

Quantifying Demographic Dividend in India and its Impact on Economic Growth : A State-Level Study

Yamini Jindal¹

Abstract

Analyzing the impact of the age-structural changes on economic growth has gained immense attention over the recent years. The present study examined the relationship between changes in the working-age population ratio and per-capita income growth. After instrumenting growth rate of working-age population ratio with birth rate at the beginning of the previous decade, working-age population (both in level and growth form) appeared to have a positive and statistically significant impact on per-capita income growth. The log of working-age population ratio was found to be robust to the inclusion of several human capital development and other policy measures such as infant mortality rate, log of per-capita development expenditure, and per-capita scheduled commercial bank credit. Moreover, growth rate of working-age population ratio was found to be robust to inclusion of infant mortality rate and per-capita scheduled commercial bank credit. At an all-India level, the addition to the per-capita income growth due to changes in the working-age population ratio from the base year (1981) onwards was found to be gradually increasing over the decades and for the period 2000s, it turned out to be almost equal to 1%. High growth rate of working-age population ratio experienced by the BIMARU states, especially over the period 2001 – 2011, exhibited enormous potential of contributing to the per-capita income growth. A differential lens in policy making needs to be adopted. While states with narrow window of demographic opportunity should focus on policies that are inter-state migration friendly, states with broader window of demographic opportunity should invest more in human capital development and employment generation.

Keywords : Demographic dividend, demographic transition, age structural dynamics, working-age population, economic growth

JEL Classification Codes : J10, J11, O53

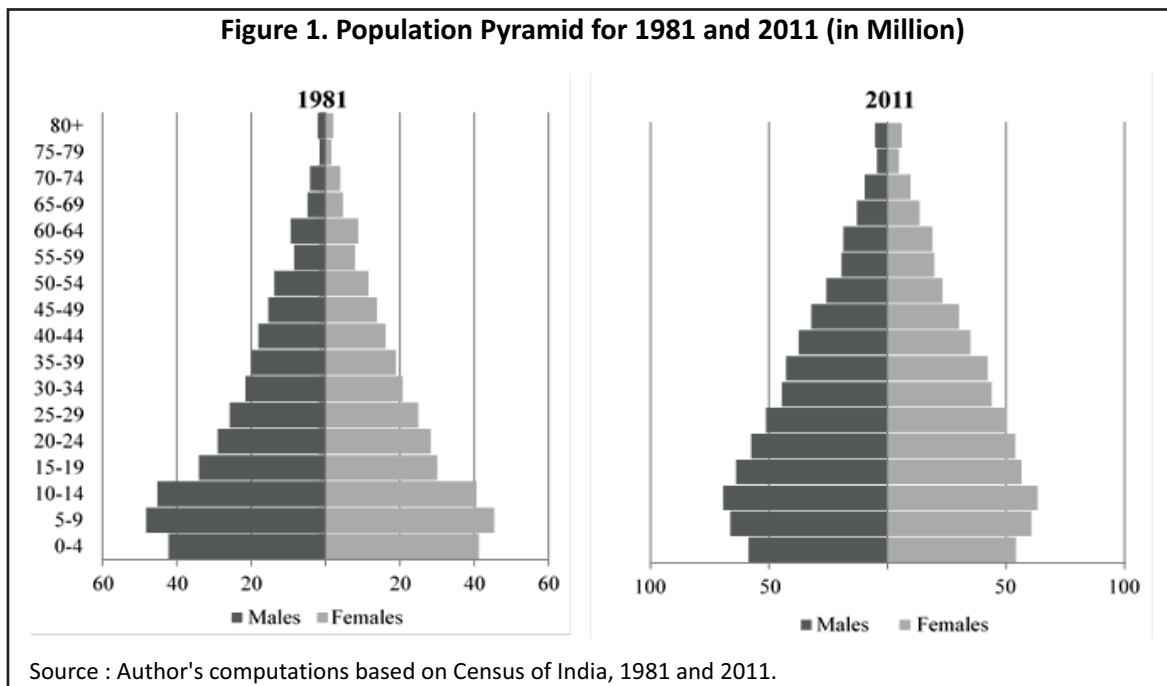
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Over the years, the classical debate about impact of population growth on economic development has evolved into an expansive notion of 'population dynamics.' While previous studies led to the emergence of several population growth theories, recent literature examining population related variables involves analyzing the dynamics of changing age-structure.¹ Every age group is characterised with distinct behavioural changes in terms of income, consumption, and savings patterns. *Demographic dividend* occurs when the share of the working-age population, that is, the population aged 15 – 64 years in the total population is high. This age group bears enormous potential to contribute to economic growth. However, such a progress is not automatic. The demographic dividend will be realised only when favourable policies that target human capital development, employment generation, and infrastructure development are formulated. Various channels through which demographic dividend can be realised are discussed at length in Appendix A.

On close examination, India's population growth offers compelling insights. The population pyramid of India

¹ A summary of population growth theories is provided in Appendix A.

¹ *Research Associate*, Koan Advisory Group, A-321, Block A, Defence Colony, New Delhi - 110 024 .
(E-mail : yaminijindal94@gmail.com) ; ORCID ID : <https://orcid.org/0000-0003-2123-5143>



is evolving in a way that there is a growing bulge in the centre, that is, proportion of the population aged 15 – 59 years (Figure 1). The share of working age population increased from 53.91% in 1981 to 60.29% in 2011. In fact, the population of India is expected to rise by 371 million from 1029 million in 2001 to 1400 million in 2026. The share of working population in this projected increase is estimated to be 83% (Office of the Registrar General and Census Commissioner of India, 2012).

The projections made for crude birth rate, crude death rate, and dependency ratio for 2001– 2026 indicate that India is experiencing a demographic transition leading to a demographic dividend phase. The birth rate is falling and dependency ratio is reducing over time. The dependency ratio was expected to further fall to from 65.2% in 2011 to 55.6% in 2026. Moreover, the median age for 2026 is predicted to be 31.39 years (Office of the Registrar General & Census Commissioner of India, 2012).

An in-depth assessment of India's demographic transition and its implications of economic growth is needed. This will serve as a ground for the development of a coherent policy framework to maximise the country's demographic dividend. This study aims to model growth rate and initial level of working-age population ratio along with other growth influencing regressors and estimate their impact on the per-capita income growth. Other studies (Aiyar & Mody, 2011 ; Bhattacharya & Halder, 2015 ; James, 2008 ; Kumar, 2010 ; Roychowdhury, Chandrasekhar, & Ghosh, 2006 ; Thakur, 2012) have explored this relationship in context of India using a panel of Indian states. However, a majority of these studies used old 2001 Census data and failed to account for labour force participation rate (LFPR), a key determinant of per-capita income growth. The employment rates have dynamically evolved in the past few decades and it is crucial to examine their impact on economic growth (Agarwal, 2014). Therefore, the present study estimates the relationship between working-age population and economic growth after accounting for changes in LFPR and uses a balanced panel of 17 states for the decades beginning in the years 1981, 1991, 2001, and 2011.

Data and Methodology

The study uses a balanced panel data of 17 states over the decades beginning in years 1981, 1991, 2001,

Table 1. Summary Statistics of Key Variables

	Mean	Std. Dev	Minimum	Maximum
Growth rate of per-capita income	3.8218	2.0934	.0394	8.5371
Growth rate of working-age population ratio	.4314	.2268	-.0487	.8943
Initial working-age population ratio	55.9081	3.2937	51.4650	63.7097
Growth rate of LFPR	-.0652	.6585	-2.0090	1.9078
Initial LFPR	60.6472	7.3261	47.0173	71.7413

and 2011.² Due to data limitations, the present study uses age-group of 15 – 59 years as the working-age population against the standard 15 – 64 years. For the bifurcated states, the population estimates are based on the old-geographical setup, that is, for years 2001 and 2011, the data series for Bihar and Jharkhand ; Madhya Pradesh and Chhattisgarh ; and Uttar Pradesh and Uttaranchal are consolidated. To arrive at comparable data for 1981–2011, the per-capita net state domestic product is rebased to 2004 – 05 constant prices (further discussed in Appendix B). Further, various labour productivity measures (such as infant mortality rate and literacy rate) and policy measures (such as per-capita development expenditure and per-capita scheduled commercial bank credit) are used to assess the robustness of the growth model.

The summary statistics clearly indicate existence of significant differences across states and over decades for all variables both in level and growth form (Table 1). To exemplify, growth rate of working age population ranges from a minimum of –0.05 to a maximum of 0.89. The aim of the study is to exploit such heterogeneity occurring across Indian states and explore the relationship between demographic variables and per-capita income growth.

There exist significant differences in the per capita income growth and working-age population between high and low growing states (Figure 2). However, changes in per-capita income growth across the two groups of states are closely linked to differences in the working-age population between them. For instance, convergence in the per-capita income growth across the two groups of states in 2000 – 2011 is accompanied with convergence in working-age population ratio. The aim of the present study is to validate this relationship between the working-age population and income growth, and identify the factors responsible for the same. Such a validation will help in arguing for more human capital development in BIMARU states, given that such states will experience high and increasing working-age population (Figure 2).

This study aims to develop a theoretical model that serves as the basis for the empirical estimation of the relationship between working-age population and per capita income growth. Various studies (Aiyar & Mody, 2011 ; Bloom & Canning, 2004) used the following conditional convergence equation developed by Barro and Sala-i-Martin (1995) to formulate such a theoretical model :

$$g_z = \lambda(z^* - z_0) \quad \text{..... (1)}$$

In the above equation, z denotes the income per worker, g_z denotes the growth rate of income per worker, z^* is the steady-state level of income per worker, z_0 is the initial level of income per worker (estimated at the beginning of the decade), and λ captures the rate of convergence (speed of adjustment) to the steady-state level of income per worker. Various factors that impact labour productivity determine the steady state level of income per worker (z^*). Taking this into consideration, the following equation is obtained :

$$g_z = \lambda(X\delta - z_0) \quad \text{..... (2)}$$

² The present study uses data till 2011 as this is the latest Census round conducted in India.

where, X is a vector of factors affecting labour productivity and δ is the corresponding vector of parameters.

The above equation is modified as follows to estimate the impact of growth in working-age population on per capita income :

$$\frac{Y}{N} = \frac{Y}{L} \cdot \frac{L}{WA} \cdot \frac{WA}{N} \quad \text{..... (3)}$$

where,

Y : Total income, that is, gross domestic product of an economy,

N : Total population,

L : Labour force,

WA : Working-age population.

Taking log of eq (3), the following is obtained :

$$\log\left(\frac{Y}{N}\right) = \log\left(\frac{Y}{L}\right) + \log\left(\frac{L}{WA}\right) + \log\left(\frac{WA}{N}\right) \quad \text{..... (4)}$$

Let :

$\log\left(\frac{Y}{N}\right) = y$, denote per-capita income,

$\log\left(\frac{Y}{L}\right) = z$, denote income per worker,

$\log\left(\frac{L}{WA}\right) = p$, denote LFPR,

$\log\left(\frac{WA}{N}\right) = w$, denote working-age population ratio.

Using the above notations, eq(4) can be written as follows :

$$y = z + p + w \quad \text{..... (5)}$$

$$\Rightarrow z = y - p - w \quad \text{..... (6)}$$

Considering the growth rates of the variables in the above equations, the following equations are obtained :

$$g_y = g_z + g_p + g_w \quad \text{..... (7)}$$

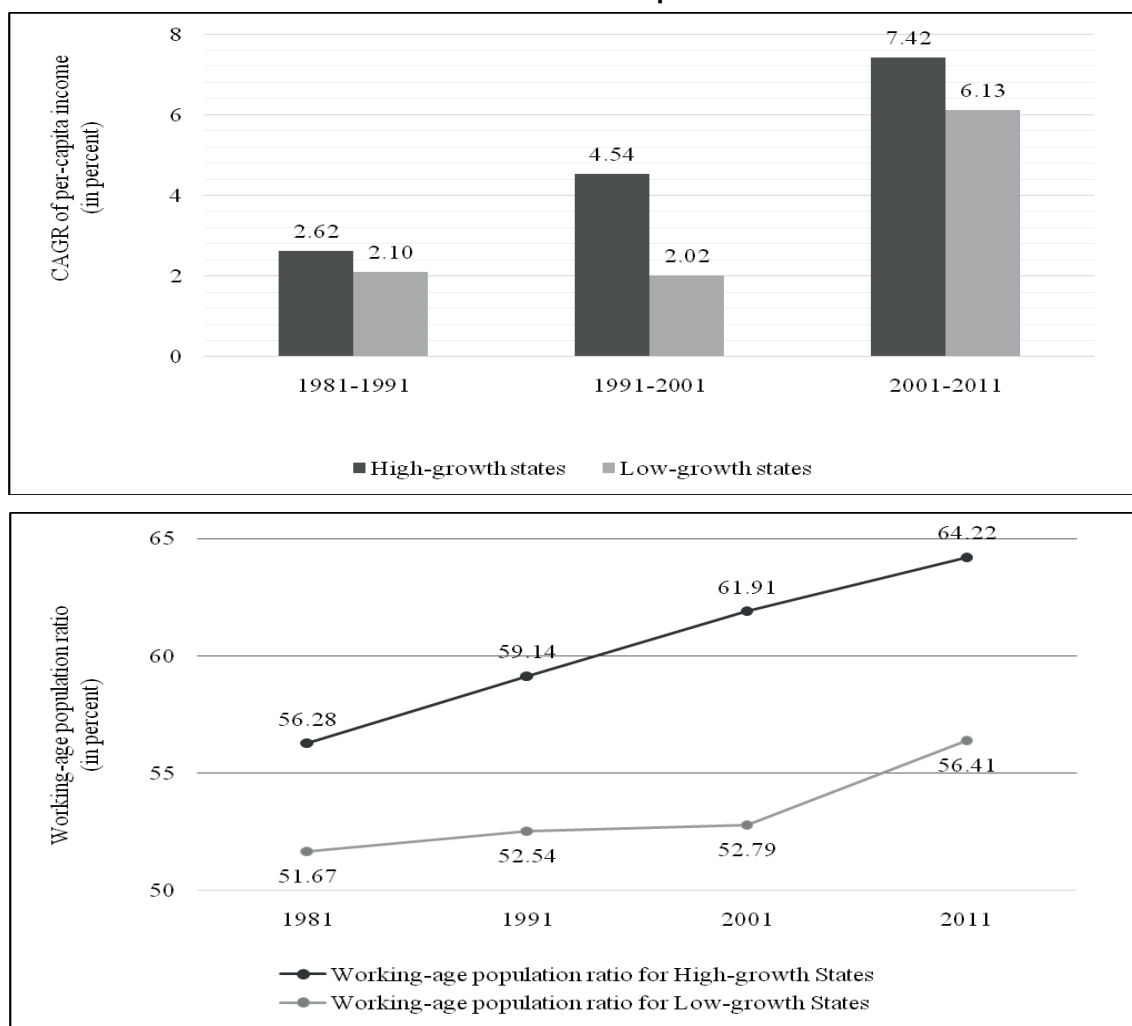
$$\Rightarrow g_z = g_y - g_p - g_w \quad \text{..... (8)}$$

In contrast to the previous studies (Aiyar & Mody, 2011 ; Bhattacharya & Haldar, 2015 ; Kumar, 2010 ; Thakur, 2012), the present study does not treat LFPR to remain constant between states and across decades.

Substituting (6) and (8) in eq (2), the following equation is obtained :

$$\begin{aligned} g_y - g_p - g_w &= \lambda(X\delta - (y_0 - p_0 - w_0)) \\ \Rightarrow g_y &= \lambda(X\delta - y_0 + p_0 + w_0) + g_p + g_w \\ \Rightarrow g_y &= \lambda(X\delta + p_0 + w_0 - y_0) + g_p + g_w \end{aligned} \quad \text{..... (9)}$$

Figure 2. Per-Capita Income Growth and Working-Age Population Ratio for Selected Group of States



Note. The plot uses 'average' values for the selected groups of states. High-growth states are Karnataka, Kerala, Tamil Nadu, and Gujarat and low-growth states are Bihar, Madhya Pradesh, Rajasthan, and Uttar Pradesh (BIMARU states).

Source : Census of India (various years)

To estimate the above equation, the following one-way error components regression model (Baltagi, 2008)³ is used :

$$g_{yi,t} = \alpha_1 g_{w,t} + \alpha_2 \log w_{i,t} + \beta \log y_{i,t} + \delta X_{i,t} + \gamma_1 g_{lfpr,t} + \gamma_2 \log lfpr_{i,t} + \alpha_i + \varepsilon_{i,t} \quad \text{..... (10)}$$

where, $g_{yi,t}$, the regressand is the compound annual growth rate (CAGR) of per-capita income for state i over the decade beginning in year t . The demographic regressors are $g_{wi,t}$; CAGR of working-age population ratio for state i over the decade beginning in year t and $\log w_{i,t}$, which is log of the initial working-age population ratio. $\log y_{i,t}$

³. Log in the model pertains to natural logarithm.

refers to log of the initial per-capita income. $X_{i,t}$ is the vector of the factors affecting steady-state productivity of labour. Growth rate of LFPR is represented by $(g_lfpr_{i,t})$ and log of initial LFPR by $(loglfpr_{i,t})$. α_i measures the state-specific effects.

It should be noted that the aforementioned demographic dividend model suffers from an endogeneity bias. Apart from growth rate of working-age population influencing per-capita income growth, it can occur that growth in per-capita income affects working-age population ratio. Inter-state migration is one possible link explaining such a reverse causality. Aiyar and Mody (2011) addressed this endogeneity bias by using inter-state migration adjusted working-age population ratio. However, the present study addresses the endogeneity bias with the help of instrument variables procedure. In this, growth rate of working-age population ratio, the endogenous regressor, is instrumented with variables explaining changes in the working-age population. Further application of this procedure is discussed in the next section.

Analysis and Results

This section presents the results obtained from estimating one-way error components regression model. The results from the Hausman test are presented in Table 3. The probability (= 0.4192) concludes that the null hypothesis – that the preferred model is a random-effects model – cannot be rejected. Therefore, results from Hausman test conclude the selection of one-way random effects error components regression model. This indicates that the state-specific effects (i.e. the unobserved state heterogeneity) are assumed to be uncorrelated with the other independent variables in the regression (Baltagi, 2008). To control for heteroscedasticity, the selected random effects model is estimated using robust standard errors.

The coefficients of the demographic variables – growth rate of working-age population ratio and log of initial

Table 3. Estimation Results from the Selected Random Effects Model

Regressand : CAGR of Per-Capita Income	
Growth rate of working-age population ratio	1.884 (1.391)
Log of initial working-age population ratio	15.832*** (4.676)
Log of initial per-capita income	2.048*** (0.769)
Growth rate of LFPR	-0.148 (0.424)
Log of Initial LFPR	0.242 (2.476)
Observations	51
Number of Groups (States)	17
Hausman Test Results	
Test: Ho: Difference in coefficients is not systematic.	
Prob > chi ² = 0.4192	
(V _b – V _B is not positive definite)	

Note. 1. *, **, *** denote the level of significance at 10%, 5 %, and 1 %, respectively.

2. Values in the parentheses report the robust standard errors.

working-age population ratio bear the predicted sign, though only log of initial working-age population ratio appears to be statistically significant (Table 3). *Ceteris paribus*, as the initial working-age population ratio increases across decades and between states by 1%, the compound annual per-capita income growth rate increases by 0.16% ($15.83/100 = 0.1583 \approx 0.16$). The log of initial per-capita income level is significant, but does not bear the sign as predicted by the theoretical model. This indicates lack of conditional convergence among states even after controlling for state-specific effects. The growth rate of LFPR and log of initial LFPR appear to be insignificant. While the estimated coefficient of growth rate of LFPR does not have the expected positive sign, the coefficient of initial LFPR bears the expected positive sign.

Lack of statistical significance of growth rate of working-age population ratio possibly reflects a larger concern. As pointed out in the previous section, the growth model suffers from an endogeneity bias. In order to address this concern, it is assumed that changes in the growth rate of working-age population ratio in a given decade are a consequence of changes in the birth rate at the beginning of the previous decade⁴ (Aiyar & Mody, 2011). Therefore, the present study uses birth rate in year $(t - 1)$ as an instrument variable (IV) for growth in the working-age population ratio in the decade beginning in year t . For instance, high birth rate in 1981 leads to low working-age population in 1991 (as the dependent population increases in 1981) and high working-age population in 2001 (i.e. high growth rate of working-age population ratio during the decade beginning in 1991).

Table 4 shows the estimation results of the random effects model with lagged birth rate as an IV. The results clearly indicate that instrumenting growth rate of working-age population ratio results not only in stronger impact of the growth rate of working-age population ratio on the per capita income growth, but also is statistically significantly different from 0 at the 5% significance level. This reflects that the states witnessing higher growth in working-age population ratio leads to higher compound annual per capita income growth. Though the coefficient of log of initial working-age population ratio has reduced from 15.83 to 14.19, it remains significant (at the 1% significance level). *Ceteris paribus*, 1% increase in the working-age population ratio across decades and between states results in 0.14% ($14.186/100 = 0.1418 \approx 0.14$) increase in compound annual per-capita income growth rate.

Table 4. Estimation Results Using Lagged Birth Rate (IV)

Regressand : CAGR of per-capita income	
Growth rate of working-age population ratio	3.197** (1.601)
Log of initial working-age population ratio	14.186*** (5.082)
Log of initial per-capita income	1.880** (0.892)
Growth rate of LFPR	0.031 (0.489)
Log of initial LFPR	0.107 (2.166)
Observations	51
Number of Groups (States)	17

Note. 1. *, **, *** denote the level of significance at 10%, 5%, and 1%, respectively.

2. Values in the parentheses report the robust standard errors.

⁴ In the present study, usage of lagged birth rate as an IV does not reduce the number of observations to 34. This is because 1971 is used as a birth rate for the decade beginning in 1981.

Table 5. Estimation Results Using Lagged Birth Rate and Lagged Working-Age Population Ratio (IVs)

Regressand : CAGR of per-capita income	
Growth rate of working-age population ratio	2.351 (1.647)
Log of initial working-age population ratio	14.699*** (5.671)
Log of initial per-capita income	2.120* (1.109)
Growth rate of LFPR	-0.177 (0.395)
Log of initial LFPR	1.010 (3.252)
Observations	34
Number of Groups (States)	17
Test of overidentifying restrictions	
Cross-section time-series model: xtivreg ec2spls robust cluster(state)	
Sargan – Hansen statistic = 10.908 ; Chi-sq(7) ; p - value = 0.1427	

Note. 1. *, **, *** denote the level of significance at 10%, 5%, and 1%, respectively.

2. Values in the parentheses report the robust standard errors.

Growth of LFPR and log of initial LFPR bear the expected sign, but are statistically insignificant in influencing the per-capita income growth.

Evaluation of the validity of the IVs is crucial. However, the standard tests of over identifying restrictions are only applicable in an over-identified equation. Therefore, the selected one-way random effects error components model is estimated with an additional IV, that is, lagged working-age population ratio (Table 5).

The Sargan – Hansen statistic (p - value = 0.1427) indicates that the null hypothesis – that the IVs considered are valid instruments – cannot be rejected (Table 5). Essentially, this implies that the IVs are uncorrelated with the error term and, therefore, are correctly excluded from the estimation.

Key variable of interest, that is, growth in the working-age population ratio is now insignificant and reduced in its impact (estimated coefficient = 2.35). Coefficient of log of initial working-age population ratio indicates significant influence on per-capita income growth rate. *Ceteris paribus*, 1% increase in working-age population ratio across decades and between states leads to 0.15% increase in compound annual per-capita income growth rate. These differences in the impact of the growth rate of working-age population ratio on per-capita income growth could occur because of the difference in the sample period. Usage of lagged working-age population ratio as an additional instrument variable reduces the number of observations from 51 to 34 as the observations for the decade beginning in 1981 are dropped, thus confining the estimation to the post liberalised period (1991 – 2011). To avoid reducing the sample size from 51 to 34 observations and losing data points capturing decade beginning in 1981, the present study uses the one-way random effects error components model with only one IV (lagged birth rate) as the baseline specification.

Accounting for Human Capital Development and Policy Measures

Human capital development measures (factors affecting labour productivity) and other policy interventions (including government spending undertaken to build social and economic infrastructure, develop skills)

Table 6. Results from Estimating Baseline Equation with Human Capital Development Measures

	(1)	(2)
Growth rate of working-age population ratio	3.955** (1.887)	0.011 (1.745)
Log of initial working-age population ratio	11.463* (6.359)	4.925 (7.926)
Log of initial per-capita income	1.705* (0.999)	1.327 (0.996)
Growth rate of LFPR	0.11 (0.524)	-0.257 (0.463)
Log of initial LFPR	0.095 (2.531)	2.008 (2.666)
IMR	-0.007	
Log of literacy rate	(0.010)	3.502* (1.877)
Observations	51	51
Number of Groups (States)	17	17

Note. 1. *, **, *** denote the level of significance at 10%, 5%, and 1%, respectively.

2. Values in the parentheses report the robust standard errors.

Table 7. Results from Estimation of the Baseline Equation Along with Policy Measures

	(1)	(2)
Growth rate of working-age population ratio	1.282 (1.769)	2.988* (1.697)
Log of initial working-age population ratio	10.920* (6.378)	10.000* (5.654)
Log of initial per-capita income	1.076 (1.177)	1.245 (0.943)
Growth rate of LFPR	-0.141 (0.525)	0.053 (0.482)
Log of initial LFPR	-0.283 (2.226)	-0.16 (2.094)
Log of per-capita development expenditure	0.663 (0.465)	
Per-capita scheduled commercial bank credit		0.00015* (0.000)
Observations	51	51
Number of Groups (States)	17	17

Note. 1. *, **, *** denote the level of significance at 10%, 5%, and 1%, respectively.

2. Values in the parentheses report the robust standard errors.

influence the relationship between demographic variables and economic growth (Subramaniam & Ben, 2018). These measures are critical in realising the demographic dividend. The aim of this section is to assess the robustness of the demographic variables after accounting for such measures.

Progress in education and health status are the principal determinants of human capital development in an economy. This study uses literacy rate and infant mortality rate (IMR) to account for education and health related outcomes, respectively. Table 6 shows the estimation results using log of literacy and IMR. Column (1) shows that the demographic variables are robust to inclusion of IMR in the estimation equation. It bears the expected sign, though it is statistically insignificant. Column (2) shows that though log of literacy rate is positive and significant in influencing economic growth, however, demographic variables are insignificant, thus implying that demographic variables are not robust to addition of log of literacy rate in the baseline equation.

Apart from human capital development measures, policy measures are crucial in influencing per-capita income growth. The present study uses development expenditure and scheduled commercial bank credit as proxy for policy measures. After including per-capita development expenditure, we see that only log of initial working-age population ratio is statistically significantly different from zero (Table 7, Column 1). Log of per-capita development expenditure is itself insignificant, but has a positive sign as predicted by the economic theory.

The demographic variables are robust to introduction of per-capita scheduled commercial bank credit (Column 2, Table 7). The estimate shows that changes in per-capita scheduled commercial bank credit have almost negligible impact on per-capita income growth (coefficient = 0.00015).

Human capital development and policy measures are, therefore, crucial in determining economic growth. Realisation of demographic dividend in India requires development of a coherent policy framework focusing on improved education, health, and investment outcomes.

Quantifying Impact of Demographic Dividend on Per-Capita Income Growth

This section aims to calculate the addition to the compound annual per-capita income growth relative to the assumption where the working-age population ratio remains fixed at the base year (assumed 1981). Using Aiyar and Mody (2011), let base year be represented as $t = 0$. The following equation estimates the impact of the changes in the working-age population ratio occurring between period t and $t + 1$ on compound annual per-capita income growth.

$$g_{y,t} = \alpha_1 g_{w,t} + \alpha_2 \log w_{i,t} + \beta \log y_{i,t} + \delta X_{i,t} + \gamma_1 g_{lfpr_{i,t}} + \gamma_2 \log lfpr_{i,t} + \alpha_i + \varepsilon_{i,t} \quad \text{..... (11)}$$

Now considering the case where the working-age population ratio stays fixed at the base year level implying that $w_{i,t} = w_{i,0}$ and $g_{w,t} = 0$. Taking this into consideration, the above equation can be written as follows :

$$g_{y,t} = \alpha_2 \log w_{i,0} + \beta \log y_{i,t} + \delta X_{i,t} + \gamma_1 g_{lfpr_{i,t}} + \gamma_2 \log lfpr_{i,t} + \alpha_i + \varepsilon_{i,t} \quad \text{..... (12)}$$

The following difference (between (12) and (11)) tells us how much the percent increase in the per-capita compound annual income growth over the decade beginning in year t can be attributed to the occurrence of age-structural changes from the base year onwards.

Increment to per-capita income growth over the decade beginning in year t due age-structural changes from 1981 onwards = $\alpha_2 (\log w_t - \log w_0) + \alpha_1 (\log w_{t+1} - \log w_t)$

α_2 and α_1 correspond to the estimates of the coefficients from the baseline specification (Table 4). Plugging the values $\alpha_2 = 14.186$ and $\alpha_1 = 3.197$ along with the data on the working-age population ratio for the time-period 1981–2011, Table 8 shows the value of increment to the per-capita income growth at an all-India level as well as for different states.

India's share of working-age population increased rapidly in the past decades from 53.91% in 1981 to 60.29% in 2011, and demographic dividend appears to mirror these changes. At an all-India level, the addition to per-capita income growth is gradually increasing over the decades and for 2000s, it turns out to be almost equal to

1%. Therefore, a fraction of India's economic growth since 1980s can be attributed to the changing age-structure of the population.

The fact that various states in India experienced demographic transition at points in time is clearly noticeable in the state-wise estimates of demographic dividend. The high-growth states, which historically saw high shares of working-age population, experienced higher demographic induced per-capita income growth rate. The demographic dividend increased from 0.16% in 1980s to 1.47% in 2000s (Table 8). Amongst the high-growth states, demographic dividend is highest for Karnataka followed by Kerala and Gujarat.

The BIMARU states exhibit large differences when compared to the high-growth states. Even though the increment in economic growth due to changes in working-age population is increasing over the decades, it is significantly low when compared to high-growth states (Table 8). Therefore, high working age population in high-growth states contributed towards improving the economic outlook of such states. However, such states made considerable investments in developing the human capital. Therefore, given that the BIMARU states are now witnessing higher shares of working-age population, necessary interventions in terms of human capital development and employment generation are needed to capitalize on the opportunity.

Table 8. Addition to Per-Capita Income Due to Changes in Working-Age Population from Base Year

	1980s (1981–1991)	1990s (1991–2001)	2000s (2001–2011)
High-Growth States			
Karnataka	0.16	0.91	1.84
Kerala	0.2	1	1.4
Gujarat	0.13	0.7	1.35
Tamil Nadu	0.15	0.79	1.3
Average	0.16	0.85	1.47
Low-Growth States (BIMARU States)			
Madhya Pradesh	0.07	0.39	0.85
Rajasthan	0.07	0.33	0.65
Uttar Pradesh	0.04	0.17	0.36
Bihar	0.03	0.12	0.19
Average	0.05	0.25	0.51
Other States Studied			
Himachal Pradesh	0.18	1.02	1.94
Andhra Pradesh	0.13	0.74	1.52
Assam	0.14	0.76	1.47
Haryana	0.07	0.5	1.45
Odisha	0.15	0.78	1.29
Punjab	0.1	0.58	1.26
West Bengal	0.07	0.45	1.22
Maharashtra	0.11	0.59	1.18
Jammu and Kashmir	0.15	0.74	1.11
All India	0.09	0.49	0.97

Note. Values reported in the table are expressed in percentage.

Conclusion and Policy Implications

The working-age population ratio in the level form appears to have a positive impact on the per-capita income growth between states and over decades 1981 – 2011. After controlling for the suspected endogeneity with the help of IV method, both growth rate and log of initial working-age population appear to have a positive and significant impact on per-capita income growth. Moreover, growth rate of working-age population ratio is robust to inclusion of infant mortality rate and per-capita scheduled commercial bank credit. Log of initial working-age population ratio continues to be statistically significantly different from zero and the estimate of the coefficient has a positive sign after the introduction of IMR, log of per-capita development expenditure, and per-capita scheduled commercial bank credit in isolation.

Therefore, in the light of the above remarks, it can be summed up that age-structural demographic variables are crucial in the study of economic growth. Indian states exhibit huge differences in the occurrence of demographic transition, and thus, demographic dividend occurs at different points in time for different states. These differences imply significant prospects for economic convergence between the high-growth states and low-growth states. The present study does not indicate any convergence, but such convergence can possibly exist in the coming decades. Inclusion of decade 2011 in the present study has given the evidence of narrowing of per-capita income growth gap between the high-growth states and low-growth states (BIMARU states) for the period 2001 – 2011 as compared to the previous decade. The beginning of convergence in the working-age population ratio across two groups of states in 2011 and its positive impact on income growth indicate that increasing demographic dividend witnessed by BIMARU states bears enormous potential of fuelling the income convergence across the two groups of states. However, a differential lens in policy making is needed which addresses the needs of different states according to the existing demographics dynamics.

The states where declining demographic window of opportunity exist should focus more on policies that are inter-state migration friendly as well as address the challenges of ageing population. Inadequate support for inter-state migration dissuade many people from migrating to other states for work. The states in India have reservations for state domiciles in areas such as public sector employment, tertiary education, and social welfare schemes (Aggarwal, Singh, & Mitra, 2019). In this regard, other states could emulate Kerala's Migrant Workers Welfare Scheme, which provide migrant workers the benefits related to health and education (Basheer, 2018).

On the other hand, states which will continue to experience the demographic window of opportunity for a longer period should instead focus on human capital investment, including health, education, skill development, as well as employment generation.

Limitations of the Study and Scope for Further Research

The present study does not control for inter-state migration while studying the impact of working-age population on economic growth. In India, inter-state migration is one of the key factors of how differences in per-capita income influence the working-age population growth across states. Till now, no study has examined the impact of migration adjusted per-capita income on working-age population growth by using the latest available 2011 Census data. Therefore, there exists scope to further build upon this study by using migration adjusted per-capita income growth.

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Appendix A

Demographic Theories and Transition

Over the years, various schools of thought examining the relationship between population growth and economic development have emerged. These include – Malthusian, Optimistic theory, and Neutralism. The table below summarises each of these theories.

Table A1. Population Growth Theories

Pessimistic View

Malthus (1817) in his seminal work, *An Essay on the Principle of Population* envisaged the occurrence of a resource crisis (referred to as 'Malthusian Catastrophe') due to an exponential growth of population. In his views, the mere arithmetic growth of food production contributing to resource shortage is incapable of feeding the geometrically rising number of mouths. Therefore, he stressed on the need to have checks on the population growth called the preventive and positive checks.

Preventive checks result in the postponement of child birth and positive implications of having a small family. He emphasised that a man should take the responsibility of a child only when he/she is fully ready to meet a child's needs. Positive checks on the other hand reduce the life span of the humans, thus resulting in declining population. These include famines, wars, spread of diseases, poverty, starvation etc. Ehrlich (1968) re-emphasised the Malthusian idea, and highlighted the need of population control measures so as to escape the dire situations of food crisis.

Optimistic View

This view revolves around the aspect that increasing rates of population can positively contribute to economic growth as the human capital forms the crucial link in the realisation of economic growth (Kuznets, 1967). In contrast to the Malthusian model, Kremer (1993), on a positive note, suggested that increasing population is a source of technological advancement and progress. More the people, more the hands to invent and innovate. For instance, innovations by humans in the agricultural sector facilitated in the discovery of ways to boost agricultural productivity, thereby overcoming food crisis in response to population growth (Boserup, 1981).

Neutralism

In the recent years, neutralist theory has gained immense attention. It emphasises on the idea that population growth is neutral to economic growth and it has no significant effect (Kelley & Schmidt, 2001). Various policy measures indicators including educational levels, quality of economic and social institutions affect the way the increase in population impacts economic growth.

The following listed are some delivery mechanisms through which the transmission of age-structure population changes into economic growth takes place.

Savings Channel

In an economy where the share of working-age population is high compared to children (less than 15 years) and old population (greater than 64 years), the dependency-ratio is low. The consumption burden of the dependents is relatively lower, thus providing the individual opportunity to save (Kelley & Schmidt, 1999 ; Mason, 1988; Leff, 1984). Increased aggregate savings contribute to increased capital accumulation. Increased potential capital stock, which forms the base for investment, directly contributes to economic growth. The following identity highlights the importance of increased private savings ($S_{pvt.}$) for an open-economy like India.

$$S_{pvt.} = I + CA + (G - T)$$

An economy's private savings can possibly be utilised for investment (I) and financing the economy's current account balance (CA) and government deficit ($G - T$).

Labour Supply Channel

When an economy enters the demographic dividend phase, greater people are available for work. The realisation of this potential labour supply into economic growth is conditional upon the policy environment (e.g. employment generation opportunities, flexibility in the labour markets, and so on). Additionally, the demographic dividend phase is characterised by increased female labour force participation. Falling birth rates provides women greater opportunity to work, as hours devoted to child-rearing previously can now be utilised in undertaking economic activities.

Human- Capital Development

The demographic dividend phase is characterised by falling birth rates. With fewer children, investment on education and health per child increases, thus generating more educated and healthier people. These parameters are key labour productivity measures. Drawing insights from the endogenous growth models, investment in human capital is considered as the most essential caveat in the generation of economic growth.

Appendix B

Data Description	Data Source
CAGR of Per-Capita Income Data for 1981– 2011 is rebased to 2004 – 05 constant prices (using splicing method). Adjustments are made to bifurcated states so as to make them consistent with the old geographical setup.	Central Statistics Office (CSO), Ministry of Statistics and Programme Implementation, Government of India (MOSPI).
Initial Per-Capita NSDP/Income CAGR of Working - Age Population Ratio Estimates for 2001 and 2011 are made consistent with the old geographical setup. As Census 1981 and 1991 were not held in Assam and Jammu & Kashmir, linear interpolation is used to estimate the working-age and total population values.	CSO, MOSPI Census of India 1981, 1991, 2001, and 2011.
Initial Working-Age Population Ratio CAGR of Total Population IMR It is defined as the number infant deaths (i.e. less than 1 year of age) per 1000 live births. Due to non-availability of data for Jammu & Kashmir (1991), 1989 value is used.	Census of India 1981, 1991, 2001, and 2011. Census of India 1981, 1991, 2001, and 2011. Sample Registration System (SRS) Reports, Office of the Registrar General & Census Commissioner, Ministry of Home Affairs, Government of India.
Literacy Rate As Census 1981 and 1991 were not held in Assam and Jammu & Kashmir respectively, linear interpolation is used to compute the literacy rate.	Office of Registrar General, Ministry of Home Affairs and National Commission on Population, Government of India.
Per-capita Development Expenditure Development expenditure is derived by adding development expenditure on social services and economic services (both revenue and capital expenditure). This also includes the loans and advances made by the State governments for developmental purposes.	Budget statements of the State Governments.
Per-capita Scheduled Commercial Bank Credit Measures the credit extended by various scheduled commercial banks in the respective states.	RBI publication: <i>Basic Statistical Returns of Scheduled Commercial Banks in India</i> .
CAGR of LFPR Labour force participation rate is defined as the percentage of people in the labour force, that is, people who are employed or seeking/available for work. This is computed based on the main workers and marginal workers data available from Census studies. The present study uses age-specific labour force participation rate (i.e. for the working-age group of 15–59 years).	General Economic Tables under Census for 1981 ⁵ , 1991, 2001, 2011.
Initial LFPR It corresponds to the labour force participation rate at the beginning of each decade.	General Economic Tables under Census for 1981, 1991, 2001, 2011.
Lagged Birth Rate Birth rates for 1971 were not available for Bihar, West Bengal, and Rajasthan. Therefore, this particular data is taken from Bhat et al. (1984).	Compendium of India's Fertility and Mortality Indicators, 1971 – 2013 based on the Sample Registration System (SRS), Registrar General, India

⁵ The author is grateful to International Institute for Population Sciences, Mumbai, Maharashtra for allowing to use the Census Series-General Economic Tables for the Census year 1981 available in the hardcopy.

About the Author

Yamini Jindal is working as a Research Associate at Koan Advisory Group, New Delhi. She is a macroeconomist by training and her primary areas of work include development issues, international trade, investment, and value chain analysis.