Product (GDP) growth at about 6.8 percent in 2018-19 makes it the world's fastest-growing major economy (Economic Survey, 2019). It is found that India is on the edge of the 'demographic revolution' with the rapidly rising share of the working-age population from approximately 58 percent in 2000 to nearly 64 percent in 2040. Furthermore, the population estimates suggest that the average age of the population in India by 2020 will be 29 years while in other countries such as USA, Europe, and Japan, it will be 40 years, 46 years and 47 years respectively (National policy for skill development and entrepreneurship report, 2015). This indicates that India is one of the 'youngest large nations' in the world which is expected to have a potential growth-inducing impact on the economy (Chandrasekhar, Ghosh, & Roychwdhury, 2006; James, 2008; Lee & Mason, 2006; Mason, 2005).

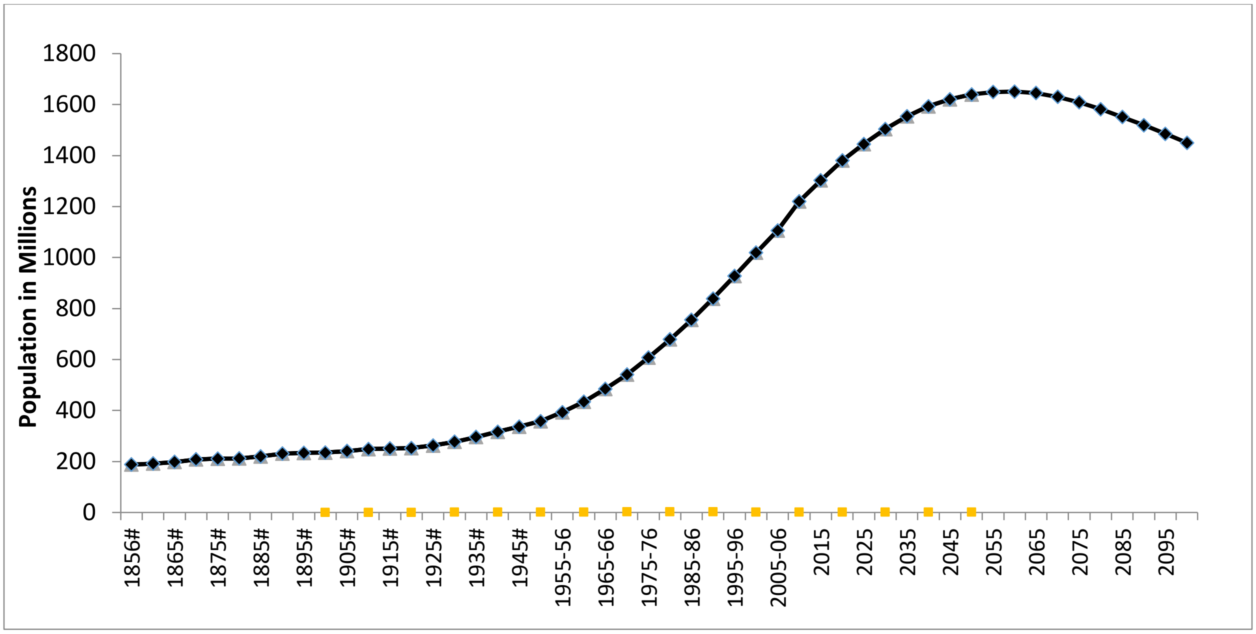
This paper is timely and relevant as India has just entered the 37 years of the window of DD opportunity beginning from 2018 to 2055. Also, there is huge inter-state variations in the availability of this window with some states like southern and western states have seen the closing of their DD phase while the window of opportunity has just begun in states like Bihar, Jharkhand, Madhya Pradesh, Rajasthan, and Uttar Pradesh (UNFPA, 2019).

Akin to global literature, the present empirical analyses in India comprises of both optimistic and pessimistic views on India's potential of realizing DD. Therefore, this paper endeavors to do a better assessment of demographic change and economic implications in India through the following ways: First, it comprehensively assesses the DD for twenty-five states of India for the time period 1981 – 2015. Secondly, it employs robust econometric models such as Pooled OLS Model, Panel Data Regression Model, Barro Conditional Regression Model, Instrumental Variable Model, and Regression-Based Inequality Decomposition Model under which a range of core policy variables are controlled to have a real demographic effect (explained in detail in data and methods section). Third, though the existing literature on this issue has theoretically argued that working age population can have a significant impact on per capita income only if it is equipped with good health, quality education, and decent employment opportunities (Chandrasekhar et al. (2006); Desai (2010); Goli and Pandey (2010); James (2011) and James and Goli (2016); Joe et al. (2018)). This dominant view has been examined empirically through the use of interaction effects and instrumental variable model (Two-Stage Least Square 2SLS). Lastly, this paper makes a significant contribution to the existing literature on this issue by exploring a new dimension in which the role of working age population in the growing income inequality across Indian states have been checked by using Regression-Based Inequality Decomposition Model which in our knowledge has not been attempted by any other study.

The rest of this paper is organized as: Section 2 discusses stylized facts on India's changing demographic profile. Section 3 provides a literature review on DD (both global and Indian experience). Section 4 deals with methods and data. Section 5 estimates the DD by using various models for the period 1981-2015. Section 6 focuses on challenges in the way of realizing DD and Section 7 concludes.

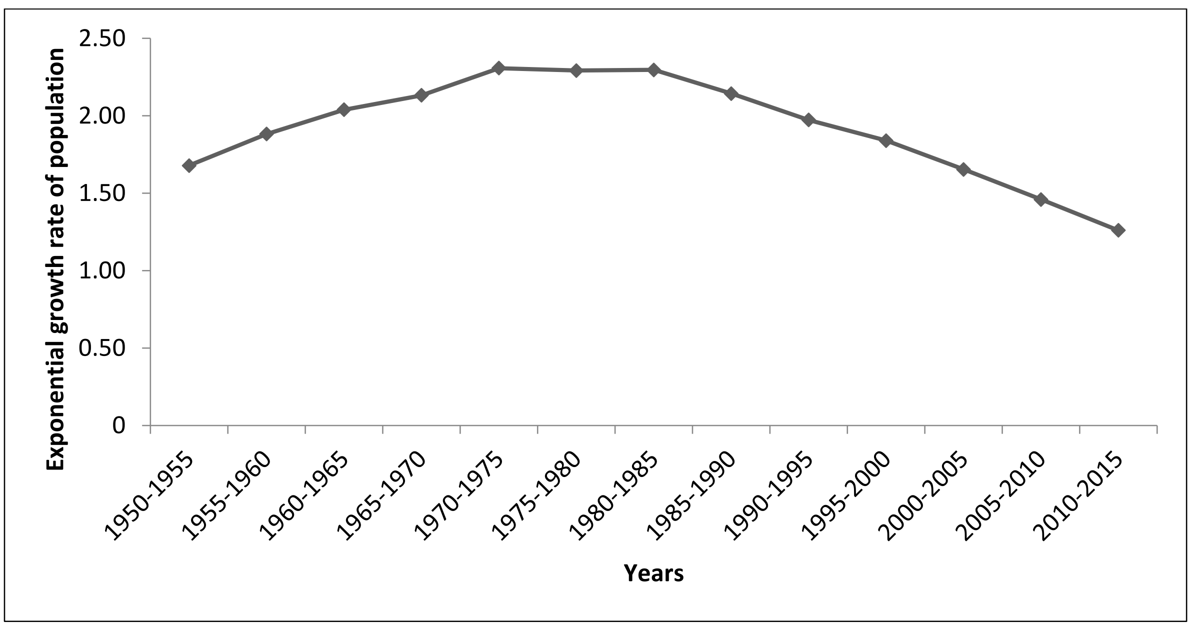
2. Stylized Facts on India's Changing Demographic Profile

An analysis of India's population since 1856 reveals that there has been a marginal increase in the population before independence but it rises tremendously thereafter to 1.2 billion in 2011. Its size is estimated to rise further to reach 1.7 billion people by 2060 but after this, a downfall in population size is projected (Fig. 1). The trends in the exponential growth rate of the population at all India level displays an inverted U-shaped pattern with continuously falling population growth rate recorded since 1990-91 (Fig. 2). This pattern of decreasing exponential growth rate of population is also discernible in all the states of India, except for Tamil Nadu where the growth rate of population is small and the present increase in its population growth is mainly attributed to its inward migration (Fig. 3). Therefore, to comprehend this eccentric pattern of demographic change in India, one has to delve into the underlying forces of fertility and mortality (James and Goli, 2016).



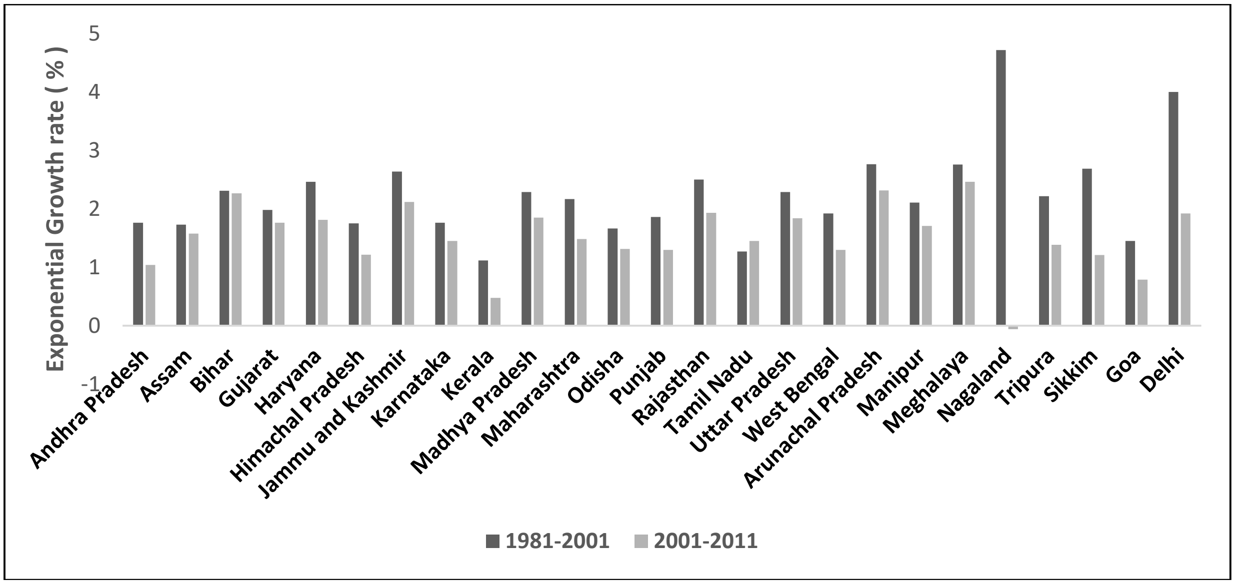
Source: World Population Prospects (19th Revision), United Nations 2019.

Fig. 1. Trends in Population Size (in millions) in India (1856 – 2100)



Source: World Population Prospects (19th Revision), United Nations 2019.

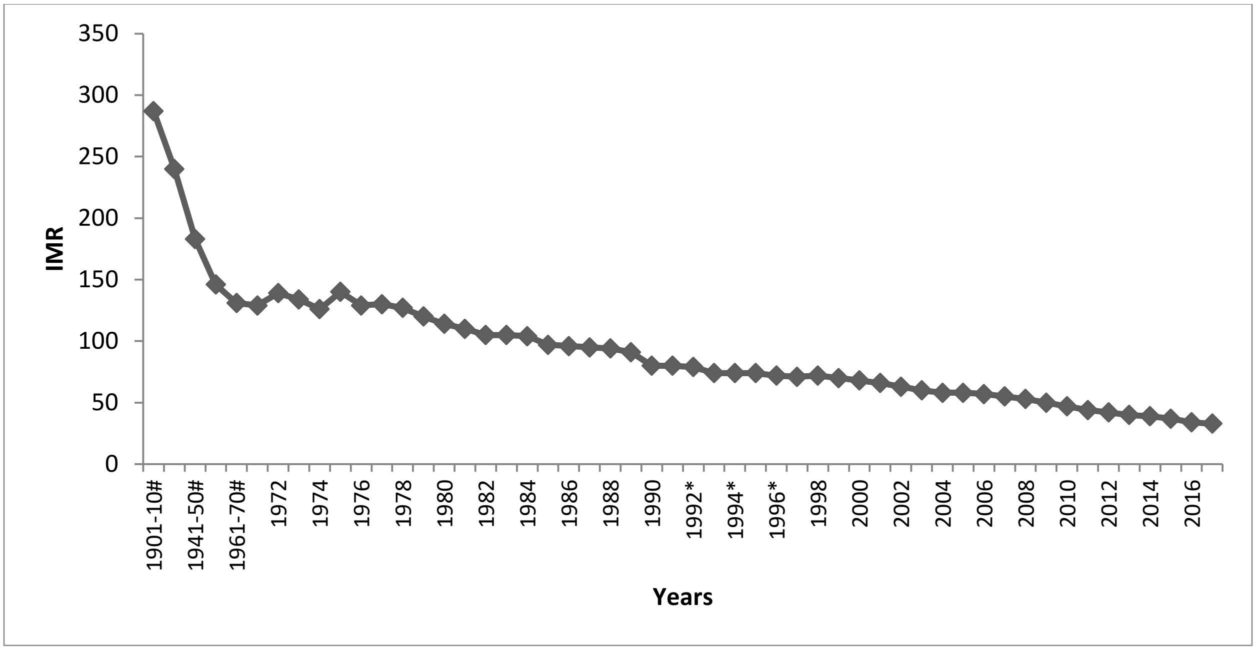
Fig. 2. Trends in Exponential Growth Rate of Population in India (in percentage)



Source: Census of India, Office of the Register General, India.

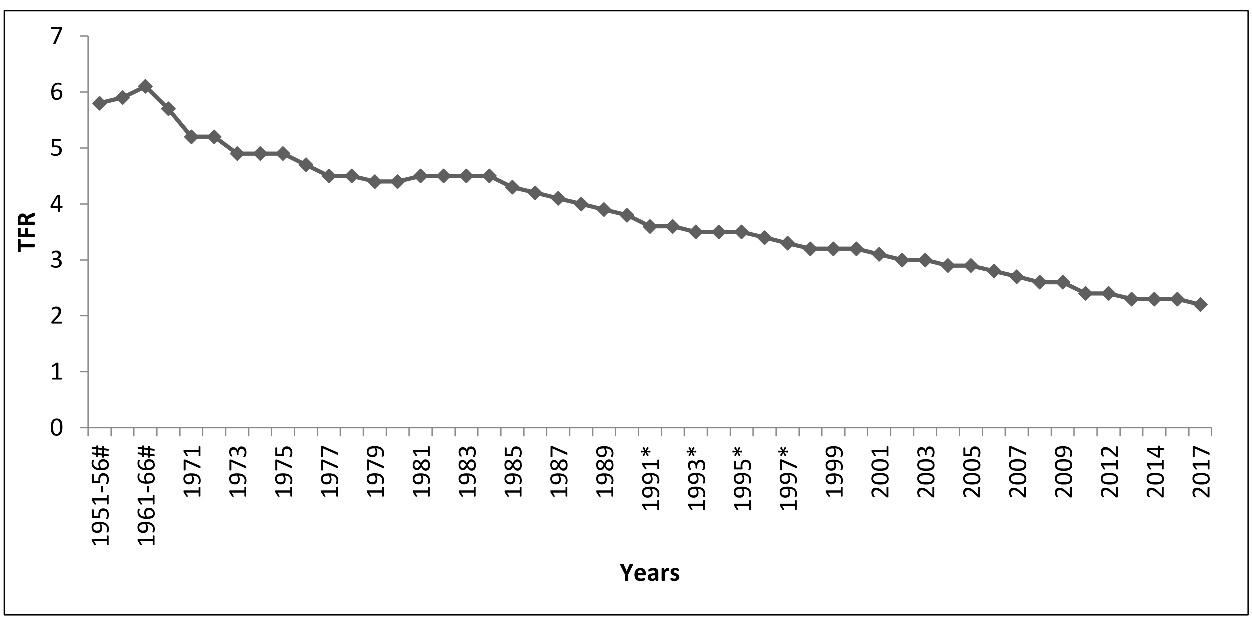
Fig. 3. Trends in Exponential Growth Rate (in percentage) across major States of India

The trends in population health parameters such as mortality rate, fertility rate, life expectancy at birth, and child birth rate and death rate (Fig. 4 to 7) reveal that there is advancement in nation's health, with analogous results at state level also, particularly in demographically laggard states (James & Goli, 2016). The mortality rate captured by Infant mortality rate (IMR) has gone down from 129 per 1,000 live births in 1971 to 33 per 1,000 live births in 2017. The Total Fertility Rate (TFR) has fallen from 5.2 children per woman in 1971 to 2.2 children per woman in 2017, almost touching the replacement fertility level of 2.1 children per woman. India's average life expectancy at birth (LEB) has risen from just 39 years in the post-independence period to 68.7 years in 2016. The trends in child birth rate (CBR) and Child death rate (CDR) show that there is a fine movement in the demographic transition process of India. All these population parameters have important implications for the age structure transition of India's population.



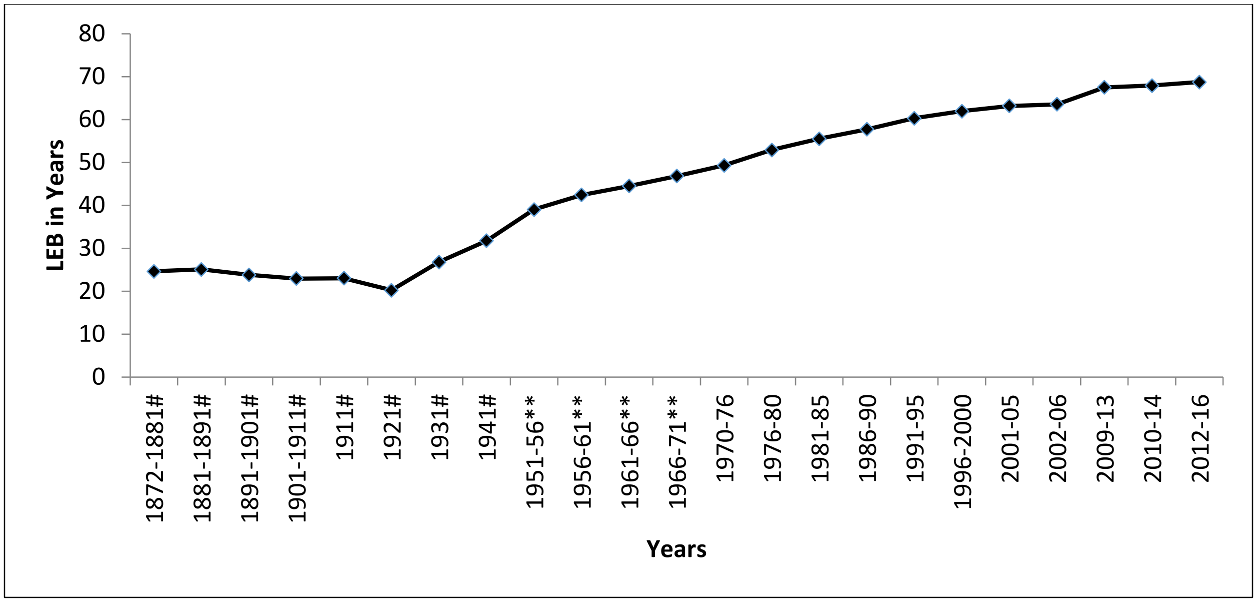
Source: Authors' estimates from various rounds of Sample Registration System

Fig. 4. Trends in Infant Mortality Rate (IMR) in India



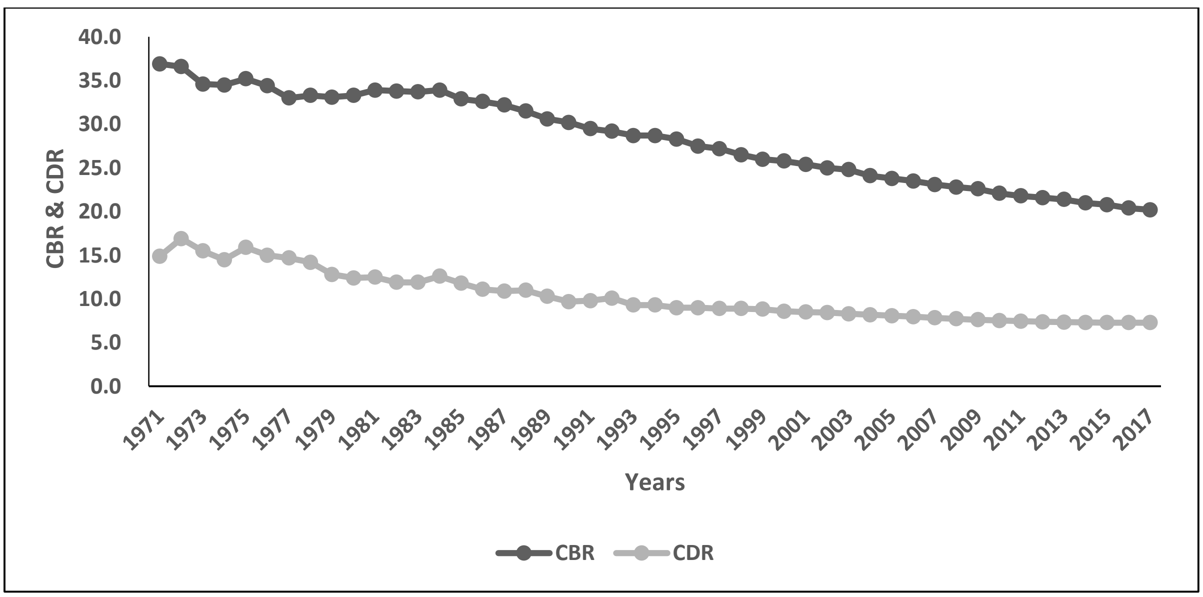
Source: Authors' estimates from various rounds of Sample Registration System

Fig. 5. Trends in Total Fertility Rate (TFR) in India



Source: Authors' estimates from various rounds of Sample Registration System

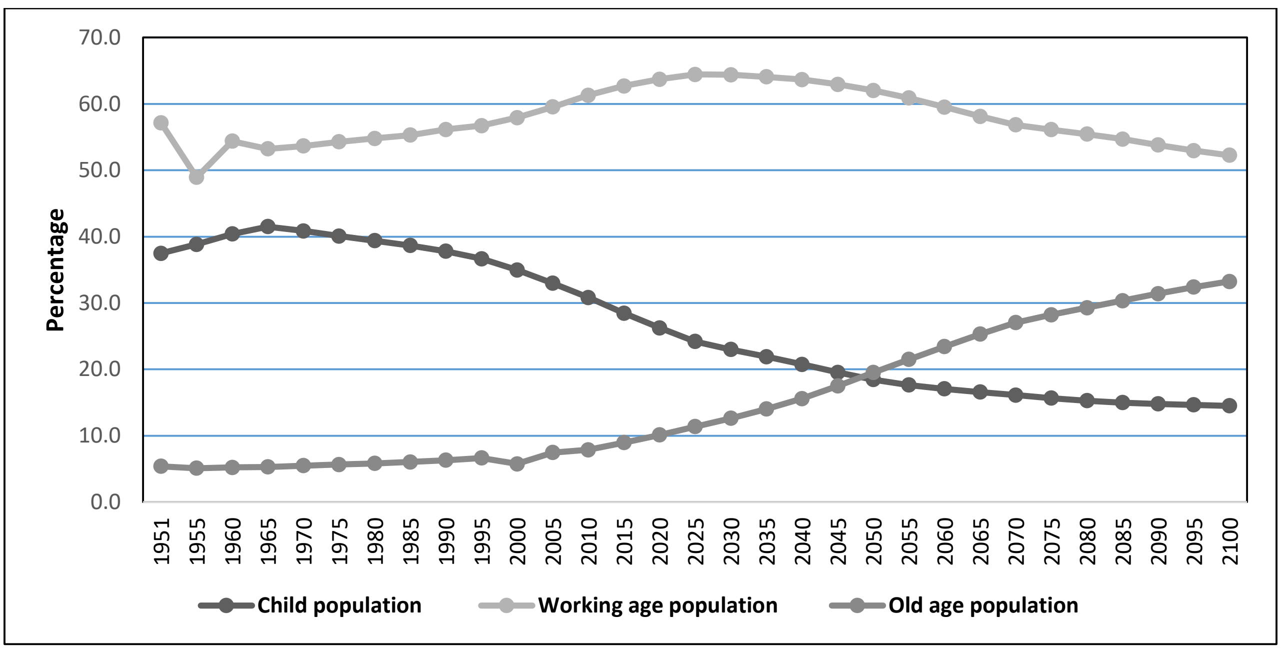
Fig. 6. Trends in Life Expectancy at Birth (LEB) in India



Source: Authors' estimates from various rounds of Sample Registration System

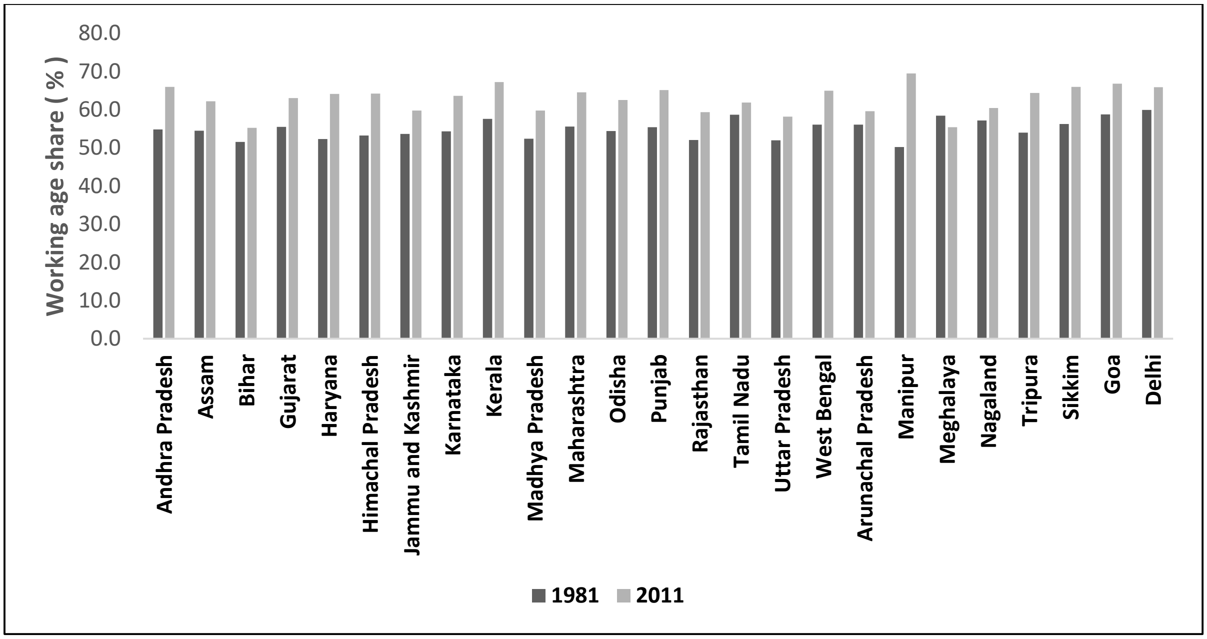
Fig. 7. Trends in Child Birth Rate and Child Death Rate (CBR & CDR) in India

The age structure transition of the Indian population (1951 – 2100) reveals that the size of the child population (0-14 years) is continuously falling whereas the share of the older-age population (above 60 years) is rising due to improvement in life expectancy. It is estimated that the percentage of the old age population will go up from 5.7 percent in 2000 to 33.2 percent in 2100, surpassing the estimated child population. Even the working age population will continue to increase till 2035 and experience a downfall thereafter (Fig. 8). Further, the trends in the share of the working-age population across different states of India (Fig. 9) highlight that the share of the working age population is rising across all the states of India (except for Meghalaya). But there is heterogeneity in its share with the proportion ranging between 55 percent for Bihar to 69.5 percent for Manipur in 2011. There is phenomenal increase in the working age share in the Manipur (around 19 percent) followed by around 10 percent rise in the Southern states (except Tamil Nadu), Haryana, Himachal Pradesh, Punjab, Tripura, Sikkim, Maharashtra, and West Bengal over the last three decades while northern and central India states like Bihar, Madhya Pradesh, Rajasthan, and Uttar Pradesh have seen smaller rise in its share. This implies that these states where the fertility rate is still moderately high will have a huge working age share in the coming years.



Source: World Population Prospects (19th Revision), United Nations 2019.

Fig. 8. Age – Composition of India’s Population (1951-2100)



Source: Census of India, Office of the Register General, India.

Fig. 9. Trends in Working Age Population Share across Indian States

3. Literature review

Demographic Dividend: Global and Indian Experience

The interest in DD began with the developing countries - especially the Asian countries - as they were having a relatively higher population and started experiencing a fertility decline. The transition occurred first in Japan among all the Asian countries, starting around 1964 and lasting till 2004. Then subsequently East and Southeast Asian countries began to reap the advantages of DD. It was estimated that nearly one-third of the economic growth (i.e. per capita GDP growth) between 1960 and 2010 of East Asian countries could be due to DD (Bloom & Williamson, 1998; Bloom, Canning, & Malaney, 2000; Mason, 2001). However, the study by Navaneetham (2002) failed to obtain similar results in the case of Latin American countries. It is due to differences in the policies related to public health, education, flexible labor market, good governance, family planning, trade openness adopted by different countries (Bloom et al., 2003).

In the Indian context, a few studies present pessimistic viewpoints on the issue of India's potential in reaping the DD. The studies by Acharya (2004); Chandrasekhar et al. (2006); Mitra and Nagarajan (2005); Desai (2010); Goli and Pandey (2010); James (2011) and James and Goli (2016) have theoretically argued that DD alone cannot bring about an impetus to growth in the country. The DD just creates a supply-side potential and cannot be realized unless the growing working age population's skills have been enhanced and accommodated in employment.

While Indian studies having empirical estimation (James, 2008; Aiyar & Mody, 2011; Bloom, 2011; Ladusingh & Narayana, 2011; Kumar, 2013; Joe, Kumar, & Rajpal, 2018) have rather found a favourable impact of working-age population on economic growth. The study by James (2008) undertook the analysis for the period 1971-2001 by using two-stage least square (2SLS) method, however, it failed to check the impact of growth in the share of the working age population, the most important component of DD. Kumar (2013) study removed this deficiency but remained skeptical about future growth prospects for India due to the major share of the rise in the working age population in the economically weaker states which have poor infrastructure and a dearth of proper policies to absorb the growing workforce. Another study by Aiyar and Mody (2011) found around 40 to 50 percent of the per capita income growth in India since the 1970s is due to DD after correcting for inter-state migration and using a two-stage procedure to check for endogeneity issue. But unlike Bloom and Canning (2004), this study did not find DD to be dependent on the policy environment which seems to be impractical in the Indian context. A recent study by Joe et al. (2018) findings and analytical approach is inconclusive as it did not find a significant impact of growth in the share of the working-age population on the per capita income growth and failed to control for key policy variables.

4. Data and Methods

4.1 . Data source and Variables

This study compiles data from widely acceptable and reliable sources for 25 states of India (Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal, Delhi, Arunachal Pradesh, Manipur, Meghalaya, Nagaland, Tripura, Sikkim, and Goa) during 1981 to 2015. A stacked time-series panel data is constructed for 25 states * 2 time periods having a total 50 cases. The study variables are grouped into outcome variable, predictor variables, and covariates. The per capita Net State Domestic Product (NSDP) (1981 to 2015) obtained from the Central Statistics Organization (indexed to 2011-12 constant prices) is the outcome variable. The working age population ratio (15 – 59 years) both level and growth (1981 – 2011) in percentage terms is considered as the main predictor variable of economic growth. Besides, other covariates of economic growth are taken to check for the robustness of the demographic factor (see appendix Table A1 for details).

4.2 Methods

The empirical analysis is done in five parts.

I. Pooled OLS Model

This model is run to check for per capita income level correlates. The statistical expression for this model is as follows:

$$Log\ per\ capita\ NSDP_{it} = \alpha + \beta_0\ Log\ working\ age\ ratio_{it} + \beta_1 Life\ expectancy_{it} + \beta_2 Years\ of\ schooling_{it} + \beta_3 Workforce\ participation\ rate_{it} + u_{it}.$$

This model is extended to include interactions between working age ratio and health, education, and employment factors. The statistical expression is given below:

$$Log\ per\ capita\ NSDP_{it} = \alpha + \beta_0\ Log\ working\ age\ ratio_{it} + \beta_1\ Log\ working\ age\ ratio_{it} * Healthloss\ index + \beta_2\ Log\ working\ age\ ratio_{it} * Years\ of\ schooling + \beta_3\ Log\ working\ age\ ratio_{it} * Workforce\ particpiation\ rate + \beta_4\ Urbanization\ rate_{it} + \beta_5\ Log\ gross\ fixed\ capital\ formation\ _{it} + \beta_6\ Infrastructure\ index_{it} + \beta_7\ Social\ sector\ expenditure + \beta_8\ Log\ net\ sown\ area_{it} + u_{it}.$$

Where, $Log\ per\ capita\ NSDP_{it}$ is the dependent variable. $Log\ working\ age\ ratio_{it}$ is the main predictor variable. Rest other variables on the right-hand side are covariates. α is the constant term. β is the coefficient for independent variables. u_{it} is the error term.

II. Panel Data Regression Model

This model is employed as it controls for variables that are not directly observable or measurable across states like cultural factors or variables that change over time but not across entities. To decide between which panel data regression model to be used: fixed or random effects, the Hausman test is used with the null hypothesis that the preferred model is random effects and the alternative hypothesis is that the fixed effects model should be used. The statistical expression for the Panel data regression model is as follows:

$$Log\ per\ capita\ NSDP_{it} = \alpha + \beta_0\ log\ working\ age\ ratio_{it} + \beta_1\ Log\ working\ age\ ratio_{it} * Health\ loss\ index + \beta_2\ Log\ working\ age\ ratio_{it} * years\ of\ schooling + \beta_3\ Log\ working\ age\ ratio_{it} * Workforce\ participation\ rate + \beta_4\ Health\ loss\ index_{it} + \beta_5\ Urbanization\ rate_{it} + \beta_6\ \log gross\ fixed\ capital\ formation_{it} + \beta_7\ Infrastructure\ index_{it}\ + \beta_8 \frac{Credit}{deposit}_{it} + \beta_9 Social\ sector\ expenditure_{it} + \beta_{10}\ Log\ net\ sown\ area_{it} + u_i + v_{it}.$$

Where, $Log\ per\ capita\ NSDP_{it}$ is the dependent variable. $Log\ Working\ age\ ratio_{it}$ is the main predictor variable. Rest other variables on the right-hand side are covariates. β is the coefficient for independent variables. u_i (i=1….n) is a fixed or random effect specific to individual state or time period that is not included in the regression. v_{it} is the error term.

III. Conditional Barro Regression Model

The general equation of conditional barro regression model is as follows:

$$g_y = \lambda\ (X\beta + p + w_o - y_o) + g_w)$$

The above equation links growth in income per capita (g_y) to a range of explanatory variable X that determine steady-state labor productivity, the initial level of income per capita y_o, and the ratio of working age to the total population w_o and its growth rate g_w. The constant term captures the participation rate p. The statistical expression used in this paper is as follows:

$$Growth\,per\ capita\ NSDP_{it} = \alpha + \beta_0\ Log\ initial\ working\ age\ ratio\ _{it} + \beta_1\ Growth\ of\ working\ age\ ratio\ _{it} + \beta_2\ Log\ initial\ income\ per\ capita_{it} + \beta_3\ Disability\ share_{it} + \beta_4\ Graduate\ share_{it} + \beta_5\ Urbanization\ rate_{it} + \beta_6\ Governance\ index\ _{it} + \beta_7\ \frac{Creidt}{deposit}_{it} + \beta_8\ Infrastructure\ index_{it} + u_{it}.$$

Where, Growth $per\ capita\ NSDP_{it}$ is the annual average growth of per capita net state domestic product in state i for the period 1981 to 2015. Rest other explanatory variables have usual interpretation. The Barro Conditional Convergence Regression model is extended to include significant interactions of Growth in working age ratio with health, education and employment factor. The statistical expression for this model is as follows:

$$Growth\,per\ capita\ NSDP_{it} = \alpha + \beta_0\ Growth\,working\ age\ ratio\ _{it} * Health\ loss\ index + \beta_1\ Growth\,working\ age\ ratio\ _{it} * Literacy\ rate + \beta_2\ Growth\,working\ age\ ratio\ _{it} * Work\ force\ participation\ rate + \beta_3\ Log\ initial\ working\ age\ ratio_{it} + \beta_4\ Log\ initial\,per\ capita\ income_{it} + \beta_5\ Health\ loss\ index_{it} + \beta_6\ \log Gross\ fixed\ capital\ formation_{it} + \beta_7\ Infrastructure\ index_{it} + \beta_8\ Social\ sector\ expenditure_{it} + u_{it}.$$

Where, Growth $per\ capita\ NSDP_{it}$ is the annual average growth of per capita net state domestic product in state i for the period 1981 to 2015. Rest other explanatory variables have usual interpretation.

IV. Instrumental Variable Model

In this model, the impact of working age share on per capita income is assessed by instrumenting it with health loss index, years of schooling, and workforce participation rate. The statistical expression for the model is as follows:

$$Log\,per\ capita\ NSDP_{it} = \alpha + \beta_0\ (\ Log\,working\ age\ ratio_{it} = Health\ loss\ index_{it}, Years\ of\ schooling_{it}, Work\ force\ participation\ rate_{it}) +$$

$\beta_1\ Urbanization\ rate_{it} + \beta_2 \log gross\ fixed\ capital\ formation\ + \beta_3$
$Social\ sector\ expenditure\ + u_{it}$.

Where, $Log\ per\ capita\ NSDP_{it}$ is the dependent variable. $Log\ working\ age\ ratio_{it}$ is the main predictor variable and it is instrumented by Health loss index, Years of schooling, and Workforce participation rate. Rest other explanatory variables have usual interpretation.

V. Regression-Based Inequality Decomposition Model

In this model, the inequality in per capita income is decomposed by using the regression-based approach. In this method, first, an income-generating function is set as

$$\ln(y_i) = \alpha + \sum_k \beta_k x_{ik} + \varepsilon$$

Where y is per capita income, x is a vector of explanatory variable and ε is the residual term. Then following Shorrocks (1982), and Fields & Yoo (2000), the contribution of each variable to total per capita income inequality can be assessed as follows:

$$\sigma^2(\text{y}) = \sum_{i=1}^{k} \beta_i \ \text{cov}(\text{y}, x_i) + \sigma^2(\varepsilon)$$

Where, $\sigma^2(\text{y})$ is the variance of y, $\text{cov}(\text{y}, x_i)$ represents the covariance of y with each variable (x_i) and this term can be considered as the contribution of the factor components to total per capita income inequality.

5. Empirical Estimation

The descriptive statistics given in appendix Table A1 highlights that there are huge demographic and economic variations in India as visible in stark differences between the maximum and minimum values of all the variables. The main variable of interest – the share of the working age population varies from 50.25 percent to 69.50 percent across states over time. Similar is the case with log per capita NSDP. Human capital variables such as literacy rate, graduate share, life expectancy at birth, disability share and other political and economic variables also demonstrate glaring variation across states over time. This heterogeneity provides the basis for further research.

Table 1 estimates the per capita income correlates for the time period 1981-2015 by using the Pooled OLS model. Model 1 to 4 first assesses the prime determinants of DD individually that is the share of working age population, life expectancy at birth, years of schooling and workforce participation rate. It highlights that the log of working age ratio is the single most important correlate of per capita income (β_0= 8.66, p<0.01) followed by human capital variables (life expectancy at birth and years of schooling) and employment. Model 5 to 7 include interactions between working age share and health, education and employment factors. The results emphasize that educated working age population (shown by interaction between log of working age ratio and years of schooling in model 6) and employed working age population (appearing as interaction between log of working age ratio and workforce participation rate in model 7) has a positive significant association with per capita income, controlling for other factors. Other significant determinants of per capita income are urbanization rate, log of gross fixed capital formation, infrastructure index, and log of net sown area. The problem of multicollinearity among the explanatory variables is checked by using the variance inflation factor (VIF) method. All the models are statistically good as suggested by the high value of Adjusted R-square.

Table 2 re-estimates the per capita income determinants by using the Panel model as it controls for variables that are not directly observable or measurable across states. Hausman test is conducted to decide between fixed and random effects. The value of R-square is satisfactorily high in all four models. The result highlights that the working age population share remains a significant determining factor of per capita income in all the models. Also, the interaction term between working age ratio and years of schooling is statistically significant (β_2= 0.074, p<0.01) in model 3, controlling for other factors, which suggests that education is a pre-condition in augmenting working age population impact on per capita income. All other control variables have expected signs and are statistically significant.

Table 1
Analysis of Per Capita Income correlates based on Pooled OLS Regression Model

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4
Log working age ratio	8.661***			
	(0.912)			
Life expectancy		0.0938***		
		(0.0117)		
Years of schooling			0.493***	
			(0.0407)	
Workforce participation rate				0.0895***
				(0.0145)
Constant	-24.72***	4.589***	8.527***	7.146***
	(3.676)	(0.727)	(0.167)	(0.522)
R-squared	0.74	0.71	0.77	0.47

VARIABLES	(5) Model 5	(6) Model 6	(7) Model 7
Log working age ratio	7.488***		5.331***
	(1.258)		(1.590)
Log working age ratio *Health loss index	-0.0787		
	(0.0900)		
Log working age ratio *Years of schooling		0.0923***	
		(0.0116)	
Log working age ratio*Workforce participation rate			0.00991**
			(0.00427)
Urbanization rate		0.00813**	
		(0.00384)	
Log gross fixed capital formation		0.0854***	
		(0.0310)	
Infrastructure index	1.362**		1.673**
	(0.619)		(0.626)
Social sector expenditure	0.0178		
	(0.0165)		
Log net sown area	-0.00483		-0.105*
	(0.0531)		(0.0565)
Constant	-20.34***	7.844***	-12.25*
	(5.042)	(0.335)	(6.134)
Observations	50	50	50
Groups	25	25	25
R-squared	0.76	0.81	0.80
Adjusted R-squared	0.74	0.80	0.78
Variance Inflation Factor	1.8	1.7	2.1

Dependent variable is log per capita Net State Domestic Product. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Population adjusted weighted regression. In model 6, the individual impact of log of working age ratio is not considered due to high pair wise correlation between log of working age ratio and years of schooling.

Table 2
The Impact of Demography on Per Capita Income based on Panel Data Regression Model

VARIABLES	(1) Random Effects Model	(2) Random Effects Model	(3) Fixed Effects Model	(4) Random Effects Model
Log working age ratio	5.169***	6.851***		5.260***
	(1.382)	(1.202)		(1.555)
Log working age ratio*Health loss index		-0.109		
		(0.0904)		
Log working age ratio*Years of schooling			0.0743***	
			(0.0111)	
Log working age ratio*Work force participation rate				0.00287
				(0.00281)
Health loss index			-1.409***	
			(0.467)	
Urbanization rate	0.0176***		0.0316**	0.00776*
	(0.00646)		(0.0134)	(0.00434)
Log gross fixed capital formation				0.119**
				(0.0546)
Infrastructure index		1.570***		
		(0.588)		
Credit/deposit ratio	0.00508		0.00305	
	(0.00465)		(0.00582)	
Social sector expenditure	0.0290***	0.0210**	0.0291***	
	(0.00806)	(0.00852)	(0.00766)	
Log net sown area	-0.00488	-0.0302	-0.284*	-0.164**
	(0.0539)	(0.0464)	(0.138)	(0.0741)
Constant	-11.52**	-17.45***	10.66***	-11.27*
	(5.380)	(4.820)	(1.074)	(6.086)
Observations	50	50	50	50
Groups	25	25	25	25
R-square	0.75	0.72	0.77	0.75

Dependent variable is log per capita Net State Domestic Product. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. In model 3, the individual impact of log of working age ratio is not considered due to high pair wise correlation between log of working age ratio and years of schooling

Next, the results from the Conditional Barro Convergence model (Table 3) bring out the positive, statistically significant and large impact of demographic factor - the initial share of working age population and its growth over the period (1981-2011) on the per capita income growth (1981 – 2015). In model 1, an increase of one percent in the growth rate of working age ratio is associated with an increase of 1.63 percent in average annual per capita income growth (β_1= 1.63, $p<0.05$) and a one percent rise in the initial working age ratio leads to around seventeen percent rise in per capita income growth over the period (β_0= 17.88, $p<0.01$). The sign of log of initial per capita income is negative but not significant, suggesting weak convergence across states. Then in models 2 to 5, the robustness of demographic factors is checked by controlling core policy variables. The model's explanatory power improve significantly with adjusted R-square reaching 65 percent. In model 5, when all socio-economic factors are controlled, the point estimate of the growth rate of the working age ratio is still quantitatively stable and has a significant impact on per capita income growth (β_1 = 1.05, $p<0.05$). The coefficient of the initial working age ratio reduces substantially in magnitude (β_0= 9.54, $p<0.05$) after controlling other factors. Further, among the core policy variables, only the credit – deposit ratio is having a significantly positive impact on per capita income growth.[2]

In Table 4 the estimates of the Conditional Barro regression model are extended to include the interaction effect of age structure variable with initial health factor, initial education factor, and initial workforce participation rate. The models are a good fit as suggested by the high value of Adjusted R-square. The results bring to notice the importance of health and employment in realizing DD. It indicates that the impact of the increase in working age share on per capita growth is reduced significantly (β_0 = - 0.69, $p<0.01$) when the working age suffers from health burden (captured by the interaction between growth in working age share and health loss index in model 1), controlling for other factors. Similarly, in model 3 the impact of the increase in working age

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[2] The existing literature argues that there is a contemporaneous relation between per capita income growth and working age population growth due to the migration effect. People of working age tend to migrate to regions experiencing better economic development and thereby leading to higher growth in the working age population in that region. However, the inter-state migration in India has been found to be less responsive to per capita income differences due to the presence of resistance from local labour unions, strong linguistic and cultural barriers and paucity of urban shelter for migrants (Cashin & Sahay, 1996; Datta, 1985; Skeldon, 1986; Aiyar & Mody, 2011). Also, the data on migration for the period 2011 from the Census of India was not available at the time of writing this paper. So the growth rate in the working age population could not be adjusted for migration effect.

share gets enhanced when working age people are employed (β_2 = 0.015, p<0.05), controlling for other factors.

Table 3
Estimates of Demographic Dividend from Conditional Barro Convergence Regression Model

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5
Log initial working age ratio	17.88***	17.99***	13.95***	9.357**	9.537**
	(3.826)	(3.936)	(4.668)	(4.295)	(4.485)
Growth in working age ratio	1.630**	1.402**	2.290**	1.210**	1.054**
	(0.773)	(0.603)	(0.804)	(0.465)	(0.445)
Log initial per capita income	-0.195	-0.0781	-0.0370	-0.257	-0.215
	(0.493)	(0.398)	(0.383)	(0.283)	(0.253)
Disability share		-3.930*			-2.024
		(1.967)			(1.478)
Graduate share		-0.187			-0.00213
		(0.109)			(0.115)
Urbanization rate			0.0169		
			(0.0230)		
Governance index			0.124*		
			(0.0703)		
Infrastructure index				0.645	
				(1.504)	
Credit/deposit ratio				0.0341***	0.0307**
				(0.0114)	(0.0116)
Constant	-71.89***	-71.60***	-61.54***	-37.85**	-37.62*
	(13.82)	(15.95)	(19.26)	(17.43)	(18.18)
Observations	50	50	50	50	50
Groups	25	25	25	25	25
R-squared	0.55	0.63	0.64	0.72	0.74
Adjusted R-squared	0.48	0.53	0.54	0.64	0.65
Variance inflation factor	1.2	1.3	1.6	1.5	1.7

Dependent variable is growth in per capita net state domestic product (1981 – 2015). Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Population adjusted weighted regression. All control variables are measured at initial time period (1981).

Table 4
Impact of the Interaction of Demography with the Key Policy Variables on Per Capita Growth in Conditional Barro Convergence Regression Model

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3
Growth in working age ratio*Health-loss index	-0.699***		
	(0.243)		
Growth in working age ratio*Literacy rate		0.00520	
		(0.00368)	
Growth in working age ratio*Workforce participation rate			0.0152**
			(0.00611)
Log initial working age ratio	7.234*	10.74***	10.10**
	(3.531)	(3.694)	(4.270)
Log initial per capita income	0.295	0.422	-0.498
	(0.280)	(0.284)	(0.403)
Health-loss index			-2.324**
			(0.887)
Log gross fixed capital formation	0.481***	0.489***	
	(0.121)	(0.155)	
Infrastructure index			0.892
			(1.516)
Social sector expenditure	0.155**	0.195**	
	(0.0709)	(0.0806)	
Constant	-32.15**	-49.80***	-32.67*
	(14.89)	(14.08)	(17.82)
Observations	50	50	50
Groups	25	25	25
R-squared	0.70	0.62	0.66
Adjusted R-squared	0.62	0.52	0.57
Variance inflation factor	1.8	1.9	1.5

Dependent variable is growth in per capita net state domestic product (1981 – 2015). Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Population adjusted weighted regression. All control variables are measured at initial time period (1981)

Table 5 presents an alternative approach of figuring out the influence of working age share on per capita income by using health loss index, years of schooling and workforce participation rate as instruments for the working age share. The Two-Stage Least Square (2SLS) estimates highlight the statistical significant bearing of working age share on per capita income (β_0 = 7.99 p<0.01), controlling for other factors. The instruments used are valid as per the test of over-identifying restrictions and the value of F-statistic shows that instruments are not weekly correlated with the endogenous regressors. Also, under the endogeneity test, the null hypothesis of the exogeneity of the working age share is rejected at a conventional level of significance. Therefore, this model reassures that the working age population works through the channels of quality education, good health, and decent employment opportunities to promote economic growth.

Next, the relative contribution of the working age population in explaining per capita income inequality across states over the period (1981 – 2015) is computed based on the Regression-Based Inequality Decomposition Model. In this method, three different models of pooled OLS regression are run based on the correlation among the explanatory variables (given in Appendix Table A2). Based on these regression results, Table 6 highlights that the maximum portion of per capita income inequality is attributable to divergent share of the working age population across states. Around 37 percent to 52 percent of income inequality is contributed by working age share across states, once we control for other core economic variables. The next important variable significantly contributing to inequality is the health factor captured by the life expectancy rate (around 35 percent). Besides this, the varying rate of urbanization across states also significantly causes income inequality (around 20 percent), followed by social sector expenditure (around 9 percent) and availability of infrastructure (6 percent). Surprisingly, the relative contribution of literacy rate and employment to explain income inequality do not turn out to be significant, possibly pointing towards their poor quality. Around 20 percent of the income inequality is still unexplained as suggested by the residual term.

Table 5
Impact of Demography on Per Capita Income through Instrumental Variables Model

VARIABLES	2SLS
Log working age ratio	7.992***
	(1.735)
Urbanization rate	0.00889
	(0.00627)
Log gross fixed capital formation	0.0244
	(0.0305)
Social sector expenditure	0.00918
	(0.0142)
Constant	-22.60***
	(6.659)
Observations	50
Groups	25
R-squared	0.77

Dependent variable is log per capita NSDP
Robust Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Population adjusted weighted regression

Instrumented: Log working age ratio
Instruments: Health loss index, Years of schooling, Workforce participation rate

First stage F statistic	23.38

Over-identifying Restrictions
Ho: zero correlation between instruments and the error term
Sargan chi2(2) = 2.05555 (p = 0.3578)
Basmann chi2(2) = 1.84357 (p = 0.3978)
Score chi2(2) = 2.13991 (p = 0.3430)

Exogeneity of instrumented explanatory variable
H0: Variable is exogenous
Robust score chi2(1) = 8.60546 (p = 0.0034)
Robust regression F(1,44) = 8.66364 (p = 0.0052)

Table 6
Contribution of Demography to Inter-State Inequality in Per Capita Income

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3
Log working age ratio	39.01***	51.29***	36.48***
Life expectancy	34.77***		
Literacy rate		18.60	
Work force participation rate			10.21
Urbanization rate			19.58***
Log gross fixed capital formation			5.28
Infrastructure index	5.70**	4.66	
Social sector expenditure		1.92	9.22**
Log net sown area	0.41	0.45	
Residual	20.10	23.05	19.19
Total	100	100	100

Dependent variable is log per capita Net State Domestic Product. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Population adjusted weighted regression. The Pooled OLS Regression of Decomposition model is given in Appendix Table A2.

6. Challenges in the way of realizing Demographic Dividend

Given the fact that the window of DD has just started in 2018 and will continue till 2055, the current demographic transition has not been accompanied by requisite socio-economic changes which pose some of the serious growth constraints mentioned below:

First, the public investments in social infrastructure in India are abysmal. The total expenditure on health as a percentage of GDP is scarcely 1.5 percent while the global average is around 6 percent. This meager budgetary allocation on health has resulted in escalating out-of-pocket expenditure of people. Although there is tremendous improvement in health indicators like Maternal Mortality Rate, Infant Mortality Rate, Under-five Mortality Rate, Life Expectancy at Birth over the past few years, yet due to prevalence of chronic illnesses and disabilities, the diseases adjusted life expectancy in India is only 53.5 years (Goli & Pandey, 2010; James & Goli, 2016). Further, there is a disparity in health infrastructure in rural areas which has led to inter-state variations in health indicators. For instance, as per the Economic Survey (2018 – 19), states with shortfalls of doctors and specialists have higher rural IMR and MMR as compared to other states. Thus, the goals of accessible, affordable and quality health care require adequate infrastructure facilities, proper monitoring of the staff, and provision of essential supplies. On the education front, the government spending on education as a percent of GDP is merely 3 percent in 2018 – 19 (Economic Survey 2018 – 19). Though there is remarkable progress in India's Gross Enrolment Ratio (GER) in the primary and secondary level, it is significantly lower in higher education (25.8 percent in 2017-18 as per MHRD provisional data). Also, there is a disparity in higher education levels across gender and backward social groups (Educational Statistics at a Glance 2018 cited in Economic Survey 2018 – 19). The literacy rate has touched 77 percent mark in 2017 – 18 (PLFS Annual report 2017-18), but the learning outcomes are still miserable. The Annual Status of Education Report (2018) cited in Economic Survey (2018 – 19) highlights that 1 out of 4 children leaving class VIII lack basic reading skills. The quality of the workforce depicted by its skill profile is also gloomy. As per the Periodic Labour Force Survey (PLFS) Annual Report (2017 – 18), the proportion of urban youth who received formal vocational training was only 4.4 percent in 2017 – 18. It seems to be a formidable task of training 400 million people by 2022 as per the target of the Ministry of Skill Development and Entrepreneurship.

Second, the generation of gainful and quality employment opportunities at a fast pace is essential in India provided the fact that 63 percent of the population is in the working age group. However, as per the PLFS Annual Report (2017 – 18), around half of the working age population in India is out of the labor market. The Labour Force Participation Rate (LFPR) in usual status has declined from 55.9 percent in 2011 – 12 to 49.8 percent in 2017 – 18. Further, there is a worsening of the quality of employment due to the growing informalization and casualization of jobs. One cannot ignore the other half of DD that is the status of women in the sphere of education, health, and labor market. The LFPR of women has declined twice as compared to their counterparts from 2011 – 12 to 2017 – 18 and less than a quarter of them are active in the labor market in 2017 – 18. Though urban women LFPR has remained stagnant at 20.4 percent from 2011 – 12 to 2017 – 18, it has declined sharply by 11 percentage points for rural females during the same period. Thus, the female LFPR in India is one of the lowest in the world. Further, it is found that there exist huge gender disparities in education, health, marriage, and the overall sex ratio which if removed could contribute an additional $2.9 trillion in real terms by 2025 (Dobbs et al., 2015). Also, there is a huge prevalence of child marriages in India. According to Goli (2016) estimates, the number of child marriage in India (103 million) is greater than the population of the Philippines and out of 28 child marriages taking place per minute across the world, more than two of them are held in India. This has a significant negative effect on health and needs to be controlled to prevent its adverse effects on the economy.

The next upcoming issue emerging from the age structure transition of the population is the rapidly growing old-age dependency ratio in the future. According to Goli and Pandey (2010) estimates from UN projections, there will be only a 2 percent increase in the working age population between 2005 – 2050 whereas the older population will go up by 13 percent during the same period. Also, in India, it takes only 25 years to double its older population as compared to the US where it takes around 70 years for the same. Thus, India will prematurely develop into aging societies which will have serious economic and health burdens. But this may provide the possibility of the 'Second Demographic Dividend' as the older population aids in capital accumulation from the savings done during their working years and thereby leading to economic growth. However, it hinges on the availability of developed financial markets, healthy older population, provision of income security and social security, which at present seems to be an arduous task in India. Therefore, India should start preparing for this future challenge otherwise it may get old before getting rich.

The fourth constraint is the negative trend in household savings rate which is a principal source of capital accumulation and an important parameter of DD. It has fallen from 23.6 percent in 2011 – 12 to 17.2 percent in 2017 – 18 which has put a drag on investment rate by almost 10 percentage points during this period. Besides this, according to Oxfam India Report (2018), India has the highest disparity among all the nations the world on all the parameters of income, wealth and consumption. This rising income disparity may further dampen the savings rate in the future.

Lastly, the level of urbanization in India is around 34 percent in 2018 as per the report of U.N. World Urbanization Prospects (2018). But there is a vast interstate disparity in its level ranging from 10 percent in Himachal Pradesh to 48.5 percent in Tamil Nadu. As cities attract working age people in search of better employment opportunities and livelihood, this promotes inter-state migration and accentuate already existing economic inequalities in India. As per Census 2011, the population growth in urban areas has been contributed more by migration than the natural population growth. Also, this rapid pace of urbanization without advancement in rural areas has put excessive population pressure in cities and simultaneously leading to urbanization of rural poverty. In such a scenario, it is essential to co-develop both urban and rural areas to maintain balance and equip the youth with quality education, skills and decent employment opportunities (James & Goli, 2016).

7. Conclusion

The analysis based on the panel of 25 states of India has reckoned DD to be about one percentage points per annum for the period 1981 – 2015, after controlling core policy variables. The results suggest that the economic convergence of states could be achieved if the working age population is healthy, educated, and employed. Also, the working age population has emerged out as a major factor contributing to per capita income inequality across states. But this common conclusion about India needs to be qualified in the light of the fact of huge inter-state variations in socio-economic and demographic profiles. The realization of DD is conditional on the performance of northern states where the population bulge or the window of opportunity has just begun but these states typically underperform as compared to other Indian states. Some other major lacunas in reaping the desired benefits of demographic change is dwindling spending on education and health sector; low adult literacy rate; skill mismatches; presence of chronic illnesses and disabilities; falling employment rates; gender disparities in education, health, labor market, and overall sex ratio; child marriage; falling household savings rate; urbanization of rural poverty; and rapidly rising aging population in future. Therefore, given India’s high levels of internal heterogeneity, prompt policy action to ameliorate these challenges is crucial to prevent DD to turn in to a demographic burden.

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APPENDIX

Table A1

Data Source and Descriptive Statistics of the Variables

Variables		Data source	Mean	Std. Dev.	Min.	Max.
Outcome variable	Log net state domestic product	Central Statistics Organization	10.7	0.9	9.1	12.5
Predictor variable						
Demographic factor	Working age ratio (%)	Census of India 1981 and 2011	58.9	4.99	50.25	69.50
Covariates						
Social factors	Literacy rate	Census of India	60.4	19.9	24.2	94.0
	Graduate share	NSSO employment–unemployment round	4.4	3.7	0.7	19.5
	Years of schooling	NSSO employment–unemployment round	4.3	1.6	1.7	7.6
	Disability share	Census 1981 and 2011	1.2	1.0	0.1	3.0
	Life expectancy at birth	Sample Registration System	64.0	7.4	50.0	75.0
	Health loss index	Constructed from weighted average of disability share, life loss and infant mortality rate.	0.5	0.2	0.1	0.9
Political factors	Urbanization rate	Census of India	28.3	17.9	6.6	97.5
	Governance index	Basu (2002)	5.0	2.9	0.0	10.0
Economic factors	Infrastructure index (Based on Road density, Electricity consumption, Rail Route length, and Post Office)	Report of Tenth Five Year Plan and RBI handbook of state statistics.	0.2	0.1	0.0	0.8
	Credit – deposit ratio	Statistical Tables Relating to Banks, RBI	54.7	25.6	6.2	116.2
	Log Gross fixed capital formation	RBI handbook of state statistics	8.8	2.8	0.3	13.5
	Workforce Participation Rate	Census of India	38.1	6.8	26.7	51.8
	Log Net sown area (thousand hectares)	M/o agriculture and farmer's welfare and RBI handbook of state statistics	7.4	1.9	3.1	9.9
	Social sector expenditure (as a % of GSDP)	Goswami and Bezbaruah (2011) and RBI handbook of state statistics	13.1	9.5	1.6	52.8

Table A2
Pooled OLS Regression-Based Decomposition of Inequality in Per Capita Income

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3
Log working age ratio	4.557***	5.993***	4.263***
	(1.409)	(1.689)	(1.347)
Life expectancy	0.0459***		
	(0.0150)		
Literacy rate		0.0100	
		(0.00778)	
Work force participation rate			0.0194
			(0.0122)
Urbanization rate			0.0189***
			(0.00665)
Log gross fixed capital formation			0.0423
			(0.0454)
Infrastructure index	1.286**	1.052	
	(0.619)	(0.702)	
Social sector expenditure		0.00606	0.0292**
		(0.0132)	(0.0145)
Log net sown area	-0.0155	-0.0174	
	(0.0581)	(0.0635)	
Constant	-11.17**	-14.70**	-8.856*
	(5.033)	(6.574)	(5.049)
Observations	50	50	50
Groups	25	25	25
R-squared	0.79	0.77	0.81
Adjusted R-squared	0.78	0.74	0.78

Dependent variable is log per capita Net State Domestic Product. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Population adjusted weighted regression