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Does demographic dividend yield economic dividend? India, a case study

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Abstract

The share of working-age population changes during the process of demographic transition; the size of working age-population in India does vary across the major states over the decades, 1971-2011. Using panel data across fifteen major states for four time points, this paper examines the effects of different age cohorts of working age-population, mortality, fertility, life expectancy, investment in social sector comprising education and health and investment in physical capital (as proxy by credit deposit ratio) on growth of income measured by per capita net state domestic product. Keeping in mind the problem of endogeneity between demographic outcome and economic growth, we have formulated different econometric models and the results support the effect of conventional growth predictors like investment in human capital, credit-deposit ratio along with shares of working age population between age 30-44 and 45-59. Population growth and fertility are not found significant predictors but life expectancy and infant mortality appear to have significant effect on growth of income. The growth of the share of working population adversely affects the growth of income which re-ignites the old debate whether India is capable or not to reap the benefits of demographic dividend.

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1. Introduction

Three schools of thought have so far emerged in relation to the linkage between population and economic growth; pessimistic view, optimistic view and independent or neutralist view (See Bloom, Canning and Sevilla, 2001). The debate is basically concerned about the relationship between the size of the population and its growth on the one hand and income or per capita income and its growth on the other ignoring the dynamics of age structure of the population. The population transition theory states that an economy is supposed to experience various phases of demographic transition as a result of economic growth from 'high fertility and high mortality' to 'low fertility and low mortality' which causes a change in the relative size of different age cohorts in the population in favour of the working age group. An increase in the share of the working age population has accompanied a decline in fertility during the course of demographic transition in most of the developing countries, offering a window of opportunity which is referred to as 'demographic dividend' (Bloom and Canning, 2001; 2004; 2008; Bloom and Williamson, 1998; Birdsall et al. 2001; Mason, 2005; 2006; Kelley and Schmidt, 2007). Large empirical cross-country studies, especially of East Asian countries, explore the effects of this demographic dividend on economic growth and most of the results show a positive relationship (Bloom and Sachs, 1998; Bloom and Williamson, 1998; Bloom, Canning and Malaney, 2000; Mason, 2001).

The dynamics of age cohort during population transition supports our conventional growth story in which low fertility and slower population growth leads to increased capital intensity and higher per capita income (Behrman et al., 1999). These effects are mediated by changing savings rates and labor force growth rates. The change in age composition is important because different age groups have different economic behaviors. An economy characterized by higher proportion of working age population, in general, is supposed to be more productive as the workers use to supply labour and save more than their consumption (Modigliani and Brumberg, 1954; Tobin, 1967; Mason, 1988; Kelley and Schmidt 1995; 2007; Bloom et al., 2008; Lee and Mason, 2007; 2011). The poor performance in regard to economic growth by African countries compared to high growth performance of countries in East Asia is well explained by the differential growth and size of the working age population (Bloom et al., 2000). Using a panel data set of countries from 1960 to 2000, Bloom et al. (2009) have observed a positive relationship between the working age population and economic growth in India and China. They have also predicted higher growth prospects for India compared to China over the next 30 years (Bloom, 2011; Bloom et al., 2010).

Being the second most populous country, India accounts for 17 percent of the global share of population (Population Reference Bureau, 2012). There exist two views regarding whether the demographic dividend is a boon or a burden for India. The recent Latin American experience shows that the age transition does not lead to economic growth (Bloom et al., 2003). Pessimists like Mitra and Nagarajan (2005), Chandrasekhar et al. (2006) have argued that demographic changes are not sufficient to provide an upward push to the rate of economic growth; this is because India has been facing a major deficit in the area of education and health which is assumed to be necessary for human capital accumulation. Using state level decadal data (viz. 1971-2001), James (2008), Aiyar and Mody (2011) and Utsab (2014) have observed a positive effect of the share as well as growth of the share of working age population on economic growth in India. The present study pertaining to the effect of demographic dividend on economic growth is different from the earlier studies (focusing India) in respect of selection of the variables influencing growth of per capita income. The earlier studies did not consider 2011 state level Census data, but there is scope to increase the time points up to 2011. In order to capture the effect of internal dynamics of population over time on growth of income, we consider the shares of different age cohorts of the population as suggested by Feyrer (2007) which have not been incorporated by the earlier studies. In addition to this, we try to examine the effects of other demographic and health outcomes such as population growth, total fertility rate, life expectancy and infant mortality rate on economic growth in India at sub-national level in a panel study framework. The effects of all these variables are not well addressed by the earlier studies.

2. Theoretical Backdrop of Economic Growth and Demographic Dividend

The standard Solow growth model (1956) assumes that population growth in the long run is exogenously given; and the growth of capital per unit of labour depends on propensity to save and average productivity of output per unit of labour; per capita output will increase if population growth falls. The theory of demographic transition considers population growth as endogenous to economic growth whereas in Solow growth model population growth is treated as exogenous, hence the two theories differ regarding the treatment of population. In the recent past, Dyson (2010) has argued that mortality as well as fertility decline is exogenous to economic development but this line of thinking is criticized by Canning (2011) and other endogenous growth theorists who have put forward the existence of bidirectional causality between demographic outcome and economic growth.

The standard Solow-Swan growth model can be written as:

$\gamma = \frac{\dot{k}}{k} = s\frac{f(k)}{k} - (\sigma + \rho)$ ……(1), where, γ denotes rate of growth of physical capital per unit of labour, *k* stands for physical capital per unit of labour, *s* is the average (=marginal) propensity to save, σ is the rate of depreciation of physical capital and ρ is the population growth rate. If ρ increases, γ falls and vice-versa. This does not mean that population, more specifically the age structure of the population is neutral to economic growth in Solow-Swan model. In steady state situation, capital per unit of labour depends on propensity to save, technological factors and population growth rate; as population growth decreases steady state capital per worker will increase[1]. Average productivity and propensity to save, the two pillars of economic growth are very sensitive to the age structure of the population; an economy with higher share of working population will grow faster compared to the economy with higher share of dependent population. In the Solow model, growth rate of labour is assumed to be identical to the growth rate of

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[1]In steady state, γ=0, this means that equilibrium capital per worker, $k^* = \left(\frac{sA}{\rho+\sigma}\right)^{\frac{1}{1-\alpha}}$ and steady state output, $Y_t^* = A^{\frac{1}{1-\alpha}}.\left(\frac{s}{\rho+\sigma}\right)^{\frac{\alpha}{1-\alpha}}.L_t$ if the production function becomes Cobb-Douglas type giving constant returns to scale as: $Y_t = AK_t^{\alpha}L_t^{1-\alpha}$

Where Y_t=output, *A*=technological parameter, K_t=physical capital, L_t=workers, α =share of capital in total output, $(1-\alpha)$=share of worker in total output, $0< \alpha <1$, σ=rate of depreciation of physical capital, ρ be the population growth rate.

population but during the process of demographic transition the growth rate of population falls while the growth rate of the share of working age population (WP/P) increases; where WP stands for population belonging to age group (15-59) and P be the population size. The effect of the size, growth and age composition of population through demographic transition on per capita income growth is not straight forward. Endogenous growth model asserts that population size of a certain country generates "scale effect" which is assumed to be crucial for long-run economic growth; larger countries are able to grow faster because there are more scientists to employ and these countries have larger markets and profit opportunities for firms engaging in research and development (R&D) (Romer, 1990; Grossman and Helpman, 1991; Aghion and Howitt, 1992). But, this argument is not supported by empirical evidence (Jones, 1995). Using Romer (1990) and Jones (1995) frameworks, Prettner (2013, pp 831) has theoretically shown in an over-lapping generation model that the impacts of demographic change on long-run economic growth perspectives are the following:

> "Decreasing mortality positively but decreasing fertility negatively affects long-run economic growth; however, the negative effects of decreases in fertility are over compensated by the positive effects of decreases in mortality in case of Romer (1990) model, whereas it hampers economic growth in Jones (1995) model."

Prettner's (2013) work is based on highly industrialized economy and in order to derive the above results he has considered Romer's (1990) endogenous and Jones's (1995) semi-endogenous growth models. How far and to what extent his conclusion is valid across the countries, especially in transition economies has been an important issue of empirical research.

Following Lucas (1988), we can argue that the stock of average human capital (viz. stock of knowledge) acts as a positive externality in the production function. During the process of demographic transition, mortality and fertility decline and the couples substitute from quantity to quality of children (viz. per child investment) as income increases; consequently average human capital increases over generations. Average human capital which is the fundamental driving force of Lucas (1988) type endogenous growth model is consistent with the demographic dividend as fertility declines. The literature on fertility and economic growth argues that along the development path, parents have fewer children, each with higher quality. As a result, fertility declines and the stock of human capital grows, which leads to sustained economic growth in per capita terms. This is the main mechanism suggested by many including Becker et al. (1990) and Galor and Weil (1999) and Galor (2005). In order to explain the impact of demographic and other factors on per capita growth of income, we consider the following simple growth model used by many (McMohan, 1998; Oketch, 2006,; Haldar, 2009; and Haldar and Mallik, 2010)

$\frac{\dot{y}}{y} = MP_K.\frac{I_K}{Y} + \frac{MP_L}{AP_L}.n + MP_H.\frac{I_H}{Y} - r$ ....(2), where, $\frac{\dot{y}}{y}$ =growth rate of per capita output=Gy, y=per capita output=Y/P, Y=output, P=population, MP_K=marginal productivity of physical capital, I_K=investment in physical capital, MP_L=marginal productivity of labour(L), AP_L= average productivity of labour(L), n=growth rate of employment=$\frac{\dot{L}}{L}$, MP_H=marginal productivity of human capital(H), I_H=investment in human capital(H) and r=rate of growth of population=$\frac{\dot{P}}{P}$. The growth rate of per capita income[2] as mentioned in equation (2) basically follows from the implicit production function, $Y_t = Y(K_t, H_t, L_t)$ …….(3), here, the argument human capital (H) is separated out of labour (*L*), although it is embodied in *L*. *K* stands for physical capital; assume K and H do not depreciate in our model. How does one can reconcile between demographic dividend caused by demographic transition and growth rate of output per capita as shown in equation (2)? Most of the countries are supposed to pass through mainly three phases of demographic transition from high fertility and mortality (1st phase), lower mortality but high fertility (2nd phase) and lastly low fertility and low mortality (3rd phase) as the economy expands; consequently, the age composition of a country's population changes (Bloom and Williamson 1998). During the process of demographic transition, all countries should have a demographic window of opportunity when the growth in the working age population is greater than the growth in the total population. Now, assuming (1) full utilization of human resources and (2) in the long run labour market is clear ensuring $AP_L = MP_L$, growth rate of labour (n) or employment exceeds the growth rate of population (r). At the end of population transition when fertility declines, the share of working population (15-59 age group) to total population (P) increases. At full employment level, working population is equal to labour (L) engaged in the economy. Thus, at the end of demographic transition, $\frac{d}{dt}\left(\frac{L}{P}\right) > 0$, this means that (n – r)>0.

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[2] Differentiating equation (3), with respect to time t, we have:

$\dot{Y} = \frac{\partial Y}{\partial L}\dot{L} + \frac{\partial Y}{\partial K}\dot{K} + \frac{\partial Y}{\partial H}\dot{H}$, dividing throughout by Y and subtracting $r = \frac{\dot{P}}{P}$ from both sides, we have:

$$\frac{\dot{Y}}{Y} - \frac{\dot{P}}{P} = \left(\frac{\partial Y}{\partial L}\right).\frac{L}{Y}.\frac{\dot{L}}{L} + \left(\frac{\partial Y}{\partial K}\right).\frac{I_K}{Y} + \left(\frac{\partial Y}{\partial H}\right).\frac{I_H}{Y} - \frac{\dot{P}}{P}$$

$$Or, \frac{\dot{y}}{y} = \frac{MP_L}{AP_L}.n + MP_K.\frac{I_K}{Y} + MP_H.\frac{I_H}{Y} - r$$

$$Or, \frac{\dot{y}}{y} = (n - r) + MP_K.\frac{I_K}{Y} + MP_H.\frac{I_H}{Y}$$

Assuming, $MP_L = AP_L$ and I_K and I_H are investments in physical and human capital respectively (assuming depreciation is zero).

Therefore, equation (2) can be written as: $G_y = \frac{\dot{y}}{y} = MP_K . \frac{I_K}{Y} + MP_H . \frac{I_H}{Y} + (n - r)$ …..(2) where (n – r) is termed as net effect of demographic dividend.

Therefore, the endogenous growth model is quite compatible with the theory of demographic transition, even if the population growth rate is positive. Moreover, the knowledge embedded per unit of labour (*h*) (in Lucas model(1988)) generates higher productivity under the situation of demographic dividend. Investment in physical capital and human capital comprising education and healthcare does play an important role in the growth model. Therefore, an enormous growth potential can be expected from the endogenous growth model, if appropriate macroeconomic policy is implemented with emphasis on education and healthcare.

3. Estimation Technique and Methodology

Following Barro and Sala-i-Martin,1995; Bloom and Canning, 2004; we consider the following conditional convergence equation:

$G_{X1} = \lambda\left(X_1^{\bullet} - X_{10}\right)$……(4) where, G_{X1}=Growth of income per worker (*Y/L*), X_1=ln(*Y/L*), X_1*=Steady-state income per worker, X_{10}=initial income per worker, λ is the speed of adjustment to the steady-state. Now, steady-state income per worker viz. average productivity of labor depends on several factors; we can represent the determinants of labor productivity by the vector ***X*** and the associated vector of parameters by ***β***. Equation (4) can be written as:

$G_{X1} = \lambda\left(X\beta - X_{10}\right)$………(5)

Note that the per capita Net State Domestic Product (PCNSDP) can be decomposed into three multiplicative forms:

$\left(\frac{Y}{P}\right)_{it} = \left(\frac{Y}{L}\right)_{it}\left(\frac{L}{WP}\right)_{it}\left(\frac{WP}{P}\right)_{it}$ ....(6) Where, *Y*=NSDP of state i, *P*=Population of state i, *L*=Employment of state i, *WP*=Working age population (age 15-59) of state i ; let us define:

$\ln(\frac{Y}{P}) = y, \ln\left(\frac{Y}{L}\right) = X_1, \ln\left(\frac{L}{WP}\right) = X_2, \ln\left(\frac{WP}{P}\right) = X_3$, where, X_1=ln(AP_L)=log of average productivity of labour, X_2=log of labour force participation rate, X_3=log of share of working population in total population. Taking log of equation (6), we have:

$y_{it} = X_{1it} + X_{2it} + X_{3it}$, ……..(7), now we can write equation (7) in growth forms as:

$G_y = G_{X1} + G_{X2} + G_{X3}$ ……….(8) for $\forall i, t$.

From (7), we initialize at t=0,

$y_0 = X_{10} + X_{20} + X_{30}$ or, $X_{10} = y_0 - X_{20} - X_{30}$, now, we insert the value of X_{10} in equation (5), we have:

$G_{X1} = \lambda\left(X\beta + X_{20} + X_{30} - y_0\right)$…………(9), inserting this G_{X1} in equation(8), we have equation (10): $G_y = \lambda(X\beta + X_{20} + X_{30} - y_0) + G_{X2} + G_{X3}$

From equation (10), we can say that the net effect of demographic dividend[3] (viz. G_{X3}) is the difference between (n-r); alternatively, equation (10) can be written as:

$$G_{X3} = G_y - \lambda(X\beta + X_{20} + X_{30} - y_0) - G_{X2} ....(11)$$

The problem of endogeneity emerges between growth of income per capita (G_y) and net effect of demographic dividend ($G_{X3}=n-r$) if we carefully examine the dynamics of age-cohort in the process of demographic transition. The basic principle of demographic transition asserts that population transition is treated as endogenous to economic growth (Birdsall, 1991; Borg, 1989; Todaro, 1991). As fertility declines during the process of demographic transition, growth of working age population (equivalently, n at full employment situation) is greater than aggregate population growth (r). Thus, it is clear from equation (10) and (11) that the net effect of demographic dividend (viz.$G_{x3}=n-r$) is also influenced by the factors determining growth of per capita income, G_y which causes the problem of endogeneity.

Keeping in mind the above theoretical backdrop, we consider the following econometric model for estimation:

$$G_{yit} = \beta_1 \ln y_{io} + \beta_2 \ln X_{3it} + \beta_3 G_{x3it} + \rho' X_{it} + \eta_i + \mu_t + \varepsilon_{it} \;.........(12)$$

$i=1,2......N,\ t=1,2.....T.\ (T<N)$, variables like, G_y, G_{X3}, y_i, X_{3i} are defined earlier; X_{it} be the vector of explanatory variables that affect G_y; η_i be the time invariant fixed effect capturing heterogeneity of state specific characters, μ_t be the time dummies; ε be the white noise error term. We consider, N=15 major states as cross-section units and t=4 (1971-1981, 1981-1991, 1991-2001 and 2001-2011). We did not include the growth of labour force participation rate (G_{X2}) as explanatory variable in model (12); this is because the growth of G_{X2} across 15 states over time is found to be very low and the data on G_{X2} do not show much variation across states over time. Average annual growth of G_y, G_{X1}, G_{X2} and G_{X3} for four time points are shown in Appendix Table-B.

Data, data sources and description of the variables which are used in econometric exercise are mentioned in Appendix-Table A.

4. Empirical Findings

Descriptive statistics pertaining to key demographic parameters and economic growth over 1971 to 2011 are given in Table-1. It is observed that the mean annual increase in the share of working age population of different age cohort is low compared to population growth rate which means that the pre-condition of enjoying the benefit of demographic dividend is yet to start. The most important feature is that Kerala has been an outlier experiencing a dramatic change in respect of the share of working age population in the age group 45-59; during 1971 to 2011, Kerala did experience a sharp demographic change; whereas Uttar Pradesh is found to be least developed in respect of demographic and health parameters like IMR, TFR and LE_0.

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[3] G_{X3} is defined as $\frac{(\dot{WP}/P)}{WP/P} = \frac{(\dot{WP})}{WP} - \frac{\dot{P}}{P} = \frac{\dot{L}}{L} - \frac{\dot{P}}{P} = n - r$, at full employment level WP (15-59) is equivalent to L, thus $G_{X3} = n\text{-}r$

Table-1 Descriptive Statistics

		Mean	S.D	Minimum	Maximum
Across 15 major States over 1971-2011	Percentage Growth of PCNSDP	3.69	2.53	0.09(Kerala)	10.53(Gujrat)
	Percentage Share of Working Age Population, 15-29(WP1) and its Growth	27.36 (0.452)	1.679 (0.429)	23.54(Bihar) (-0.81)(Kerala)	30.7(Gujrat) 1.57(Haryana)
	Percentage Share of Working Age Population, 30-44(WP2) and its Growth	19.39 (0.729)	2.403 (0.879)	14.7(Haryana) (-1.35)(Gujrat)	24.5(W.B) (3.57)(Orissa)
	Percentage Share of Working Age Population, 45-59(WP3) and its Growth	11.26 (0.611)	1.642 (1.09)	8.25(Haryana) (-3.01)(Kerala)	16.86(Kerala) (4.54)(Kerala)
	Percentage Share of WorkingAge Population,15-59(WPT), its Growth	58.023 (0.291)	4.905 (0.248)	51.21(Assam) (-0.47)(Kerala)	68.67(Kerala) (1.106)(Gujrat)
	PGR(r)	2.11	0.559	0.486(Kerala)	3.29(Rajasthan)
	TFR	3.29	1.11	1.6(Maharastra)	5.8(U.P)
	IMR	69.6	31.44	12(Kerala)	150(U.P)
	LE_0	62.1	7.18	47.3(U.P)	75.4(Kearala)

Notes: Growths of income (PCNSDP) is at 2004-05 constant prices; PCNSDP and demographic parameters are annual average. PGR=Population Growth Rate, TFR=Total Fertility Rate, IMR=Infant Mortality Rate, LE_0=Life Expectancy at Birth. Values in parentheses represent annual growth. Working population (WP) for Assam was interpolated. Newer states like Jharkhand, Chhatrishgarh & Uttaranchal are created in fall 2000. Thus, we consider values of the variables of the states like Bihar including Jharkhand, Madhya Pradesh including Chhatrishgarh, Uttar Pradesh including Uttaranchal for the years 2001 and 2011 to make it consistent with old geographical divisions.

Since, our primary objective is to explore the effect of demographic outcome on economic growth in India, we have formulated different econometric models keeping in mind the problem of endogeneity. Results are shown in Table-2.

Table-2 Impact of the share and growth of working age population on economic growth

Explanatory Variables	Model-1	Model-2	Model-3	Model-4	Model-5
Constant	-47.34***(17.24)	-5.82(15.61)	-60.08***(20.4)	-35.9***(9.05)	-94.09***(33.1)
lnWPT_10	10.54***(4.68)				
GrowthWPT_10	0.88(1.31)				
lnPCNSDP_10	-0.605(0.642)	0.238(0.861)	0.713(1.07)	0.579(0.82)	1.50(1.30)
lnSSE	1.06***(0.26)	1.44***(0.27)	0.957**(0.506)	1.16***(0.29)	0.99***(0.38)
lnCDR	1.873***(0.819)	2.54***(0.901)	0.058(1.59)	-0.15(1.36)	2.98***(1.31)
lnWP1		-3.65(6.31)			
GrowthWP1		-0.27(1.09)			
lnWP2			17.95**(7.81)		
GrowthWP2			-3.04**(1.33)		
lnWP3				11.89***(4.1)	
GrowthWP3				-1.79***(0.73)	
lnWPT					16.93**(8.25)
GrowthWPT					-9.71***(4.14)
Regression Diagnostic					
R^2	0.69	0.63	0.76	0.80	0.80
Adj. R^2	0.66	0.60	0.65	0.71	0.71
N	60	60	60	60	60
F	F(5, 54)=24.7				
Instrumented Variable	No endogeneity	GrowthWP1	GrowthWP2	GrowthWP3	GrowthWPT
Wald Chi-square		103.35	47	78.39	57.35
Pooling Vs. Panel		(5 d.f, p=0.00)	(5 d.f, p=0.00)	(5 d.f, p=0.00)	(5 d.f, p=0.00)
LM Tests (Baltagi-Li)	0.20 (1 d.f, p=0.65)	0.57 (1d.f, p=0.44)	0.03 (1d.f, p=0.85)	0.27 (1d.f, p=0.60)	0.30 (1d.f, p=0.58)
Hausman Test (FE vs. RE)	5.85(5 d.f p=0.32)	11(5 d.f p=0.05)	4.8(5 d.f, p=.43)	7.5(5d.f, p=.18)	5.1(5d.f, p=.39)

Note: Model-2 to Model-5 are estimated using 2SLS (Instrumental Variable) method. LM means Lagrange Multiplier, FE stands for fixed effect, RE stands for random effect. *** and ** indicates 1% and 5% level of significance respectively. Values in the parentheses of the regression coefficients represent standard error.

Here, in all the models we have incorporated per capita credit deposit ratio (CDR) and social sector expenditure (SSE) as proxy for physical capital and human capital respectively as implied by the theory of growth models as outlined earlier. Here, we hypothesize that investment in human capital (on education and healthcare) augments the level of income. We could incorporate the effect of human capital like mean years of schooling or school enrollment ratio etc. but due to lack of data across states over long period of time, we could not include these variables. In order to avoid endogeneity between economic growth and growth of the working population, we first formulate model-1, in which the lag (by 10 years) of the share of working age population and its growth are taken into account as predictors. Model-2 to Model-5 are estimated assuming endogeneity between current income growth and current demographic outcome. Baltagi-Li tests pertaining to panel vs. pooling gives us that all the models support pooling instead of panel. Moreover, Hausman tests support the RE which is consistent with the pooling results (Greene 2003).

All the models do support the endogenous growth theory in which human capital investment (SSE) plays a dominant role of economic growth. Similarly, physical capital accumulation as proxied by credit deposit ratio (CDR) appears as significant predictor (except Model-3 and Model-4) of economic growth. It is interesting to note that the growth of working population total (WPT), WP2 and WP3 reduce the per capita growth of NSDP, this result is contrary to the earlier works done by Aiyar and Mody, 2011; Utsab, 2014; and James, 2008. What are the reasons of getting such results? The plausible explanations could be the following:

Aiyar et al. (2011) and James (2008) have used the data for the period of 1961-2001; Aiyar et al. have considered 22 states and James has considered 15 major states. Our empirical findings are not based on 1961-1971 data; rather we have incorporated 1971-2011 data. Findings of Utsab(2014) is based on 17 states for the period of 1971-2001; but inclusion of time and state specific dummy creates a problem of degrees of freedom that is not specifically mentioned in Utsab's(2014) model. Even if we exclude 2011 data, our results do not fully support the earlier empirical findings as given in Appendix Table-C. Decomposition of growth of PCNSDP into three components (as given in Appendix Table-B) for 4 time points clearly support our findings; mean growth of PCNSDP has increased from 14.74 in 1971 to 36.74 in 2001 while mean growth of share of WPT has declined from 4.33 in 1971 to 4.01 in 2001.The age structure of population cannot be invariant over time in transitional economies. During 2001 to 2011, many states, on an average have experienced a fluctuating growth of WP. Demographic dividend means a sustained growth of WP but none of the states did experience such continuous increase in WP during 1971 to 2011. Moreover, for further confirmation, we have checked the influence of the growth of WP (with different age cohorts) on per capita NSDP using simple OLS but our results could not differ. The total size of working population (WPT) affects positively per capita NSDP but the decomposition of WPT gives interesting results. Results give us that the size of the WP3 and WP2 positively contribute to growth in per capita NSDP but the younger working age cohort (WP1) does not appear significant in our models. This result is quite consistent with the life cycle savings pattern and its consequent impact on aggregate economic growth. The more aged as well as middle aged work force save more compared to the younger workforce. Our findings support the "scale effect" of endogenous growth model. Initial level of income does not affect the current growth of output.

Now, in order to explore the impact of other demographic and health related parameters on per capita NSDP, we estimate Model-6 to Model-9 as shown in Table-3. We cannot draw any definite conclusion regarding the effect of population growth on economic growth, though the regression coefficient is found to be negative but is not significant. Our result supports the earlier works done by Dawson and Tiffin (1998) that have used time series data and found no long-run

Table-3 Impact of Population Growth, Fertility, Mortality and Life Expectancy on Economic Growth

Explanatory Variables	Model-6	Model-7	Model-8	Model-9
Constant	-12.92***(5.64)	-13.22(8.33)	-4.08(7.57)	-45.33***(18.66)
lnPCNSDP_10	-0.12(0.64)	-0.14(0.733)	-0.616(0.691)	-0.84(0.754)
lnPCSSE	1.419***(0.249)	1.434***(0.291)	1.279***(0.257)	0.900***(0.384)
lnCDR	2.283***(0.834)	2.324***(0.846)	2.543***(0.803)	2.860***(0.853)
PGR	-0.238(0.574)			
lnTFR		-0.244(1.387)		
lnIMR			-1.190*(0.746)	
lnLEB				9.597**(5.412)
Regression Diagnostic				
R^2	0.635	0.634	0.65	0.64
Adj. R^2				
N	60	60	60	60
F				
Instrumented Variable	PGR	lnTFR	lnIMR	**lnTFR**
Wald Chi-square	102.56(4 d.f)	102.4(4 d.f)	112.55(4 d.f)	**110.03(4 d.f)**
Pooling Vs. Panel				
LM Tests (Baltagi-Li)	0.46 (1d.f, p=0.49)	0.21 (1d.f, p=0.64)	0.25 (1d.f, p=0.61)	**0.21 (1d.f, p=0.64)**
Hausman Test (FE vs. RE)	5.15 (4 d.f, p=0.27)	2.30 (4d.f, p=0.67)	3.06 (4d.f, p=0.54)	**2.30 (4d.f, p=0.67)**

Note: Model-6 to Model-9 are estimated using 2SLS (Instrumental Variable) method. LM means Lagrange Multiplier, FE stands for fixed effect, RE stands for random effect. ***, ** and * indicate 1%, 5% and 10% level of significance respectively. Values in the parentheses of the regression coefficients represent standard error.

relationship between population growth and economic development in India. Income-fertility relationship is examined in Model-7 but the PGR result is replicated. Infant mortality negatively affects economic growth and the regression coefficient of IMR is significant at 10 percent level. Life expectancy at birth is assumed to be considered as general health status of the population. The states with higher life expectancy manifest faster economic growth. The regression coefficient of LE_0 appears significant at 5 percent level.

Given that most states by now have made progress towards a demographic transition, the average causal effect of improvements in life expectancy on per capita income is likely to be positive for health innovations and mortality reductions. Our results do support what Bloom et al (2004) have obtained in their cross-country study. The link between health and economic growth has been well established at the individual level. There are multiple channels through which life expectancy affects economic growth positively. First, healthier individuals increase their incomes by being more productive, physically more energetic and mentally more robust. A second mechanism for improved economic development is through increases in savings. If a population lives longer, they will want to invest more in their retirement. Third, improved health can lead to increase in economic growth through increase in education levels. A healthier population will want to invest more in their skills in order to earn higher wages. A healthier child will be able to attend school, learn more and have higher cognition. This can lead to higher wages in the long term.

5. Limitations of the study

Migration, human capital outcome variables like mean years of schooling, enrollment of students at primary, secondary and higher, labor force participation etc. are not taken into account in our growth models. We acknowledge the importance of variables like physical, social and financial infrastructure, political institution and its stability, corruption etc. affecting economic growth but it is beyond our scope to incorporate all these variables in the present context. Here, literacy rate, female literacy rate, per capita development expenditure other than social sector, road length per square kms, medical bed availability etc. are used indirectly in different econometric models as instrumental variables in 2SLS regression models.

6. Conclusion

Our results partially support the theoretical work relating to the impact of demographic outcomes on economic growth done by Prettner (2013). The present studies of the impacts of demographic change on long-run economic growth in India are the following:
(i) Increase in life expectancy and decrease in IMR positively affect economic growth, (ii) size of the working population positively affects economic growth but its growth affects negatively, (iii) fertility and population growth rate appear to be insignificant in our empirical analysis. Therefore, semi-endogenous growth model (as developed by Jones (1995)) does not hold good because the fertility and population growth rate do not have any significant impact on economic growth; moreover, the effect of the growth of working age population on economic growth is found to be negative which goes against the predictions of Jones(1995).

There exists a wide range of variations of income, health and demographic parameters like share of the working age population (WPT) and its components (viz. WP1, WP2, WP3) across 15 major states in India. This is quite evident from low mean and high variance as shown in Table-1. Only an increase in the size of WP2 and WP3 positively affect PCNSDP but their growths adversely affect per capita NSDP. Our results partially support the pessimists who are not in favour of economic dividend from demographic outcome. From the overall findings we can argue that if inter-state variations in fertility, mortality and life expectancy can be reduced by raising investment in human capital and if the labor force is absorbed in gainful employment then demographic dividend may augment economic return. After structural adjustment programme in 1991, central as well as many state governments have reduced subsidy on education and health; moreover the incidence of malnourishment, poor reproductive and child health, widespread poverty are assumed to be other obstacles towards effective human capital formation. Moreover our labour force participation especially female labour force participation is extremely poor. Since future demographic dividend is largely dependent on poorer states, therefore, a special drive is urgently needed towards improvement of health and education of the children of those backward states like Uttar Pradesh, Orissa, Bihar and Madhya Pradesh. Presently, about 92 percent workforce are absorbed in informal sector where productivity is low; now in the near future if extra labor force adds in this unorganized sector which will mainly originate from those backward states, the problem will aggravate. Thus, we can argue that policy choices can potentiate India's realization of economic benefits stemming from demographic change; but failure to take advantage of the opportunities inherent in demographic change can lead to economic stagnation.

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Appendix-Table A Data, Data Source and Description of Variables

Data	Data Source	Description of Variables
Per capita net state domestic product, state wise credit deposit ratio, per capita education and healthcare expenditure, per capita state development expenditure other than health and education	Central Statistical Organization(CSO) and Reserve Bank of India(RBI) downloaded from indiastat.com	Per capita net state domestic product=PCNSDP, state wise credit deposit ratio(%)=CDR, per capita education and healthcare expenditure(viz. social sector)=SSE, per capita development expenditure other than social sector=PCDE
Different age cohort of the share of working age population, population growth rate, infant mortality rate, total fertility rate, life expectancy at birth, literacy rate, female literacy rate and urbanization	Different Census Reports and Sample Registration System, Registrar General, Government of India, downloaded from indiastat.com	State level share of the working population between age 15 to 59 lagged by 10 years and current are denoted by WPT_10 and WPT respectively; share of working population between age 15-29, 30-44 and 45-59 are described as WP1, WP2 and WP3 respectively; population growth rate=PGR, infant mortality rate=IMR, total fertility rate=TFR, life expectancy at birth=LEB, literacy rate=LR, female literacy rate=FLR, urbanization=UR
Social and physical infrastructure: Road length per 100 square km, village electrification, medical bed availability	Central Statistical Organization, Ministry of Health and Family Welfare,Govt. of India. Data are available in indiastat.com	Road length per 100 sq. km.=RL, % of village electrified=VE, medical bed availability per 10000 population=MB

Appendix Table-B

Decomposition of decadal growth of PCNSDP (G_y) into growth of AP_L(G_{X1}), growth of labour force participation rate (G_{X2})and growth of share of working population between age 15-59 (G_{X3})

States	Decomposition of growth PCNSDP(Gy) into different components: Gx_1, Gx_2 and Gx_3															
	1971-1981				1981-1991				1991-2001				2001-2011			
	G_y	G_{x1}	G_{x2}	G_{x3}	G_y	G_{x1}	G_{x2}	G_{x3}	G_y	G_{x1}	G_{x2}	G_{x3}	G_y	G_{x1}	G_{x2}	G_{x3}
Andh. Pr	21.16	17.44	0.74	2.97	49.27	45.33	-0.02	3.96	48.25	42.6	-0.0007	5.59	76.2	70.1	0.007	6.09
Assam	1.08	-6.8	2.07	5.8	20.24	14.9	-0.32	5.57	5.17	-0.3	-0.002	5.52	34.81	28.77	0.02	6.01
Bihar	11.36	9.86	0.70	0.79	21.7	21.6	0.002	0.03	9.47	9.26	-0.002	0.21	55.06	54.44	0.09	0.52
Gujrat	39.07	31.2	0.9	6.9	36.28	32.4	0.06	3.75	38.03	33.1	0.002	4.9	105.3	100.6	-0.001	4.6
Haryana	25.3	16.47	1.02	7.79	37.3	36.2	-0.02	1.11	35.8	28.23	0.001	7.5	81.6	72.1	0.05	9.43
Karnataka	17.6	14.4	0.82	2.39	34.2	30.23	0.02	4.93	61.86	54.97	-0.00	6.89	64.37	57.67	0.05	6.64
Kerala	0.97	-7.6	0.69	7.89	13.06	6.36	-0.03	6.73	64.03	61.14	-0.005	2.8	82.6	79.4	0.14	3.1
M.P	8.86	4.41	0.86	3.58	12.15	9.97	0.006	2.16	27.6	25.4	0.001	2.15	52.35	45.46	0.02	6.87
Maharastra	31.27	25.18	0.82	5.27	40.2	37.6	0.004	2.5	45.7	41.4	0.001	4.3	94.4	87.9	0.01	6.4
Orissa	3.24	-1.67	0.91	4.0	29.3	24.23	-0.02	5.09	2.35	-1.5	-0.0003	3.8	79.3	74.05	0.12	5.16
Punjab	23.3	15.17	0.72	7.4	39.5	36.6	-0.02	2.87	27.5	24.1	0.002	3.4	38.6	29.23	0.12	9.24
Rajasthan	2.88	-0.05	0.92	2.01	40.42	38.3	0.06	2.06	35.03	33.5	-0.001	1.53	51.13	43.96	0.09	7.07
TN	11	6.79	0.72	3.47	39.7	34.32	0.01	5.45	72.6	68.4	-0.002	4.1	75.6	71.5	0.07	3.97
UP	11.13	10.7	0.42	-0.05	24.64	23.42	0.17	1.04	14.11	13.51	-0.006	0.6	35.74	29.57	0.03	6.13
WB	12.88	7.37	0.83	4.67	17.65	14.53	0.05	3.06	63.55	57.09	-0.005	6.4	59.87	51.05	0.13	8.68
Mean	14.74	9.53	0.88	4.33	30.44	27.08	-0.003	3.36	36.74	32.73	-0.001	4.01	65.81	59.74	0.067	6.0
GE(2)	0.047	0.67	0.08	0.02	0.07	0.09	506	0.16	0.19	0.22	2.9	0.15	0.05	0.007	0.27	0.07

Note: Census was not conducted in Assam in 1981, therefore, the values of AP_L, LFPR, SWP are estimated using interpolation. Growth of income (PCNSDP) is at 2004 constant prices. We consider values of the variables of the states like Bihar including Jharkhand, Madhya Pradesh including Chhatrishgarh, Uttar Pradesh including Uttaranchal for the year 2001 and 2011 to make it consistent with old geographical divisions

Appendix Table-C Impact of share of WP on Growth of Per Capita NSDP: A Comparative Analysis
Dependent Variable: Average Annual Growth of PCNSDP

Explanatory Variables	Present Study		Study of Aiyer et al.(2011)		Study of James(2008)		Study of Utsab(2014)	
	Pooling	IV(2SLS)	Pooling	IV(2SLS)	Pooling	IV(2SLS)	Pooling	IV(2SLS)
Constant	-87.37(19.65)***	-65.6(36.6)**	-	-	5.56(18.75)	-2.83(14.94)	0.943(0.18)***	1.09(0.22)***
lnPCNSDP_10	1.796(0.743)**	1.16(1.24)	-0.08(0.01)***	-0.076(0.02)***	-0.97(2.08)	-0.81(1.72)	-0.076(0.01)***	-0.07(0.02)***
lnWPT_10	19.72(5.10)***	15.04(8.1)**	0.18(0.07)***	0.36(0.12)***	-	-	0.37(0.13)**	0.66(0.09)***
GrowthWPT	-2.068(1.353)	1.9(5.56)	2.47 (1.02)***	4.13(2.34)**	-0.35(0.86)[C]	24.2(4.1)[C]***	2.71(1.16)**	2.62(1.07)**
Regression Diagnostic								
R^2	0.428	0.32	0.73		0.36	0.62	Not Reported	Not Reported
F	F(3,41)=9.20***	-	-	10.7			Not Reported	Not Reported
Wald Chi-square(3)	-	24.17***		-				
Instruments		lnTFR, lnLEB		Lagged CBR		Not Reported		Not Reported
Baltagi-Li form of LM Statistic	3.24[a]						-	
FE vs. RE Test(Hausman)	5.71[b]							
Number of Observations	45		76		60		48	32
Number of Groups	15		22		15		17	17
Period of Study	1971-2001	1971-2001	1961-2001	1961-2001	1961-2001	1961-2001	1971-2001	1971-2001

Notes: [a]Baltagi-Li form of LM Statistic favours pooling, [b]Hausman test favors RE, [C]instead of share, James has considered growth of working population; values in parentheses represent standard error, ***means 1 %, **means 5%, GrowthWPT is the instrumented variable(lnTFR and lnLEB are used as instruments in our present 2SLS model). Source: Regression results of Aiyer et al (2011) is drawn from the paper "The Demographic Dividend: Evidence from the Indian States" IMF Working Paper WP/11/38, February, European Department, pp.16; James (2008) result is derived from the paper ""Glorifying Malthus: Current Debate on Demographic Dividend in India," *Economic and Political Weekly*, No. 43(25), June 21, pp. 68; Results of Utsab, K (2014) is compiled from the paper "India'sDemographic Transition: Boon or Bane?" Asia & the Pacific Policy Studies, Volume 1(1), January, 193.