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The Demographic Dividend: Evidence from the Indian States

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Abstract

Large cohorts of young adults are poised to add to the working-age population of developing economies. Despite much interest in the consequent growth dividend, the size and circumstances of the potential gains remain under-explored. This study makes progress by focusing on India, which will be the largest individual contributor to the global demographic transition ahead. It exploits the variation in the age structure of the population across Indian states to identify the demographic dividend. The main finding is that there is a large and significant growth impact of both the level and growth rate of the working age ratio. This result is robust to a variety of empirical strategies, including a correction for inter-state migration. The results imply that a substantial fraction of the growth acceleration that India has experienced since the 1980s—sometimes ascribed exclusively to economic reforms—is attributable to changes in the country's age structure. Moreover, the demographic dividend could add about 2 percentage points per annum to India's per capita GDP growth over the next two decades. With the future expansion of the working age ratio concentrated in some of India's poorest states, income convergence may well speed up, a theme likely to recur on the global stage.

JEL Classification Numbers: O47, O15, O53, J11

Keywords: Demographic dividend, Indian states, age-structure, migration, convergence.

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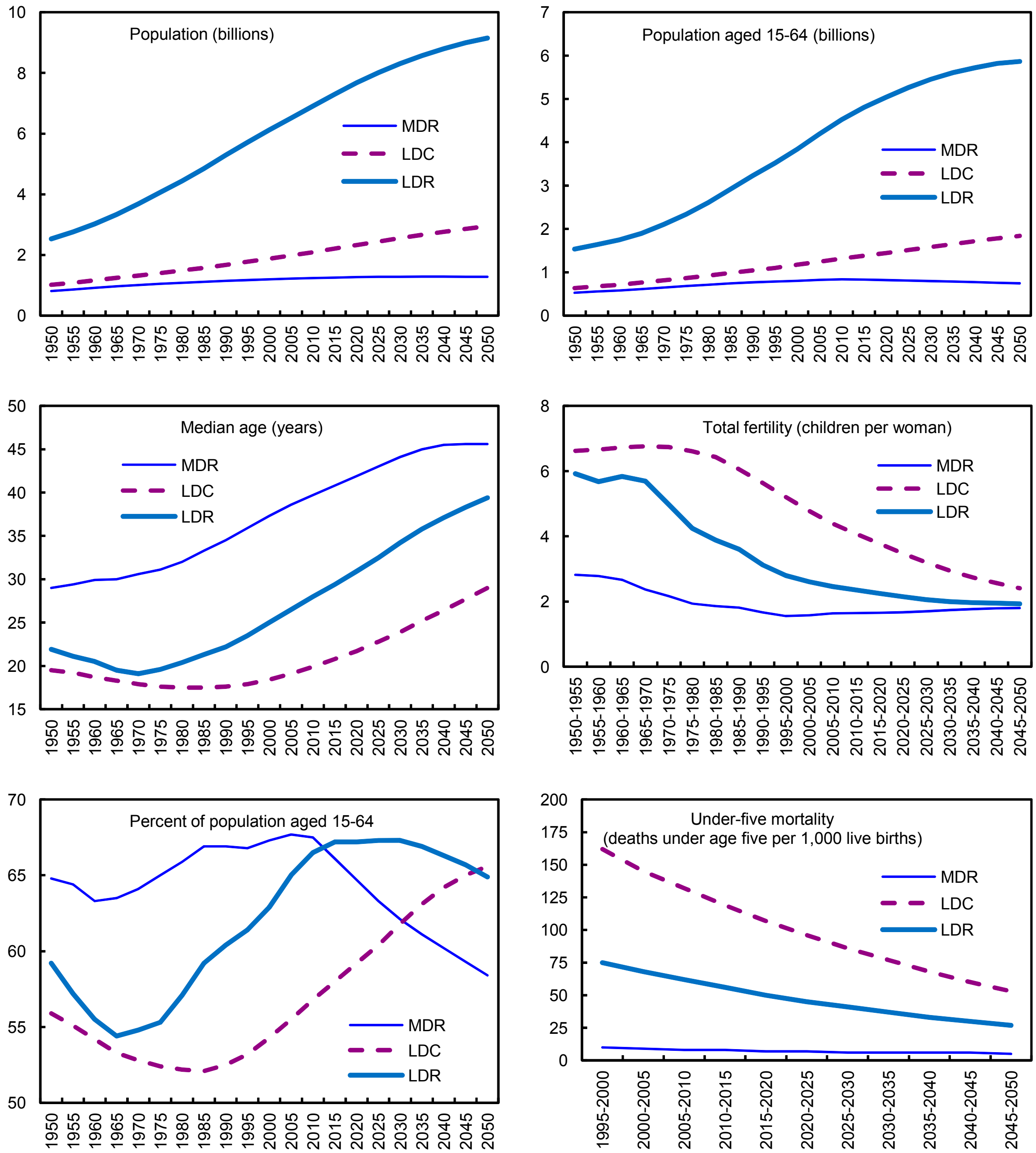
I. Introduction

In the next 40 years, the world's population will grow by about 2.4 billion people, almost all of them in developing countries (Figure 1). The large bulk of this increase will be between the ages of 15 and 64, the so-called "working age" population. This huge boost reflects a delayed demographic transition: declining infant mortality rates are being followed by falling fertility rates. Thus, with children more likely to survive into productive adulthood and fewer children being produced, the share of working age populations will increase. For the least developed countries, this share will continue to increase through 2050; for other less developed countries, the share has been steadily increasing and will peak in the coming two decades.

An increase in the working age ratio can raise the rate of economic growth, and hence confer a "demographic dividend." People of working age are on average more productive than those outside this age group. Also, because workers save while dependants do not, a bulge in the working age ratio contributes to higher savings rates, increasing the domestic resources available for productive investment. In addition, the fertility decline that is the source of the changed age structure may act directly to induce greater female labor supply (Bailey (2006)) and increase attention to primary education and health (Joshi and Schultz (2006)).

While there is a sizeable literature on demographic trends and their economic ramifications, the econometric evidence for the growth impact of the working age ratio is more limited. Bloom and Canning (2004) is a landmark contribution: for a panel of countries from 1965–1995, the authors find a sizeable impact of the working age ratio on economic growth but only if the economy is "open." Thus, they conclude that the potential for a dividend exists but that it is realized mainly when incentives are in place to exploit that potential. Several papers find that national savings rates are strongly connected to demographic structure (Fry and Mason (1982), Higgins (1998), and Kelley and Schmidt (1996)). Other papers focus on particular countries or regions. Person (2002) and Feyrer (2007) document the relationship in the US between demographic structure and, respectively, output and productivity. Bloom, Canning and Malaney (2000) and Mason (2001) conclude that East Asia's "economic miracle" was associated with a major transition in age structure, while Bloom, Canning and Sevilla (2002) find that much of Africa's relatively poor economic performance can be accounted for by the lack of such a transition.

Figure 1. The Demographic Transition



Source: UN, World Population Prospects.
MDR=More developed regions
LDC=Least developed countries
LDR=Less developed regions, excluding least developed countries

Given the importance of the demographic transition, this paper seeks to deepen our understanding of the size and circumstances of the demographic dividend. In doing so, we focus on India. This focus is motivated by several factors. First, a latecomer relative to advanced Western nations and East Asian economies, India is in the midst of a major demographic transition. That transition started about 40 years ago and will likely last another 30 years. As a simple quantitative matter, about a quarter of the projected increase in the global population aged 15–64 years between 2010 and 2040 will occur in India.[1] The working-age ratio in the country is set to rise from about 64 percent currently to 69 percent in 2040, reflecting the addition of just over 300 million working-age adults. This would make India—by an order of magnitude—the largest single positive contributor to the global workforce over the next three decades.

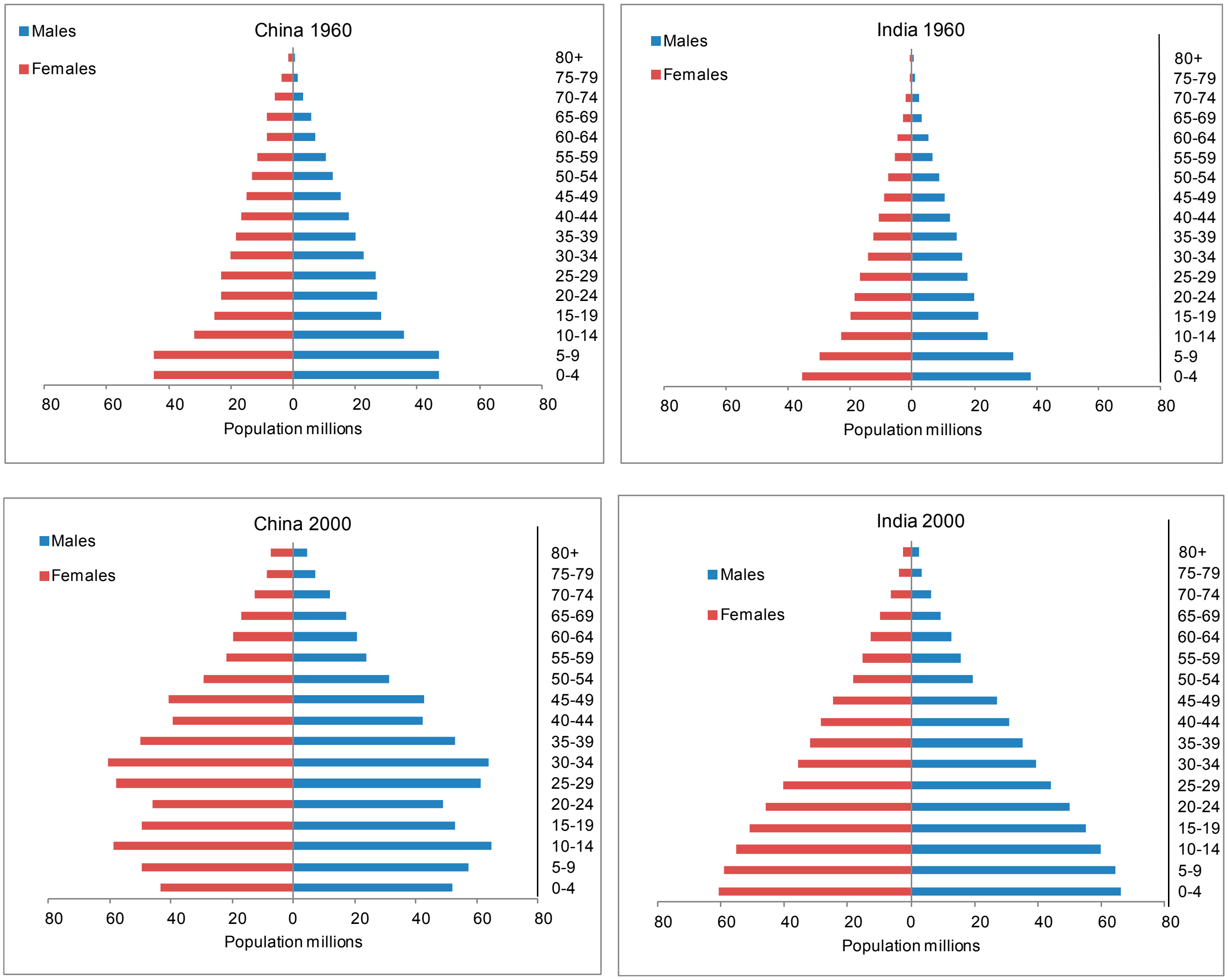
Second, recent research on economic growth emphasizes the challenges of capturing widely differing economic and non-economic conditions in the cross-section of countries. For this reason, country focus and "narrative" analysis has gained favor (Rodrik ed. (2003)). We are able to go one step further. Indian states have historically exhibited large differences in age structure, both in the level and growth rate of the working age ratio. And the summary indicators suggest a strong link between states' demographic trends and economic performance. We are able to exploit the heterogeneity in the evolution of demographic patterns across Indian states to econometrically estimate the impact of the working age ratio on economic growth.

Third, for those engaged in the sport of India-China comparisons, the demographic dividend offers the single biggest hope for India to catch up (Kelkar (2004)). China saw its population pyramid shift from the bottom-heavy distribution typical of a young and growing population in the early 1980s to a mature population structure by 2000 (Figure 2). Over the coming decades, as the working age population China declines, that of India will rise rapidly. A not atypical prognosis is offered by the *Economist* (August 21–27, 2010):

> "As recently as the early 1990s, India was as rich [as China], in terms of national income per head. China then hurtled so far ahead that it seemed India could never catch up. But India's long term prospects now look stronger. While China is about to see its working age population shrink, India is enjoying the sort of bulge in manpower which brought sustained booms elsewhere in Asia. It is no longer inconceivable that its growth could outpace China's for a considerable time."

[1] United Nations (2009)

Figure 2. Comparative Evolution of Population Pyramids



We describe how a standard conditional convergence framework can be used to derive a panel specification in which both the level and the growth rate of the working age ratio serve as explanatory variables for economic growth. Applying this specification to the data on Indian states, we reach three principal conclusions.

First, the demographic dividend is substantial. This result is robust to corrections for the possible response of inter-state migration to differential economic growth, and to a two-stage procedure in which lagged fertility decisions are used to instrument the growth in working age population. Our econometric estimates imply that from the 1970s onwards, between 40 to 50 percent of the per capita income growth was attributable to the ongoing demographic dividend. While policy reforms had an important role to play in the growth acceleration starting in the 1980s, the results caution that this was less so than commonly perceived once the concurrent rise in working-age ratios is taken into account. Second, unlike Bloom and Canning (2004), we do not find the demographic dividend to be conditional on specific policies or social environments. We read the evidence to say that the very features that lead to a demographic transition—mortality decreases followed by fertility decline—also reflect broader health and educational achievements that are conducive to the exploitation of the demographic dividend. Finally, going forward, it is the poorest Indian states that stand to gain the most from the forthcoming demographic transition, since they are the ones that have so far lagged behind in both the transition and in income growth. The prospect of such gains is a source of hope beyond India, where the potential benefits of the demographic dividend are also most on tap for the least developed economies.

The rest of this paper is organized as follows. Section 2 reports on state-specific trends in the age structure of the population and its correlations with income growth. Section 3 describes an econometric framework that is used in Sections 4 and 5 to estimate the demographic dividend, paying attention to various robustness considerations. In Section 6, we use the regression coefficients to quantify the contribution of the demographic dividend in the past four decades and in the decades beyond. A final section offers some concluding remarks.

II. Data and Summary Statistics

We create a database of the age distribution of population, per capita income, and numerous social and economic indicators across Indian states by decade. Data on the age distribution are from successive rounds of the Census of India (COI).[2] Unfortunately, the age groups reported in successive COIs are not uniform. Hence, instead of defining the working age ratio as the share of population aged 15–64 years, as is conventional, we define it instead as the share of population aged 15–59 years, a group for which we do have a consistent panel. Two adjustments are made to the population data to account for the creation of new states during the sample period. First, the 2001 data is adjusted to take account of the creation of Jharkhand and Chattisgarh. These states were carved out of the existing territory of the states of Bihar and Madhya Pradesh in 2000. The COI 2001 reports age distributions for these states separately. Since we have the complete age distribution for both the new states as well as the rest of the old states, we consolidate Bihar with Jharkhand and Madhya Pradesh with Chattisgarh, so that the time series for each state remains consistent with the old geographical divisions. Second, a more complicated adjustment is made to account for the creation of Haryana from the territory of Punjab in 1966.[3]

[2] The Indian census is conducted every ten years and published in the first year of the decade; thus the ones used in this study are for the years 1961, 1971, 1981, 1991 and 2001.

[3] The 1966 redesignation also created the Union Territory of Chandigarh, originally a city in Punjab, to serve as the joint capital of Punjab and Haryana. From the COI 1971, we calculate Punjab's population as a ratio of the combined population of Punjab, Haryana and Chandigarh. We do this separately for each age group. We then apply this ratio to the COI 1961 population data on (the old) Punjab, to get a time series that is consistent with the new geographical area. We repeat the procedure for Haryana.

Per capita income is constructed from data on net state domestic product (NSDP) together with estimates of state population from the COIs.[4] With that, for income and age distribution, we have a largely balanced panel of 22 states, with data at ten year intervals from 1961 to 2001.[5] Data sources for the other variables used will be described as they are introduced, in sections 4 and 5.

Table 1 reports summary statistics for the key variables of interest: the growth in per capita income, the working age ratio, and the growth rate of the working age ratio. The first three rows show summary statistics treating each state-time period combination as a separate observation, while the next three rows show summary statistics across states (averaged over time). Both panels attest to the enormous diversity across Indian states.

Table 1. Summary Statistics

		Mean	S.D.	Minimum	Maximum
Across states and time periods	Per capita income growth (percent)	2.13	1.67	-1.83 Rajasthan (1971-81)	6.26 Tripura (1991-2001)
	Working age ratio (percent)	54.93	3.37	47.98 Haryana (1971)	64.4 Tamil Nadu (2001)
	Working age ratio growth (percent)	0.22	0.38	-0.68 Madhya Pradesh (1961-71)	0.85 Tripura (1971-81)
Across states	Per capita income growth (percent)	2.18	0.79	0.87 Madhya Pradesh	3.8 Arunachal Pradesh
	Working age ratio (percent)	54.9	1.89	52.2 Bihar	59.7 Tamil Nadu
	Working age ratio growth (percent)	0.21	0.19	-0.09 Jammu & Kashmir	0.55 Haryana

Table 2 reports the evolution of our variables of interest for six selected states. The states have been chosen as representative of two groups: "Leaders" or high-growth states, typically from the south and west of the country, and "Laggards" or low-growth states, largely

[4] The Economic and Political Weekly Research Foundation (EPWFR) panel of NSDP (from 1961 through 2004) is available on CD-ROM, and sourced from the Directorates of Economics and Statistics of respective state governments. The data for 1961-1971, however, covers only 4 states. Hence for that decade we use data from Indiastat (http://www.indiastat.com), a website that agglomerates Indian national and state-level data from diverse sources. The series on NSDP is originally sourced from the Central Statistical Organization (CSO).

[5] The states are: Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Kerala, Karnataka, Maharashtra, Manipur, Madhya Pradesh, Meghalaya, Nagaland, Orissa, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal. Data are missing on income and age distribution for Arunachal Pradesh 1961; income data are missing for Nagaland 1961, Meghalaya 1971 and Nagaland 1971; and age distribution data are unavailable for Assam 1981 and Jammu and Kashmir 1991. Age distribution data for Jammu and Kashmir in 1991 are unavailable because there was no census carried out in Jammu and Kashmir in that year.

concentrated in a broad swath of territory running across central and northern India where Hindi and associated dialects are spoken (hence the term “Hindi Heartland”). The divergence in per capita income growth between Leaders and Laggards is well known, with the divergence being highest for the most recent period 1991–2001. What may be less well known is that these trends in income growth are mirrored in the demographic data. A large and widening gap has opened up between the working age ratios in Leaders and Laggards over the 40-year period. In the decade 1991–2001, the gap reached 8.7 percentage points or 2.6 standard deviations (across state-time observations). Figure 3 illustrates these trends graphically.

Table 2. Demographic Evolution and Income Growth in Selected States

		1961	1971	1981	1991	2001
Working Age Ratio	Leaders (South and West)					
	Tamil Nadu	56.8	56.5	58.6	62.4	64.8
	Karnataka	52.1	51.5	53.9	57.8	60.8
	Gujarat	52.2	51.7	55.3	58.8	60.6
	Simple Average	*53.7*	*53.2*	*55.9*	*59.7*	*62.1*
	Laggards (Heartland)					
	Bihar	52.1	51.5	51.5	53.6	52.5
	Madhya Pradesh	54.0	50.5	52.3	55.3	55.1
	Uttar Pradesh	53.2	51.4	51.5	53.7	52.5
	Simple Average	*53.1*	*51.1*	*51.8*	*54.2*	*53.4*
		1961–71	1971–81	1981–91	1991–01	
Working Age Ratio Avg. Annual Growth Rate (%)	Leaders (South and West)					
	Tamil Nadu	-0.055	0.364	0.641	0.372	
	Karnataka	-0.129	0.455	0.714	0.504	
	Gujarat	-0.096	0.675	0.610	0.309	
	Simple Average	*-0.093*	*0.498*	*0.655*	*0.395*	
	Laggards (Heartland)					
	Bihar	-0.107	0.000	0.397	-0.208	
	Madhya Pradesh	-0.673	0.354	0.546	-0.030	
	Uttar Pradesh	-0.352	0.022	0.416	-0.223	
	Simple Average	*-0.378*	*0.125*	*0.453*	*-0.154*	
		1961–71	1971–81	1981–91	1991–01	
Per Capita Income Avg. Annual Growth Rate (%)	Leaders (South and West)					
	Tamil Nadu	0.4	0.1	4.1	5.1	
	Karnataka	2.0	0.7	3.0	6.0	
	Gujarat	1.9	0.9	3.1	3.6	
	Simple Average	*1.4*	*0.5*	*3.4*	*4.9*	
	Laggards (Heartland)					
	Bihar	0.3	0.6	2.7	-0.1	
	Madhya Pradesh	-0.5	0.6	2.2	1.1	
	Uttar Pradesh	0.7	0.7	2.6	0.8	
	Simple Average	*0.2*	*0.6*	*2.5*	*0.6*	

Figure 3. Income Growth and the Working Age Ratio in Selected States

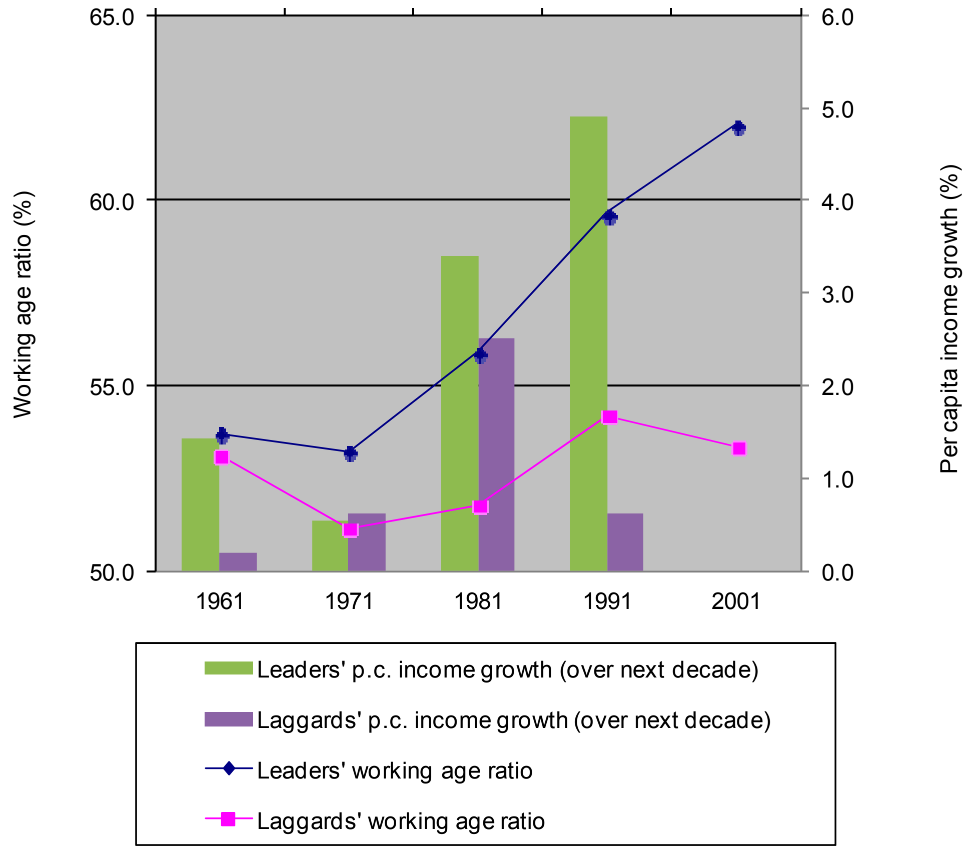


Table 3 reports some bilateral correlates of per capita income growth. Each column shows results from a pooled OLS regression with a single regressor and no control variables. The correlation of income growth with the working age ratio is as significant as its correlation with the literacy rate, which is often identified with human capital and thus a priori an important determinant of growth. Column 5 suggests that the correlation between per capita income growth and the working age ratio does not arise simply from any mechanical relationship between the latter ratio and population growth.

Table 3. Growth Correlates 1/

Initial Period Variable	(1) Log Initial P.C. Income	(2) Log Literacy Rate	(3) Log Working Age Ratio	(4) Log Population Growth
Coefficient	0.01*	0.015***	0.155***	-0.184
Standard Error	0.006	0.005	0.032	0.20
Observations	81	78	78	76

1/ Each column reports a separate regression using pooled OLS without any controls. In every regression, the dependant variable is annualized decadal growth. Regressors are measured at the beginning of each decade. *, ** and *** denote significance at the 10%, 5% and 1% levels respectively, a convention that is followed in all the succeeding tables.

III. Estimation

Following Bloom and Canning (2004), we use a standard conditional convergence equation to derive a relationship between per capita income growth and demographic trends.

$$g_z = \lambda(z^* - z_0)$$

The equation above is a staple of the growth literature, derived and extensively discussed in Barro and Sala-i-Martin (1995). Log income per worker is denoted by z, and growth in income per worker by g_z. The equation states that, over any given time period, growth in per worker income is related to the gap between the steady state level of income per worker and the level of income per worker at the beginning of the period. λ parameterizes the speed of adjustment to the steady state. In turn, the steady state income per worker is a function of several variables that impact potential labor productivity. These include measures of health and education, which determine the quality of the labor stock, or time-invariant factors such as climate, geography, and culture. Denoting these determinants of labor productivity by the vector X and the associated vector of parameters by β, the equation can be rewritten as:

$$g_z = \lambda(X\beta - z_0) \qquad (1)$$

To relate this to demographic variables, consider the following simple identity:

$$\frac{Y}{N} = \frac{Y}{L}\frac{L}{WA}\frac{WA}{N}$$

where N denotes population, L the labor force and WA the working age population. The identity states that income per capita equals labor productivity times the participation rate times the working age ratio. Let lower case letters represent the log of these ratios,

$$y = \ln(\frac{Y}{N}); z = \ln(\frac{Y}{L}); p = \ln(\frac{L}{WA}); w = \ln(\frac{WA}{N}).$$

It follows that:

$$z = y - p - w \qquad (2),$$

And, assuming that participation rates remain constant within each state,

$$g_y = g_z + g_w \qquad (3),$$

where g_y is the growth in income per capita and g_w the growth in the working age ratio. Substituting (2) and (3) into (1) yields:

$$g_y = \lambda(X\beta + p + w_0 - y_0) + g_w \qquad (4)$$

Equation (4) is the basis for our empirical estimation. It says that over a given time period, both the initial working age ratio and the growth rate of the working age ratio should be positively related to per capita income growth. This is in addition to the impact of any other factors that may impact steady state labor productivity. Note that the vector X could also contain time-invariant variables.

Equation (4) imposes strict parameter restrictions on the coefficients for the working age ratio and the growth rate of the working age ratio. But the restrictions will not be valid if behavior changes in response to the changes in the working age-population ratio. As argued by a large literature, this is unlikely to be the case. The life cycle hypothesis posits that workers have positive savings while the young and the old consume more than they earn. Thus an expansion in the working age ratio—the converse of the dependency ratio—is likely to be associated with increased aggregate savings and hence the potential stock of capital. Being born into a large cohort—so called "generational crowding"—could also impact behavior, influencing individual labor supply and relative wages (Easterlin 1980, Bloom, Freeman, and Korenman 1987; Korenman and Neumark 2000). Changes in the working age ratio could also influence fertility decisions and participation rates. Moreover, to the extent that workers are healthier than the old, an expansion in the working age ratio could also be accompanied by improvement in the stock of human capital stock, which may not be captured by "input" indicators of health. For these reasons, no restrictions are imposed on the coefficients of demographic variables, allowing the data to speak to their effect.
We estimate various specifications of the form:

$$g\_y_{i,t} = \rho \ln y_{i,t} + \beta_1 \ln w_{i,t} + \beta_2 g\_w_{i,t} + \gamma' X_{i,t} + f_i + \eta_t + \varepsilon_{i,t} \qquad (5)$$

where the dependant variable $g\_y_{i,t}$ is the annual average growth rate of per capita income in state i over the decade beginning in year t. The main regressors are the log of initial per capita income, the log of the initial working age ratio, and the average annual growth rate of the working age ratio over the decade. $X_{i,t}$ is a vector of explanatory variables that might impact steady state labor productivity. f_i is a time-invariant fixed effect, capturing state-specific effects, while η_t is a time dummy, capturing effects unique to the decade beginning in year t (in our case, the national policy environment and international growth impulses). Thus the framework comprises a standard application of the within estimator.

All regressions are estimated with heteroskedasticity-robust standard errors. All control variables are measured at time t, and, like the initial working age ratio, should be predetermined with respect to income growth over the following decade. The growth rate of the working age population, being contemporaneous with the dependant variable, is potentially more problematic. The main determinant of this growth rate should be fertility decisions in the previous decade or earlier. However, other, contemporaneous influences on the growth rate of the working age population may include feedback effects from income growth. This endogeneity concern is taken up at some length in the next section.[6]

IV. The Demographic Dividend

Column 1 in Table 4 below presents the results from a regression using our two demographic variables—initial working age ratio and the growth rate thereof—together with state-specific fixed effects and time period dummies. Both variables have the expected sign and are significant. Moreover, their magnitude is large, implying a very substantial impact on income growth. An increase of 0.01 in the log of the initial working age ratio (i.e. a 1 percent increase in the working age ratio) is associated with a 0.2 percentage points increase in annual average per capita income growth over the succeeding decade. Since the standard deviation of $\ln w_{i,t}$ across states is 0.03, a one standard deviation increase in the working age ratio is associated with an increase of about 0.6 percentage points in per capita income growth. Also, a one standard deviation increase in the growth rate of the working age ratio is 0.19, which would increase per capita income growth by about 0.5 percentage points.

[6] The specification in equation (5) is technically equivalent to a dynamic panel with a lagged dependent variable, raising the usual issue of upward bias in the lagged dependant variable, in this case the log of initial per capita income. It has become customary to address this bias using one of two variants of GMM, the difference estimator and the system estimator (Arellano and Bond (1991), Blundell and Bond (1998)). We do not follow this approach here. The difference and system estimators suffer from econometric issues of their own, which in this application are larger than the problems with the within estimator. The difference estimator uses lagged levels to instrument for a specification in first differences; this has the effect of magnifying gaps in unbalanced panels like ours and reducing the number of usable observations. In our case, using the difference estimator reduces the sample size to 38 observations, which we judge insufficient given that we must estimate 27 parameters (fixed effects for each state, plus time dummies, plus coefficients on the lagged dependant variable and demographic variables). The system estimator, on the other hand leads to a proliferation of instruments. In our case, 29 instruments are generated, relative to only 22 groups (panels). Such overfitting can result in biased estimates. Moreover, since the number of elements in the estimated variance matrix of moments is quadratic in the instrument count, it is quartic in T. In our case, with a relatively small sample size, the matrix becomes singular for both estimators, forcing the use of a generalized inverse. This distances the estimates from the asymptotic case and weakens the Sargan-Hansen test (Anderson and Sorenson (1996), Bowsher (2002)). Having said this, the estimates of the impact of demographic variables obtained from the difference and system estimators are qualitatively similar to those obtained by the within estimator (but not so for the lagged dependent variable).

Table 4. The Impact of Demography on Per Capita Growth
Controlling for Migration 1/

Dependent variable: Annual per capita income growth	(1)	(2)
Log initial income per capita	-0.088***	-1.01***
	0.0175	0.013
Log initial working age ratio	0.188**	0.234***
	0.077	0.081
Growth rate of working age ratio	2.478**	
	1.026	
Adjusted growth rate of working age ratio 2/		1.57***
		0.50
R-squared	0.73	0.69
Observations	76	72
Groups	22	22

1/ All regressions employ the within estimator with robust standard errors.
2/ It is assumed that all migrants are of working age. Accordingly, for each decade a counterfactual growth rate of the working age ratio is constructed by deducting the number of net inward migrants over the decade from both the end-of-decade population and the end-of-decade working age population.

As noted in the previous section, the initial working age ratio should be pre-determined with respect to per capita income growth. However, there is one obvious channel through which per capita income growth could have a contemporaneous impact on the growth rate of the working age ratio: inter-state migration. Cashin and Sahay (1996) studied migration between the Indian states, and found little evidence that inter-state population flows responded to income differentials.[7] They pointed to strong barriers to the mobility of labor, such as local labor unions that resist competition from migrants, lack of urban housing in migrant destinations, and most importantly, linguistic and cultural impediments to cross-border labor substitutability. In fact, most migration tends to be within-state female migration caused by newly married wives relocating to their husband's village (Datta (1985), Skeldon (1986)).

[7] They write (p. 162): "…while the [inward] migration rate for the states of India is positively related to initial per capita income, it is not statistically different from zero. In that sense, the income elasticity of migration across the states of India more closely resembles the relatively weak responsiveness of population movements to differentials in the regions of Europe than the relatively stronger responsiveness to differentials in the states of the USA or the prefectures of Japan."

Nonetheless, we attempt to control for the impact of migration on our contemporaneous regressor, using inter-state migration data from the COI.[8] For each decade, we construct a counterfactual growth rate of the working age ratio, i.e. that growth rate which would have prevailed in the absence of inward or outward migration. Lacking data on the age distribution of migrants, we assume that all migrants are of working age. For each decade and state, we subtract the number of (net inward) migrants from both the end-of-decade total population and the end-of-decade working age population. This yields a migration-adjusted end-of-decade working age ratio, which is compared to the initial working age ratio to calculate an adjusted growth rate. Note that our assumption that all migrants are of working age maximizes the possible impact of migration on the growth rate of the working age ratio. If we had assumed that migrants had the same age distribution as the initial age distribution of the existing population, this would lead to a much smaller adjustment for migration.

Column 2 in Table 4 shows the results from a specification with the growth rate of the working age population adjusted for migration in this manner. Both the initial level of the working age ratio and its growth rate remain significant. While the point estimate of the coefficient on the adjusted growth rate of the working age ratio falls slightly, it is statistically indistinguishable from the non-adjusted co-efficient, and is more tightly estimated. These results provide confidence that migration flows in response to per capita income growth are not the main story; instead causation does seem to run from the demographic variables to income growth.

Table 5 provides an alternative approach to identify the impact of growth in the working age ratio on income growth. Column 1 reports again the result from the baseline specification. Columns 2 and 3 are IV specifications to reduce the potential bias arising from endogeneity, or from omitted or mismeasured variables. In column 2, the lagged birth rate is used as an instrument.[9] That is, the birth rate in 1961 is used as an instrument for the average annual growth rate of the working age ratio between 1971–81, and so on. Ceteris paribus, a high birth rate in 1961 should be associated with a lower working age ratio in 1971 (the working age population begins at age 14, so additional births in 1961 increase the population of dependents in 1971) and a higher working age ratio in 1981 (because additional births in 1961 increase the population of workers in 1981). Thus an increase in the birth rate in 1961

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[8] We are grateful to Cashin and Sahay for making their dataset on immigration available to us, which fills some omissions in the census data with calculations from vital statistics. Their dataset, however, only contains net migration data for the 1960s, 1970s and 1980s. For the period 1991-2001 we use our own calculations. For each state, the net inward migration rate is given by $g_N - (br - dr)$, where g_N is the annual growth rate of the population (in percentage terms), and br and dr are the crude birth and death rate per 100 persons respectively.

[9] State-wise data on birth and death rates in India have several gaps. Moreover, because their source is the Sample Registration System (initiated in 1964-65), and various fertility surveys (initiated in 1972), no direct estimates are available for 1961. For that year we use intraracensal 1961–1971 estimates from Bhat et al (1984). Bhat et al estimate 1961–1971 birth and death rates using both forward and reverse survival analysis; we take the mean of these two techniques.

should unambiguously lead to a higher growth rate of the working age population between 1971 and 1981. And fertility decisions lagged by a decade should be exogenous with respect to current income growth.

Table 5. The Impact of Demography on Per Capita Growth
Instrumental Variables

Dependent variable: Annual per capita income growth	(1)	(2)	(3)
Log initial income per capita	-0.088***	-0.076***	-0.080***
	0.0175	0.025	0.025
Log initial working age ratio	0.188**	0.36***	0.38***
	0.077	0.12	0.093
Growth rate of working age ratio	2.478**	4.13*	4.98**
	1.026	2.34	1.98
Instruments			
Lagged birth rate		Y	Y
Lagged working age ratio		N	Y
R-squared	0.73		
Observations	76	48	47
Groups	22	18	18
First stage F-statistic		10.7	8.3
Overidentifying restrictions (H0: Instruments uncorrelated with error process)			
Sargan-Hansen statistic			0.23
p-value			0.63
Exogeneity of instrumented explanatory variable (H0: Variable is exogenous)			
Difference in Sargan statistic		0.032	0.067
p-value		0.86	0.79

With one instrument for one endogenous variable, standard tests of overidentifying restrictions are not possible, so column 3 uses the lagged working age ratio as an additional instrument.[10] The results are almost identical to column 2, and the Sargan-Hansen statistic implies that we cannot reject the null hypothesis of zero correlation between the instruments and the error process of the structural equation.

Although columns 2 and 3 verify the important impact of our demographic variables on income growth, the IV procedure suggests an even stronger impact of demographic variables on income growth (although the error bands of point estimates in columns 2 and 3 encompass

[10] Note that the lagged death rate, unlike the lagged birth rate, is not an ideal instrument. In the absence of data on the age distribution of mortality, the relationship of the death rate with the working age ratio, and the growth rate thereof, is ambiguous.

the point estimate in column 1). This may imply that higher growth, rather than stimulating an increase in the working age population through inducing inward migration, instead increases the demand for children and hence lowers the working age population. The result could also reflect differences in the sample. The IV procedure necessitates a significantly smaller sample: our data on birth rates begins in 1961, so the observations in the structural equation are limited to the period 1971–2001.

A large enough quantitative difference between the baseline and IV estimates could indicate that the growth rate of the working age ratio is not, in fact, exogenous in the structural equation. To assuage this concern, a formal test of exogeneity is provided by the Difference-in-Sargan statistic. This is constructed as the difference of two Sargan-Hansen statistics, one in which the suspect regressor is treated as endogenous, and the other in which it is treated as exogenous. Under the null hypothesis that the regressor is actually exogenous, the statistic is distributed as chi-squared with one degree of freedom.[11] In the present case, the null cannot be rejected at conventional levels of significance under either IV specification. Given this result, and given the much larger sample available under OLS and its greater efficiency relative to IV, we use the standard within estimator in the rest of this paper. While the remaining results are presented using a non-adjusted growth rate for the working age ratio, all specifications have been checked using the adjustment for net migration described in Table 4, with qualitatively identical and quantitatively very similar results.

V. Allowing for Other Growth Influences

Are the demographic variables reflecting other growth influences? In this section, we consider a variety of other correlates of growth to assess the robustness of our estimates of the demographic dividend. Table 6 introduces three "core" variables to control for human capital and social development.[12] These include the literacy rate, the number of hospital beds per 1,000 residents, and the sex ratio. Of course, there are numerous alternative indicators of education and health. Hospital beds, in particular, are an "input" measure of health rather than the kind of "output" measure that would be more desirable in principle. But in the

[11] The test is a heteroskedasticity-robust variant of a Hausman test, to which it is numerically equivalent under homoskedastic errors. See Hayashi (2000).

[12] Several studies have used educational attainment to measure the stock of human capital in an accounting framework, such as Klenow and Rodriguez-Clare (1997), Hall and Jones (1999), Aiyar and Dalgaard (2002) and Caselli (2004). Cross-country panel studies have found that education has a significant impact on income growth (Barro and Lee (1994), Islam (1995), and Caselli, Esquivel and Lefort (1996)). Indicators of health—often proxied by life expectancy—are almost as ubiquitous in the development accounting and empirical growth literatures. Examples include Barro and Lee (1994), Caselli, Esquivel and Lefort (1996), Shastri and Weil (2003) and Weil (2007). Aiyar (2001) and Purfield (2006) have used both variables to proxy for human capital in cross-state growth regressions for India.

context of the Indian states, these variables have the best data availability in long time series.[13]

The sex-ratio captures gender bias. Sen (1992) and others have argued that the phenomenon of "missing women" reflects the cumulative effect of gender discrimination against all cohorts of females alive today. Gender bias could impact economic growth through higher child mortality, increased fertility rates, and greater malnutrition (Abu-Ghaida and Klasens (2004)). Gender bias also acts to reduce the current average level of human capital (Knowles et al (2002)), while limiting the educational gains of the next generation. More generally, increased bargaining power for women within the household is associated with a range of positive development outcomes (World Bank (2001)). As such, gender bias acts as a proxy indicator for social development more generally.

Because data on these variables is complete, introducing them into the baseline specification leads to no reduction in observations, an important consideration given our limited sample size. We subsequently report results with additional variables of policy relevance, but, that entails substantial attenuation of the sample size.

Table 6. Introducing Core Control Variables

Dependent variable: Annual per capita income growth				
	(1)	(2)	(3)	(4)
Log initial income per capita	-0.096***	-0.09***	-0.092***	-0.103***
	0.0133	0.017	0.016	0.013
Log initial working age ratio	0.226***	0.177**	0.147*	0.169***
	0.056	0.084	0.076	0.059
Growth rate of working age ratio	2.375**	2.52**	2.22**	2.214**
	0.917	1.019	1.04	0.928
Core controls				
Literacy rate	0.03			0.031
	0.019			0.02
Hospital beds per 1000 residents		0.003		0.006
		0.005		0.007
Sex ratio (females / males)			0.133**	0.123***
			0.053	0.042
R-squared	0.74	0.73	0.75	0.76
Observations	76	76	76	76
Groups	22	22	22	22

[13] For example data on infant mortality rates—a frequently used "output" measure of health—is only widely available on a state-specific basis since the 1980s.

Columns 1 to 3 of Table 6 introduce each of these variables separately, and column 4 introduces them in tandem. The sex ratio is highly significant: more women relative to men is not only good social policy but is associated with higher economic growth. The other two human capital indicators, though bearing the right signs, are not statistically significant. Importantly, the working-age ratio variables remain strongly robust to the introduction of these additional explanatory variables.

Much effort has been devoted to identifying various growth-enhancing policies in the Indian context (as surveyed by Purfield (2006)). Besley and Burgess (2000, 2004) examine the impact of land reforms and labor legislation on agricultural and manufacturing growth. Banerjee and Iyer (2005) find differences in agricultural productivity between districts that assigned proprietary land rights to cultivators rather than landlords. Kocchar et al (2006) find that states with weaker institutions and infrastructure suffer lower GDP and industrial growth.

In many cases, the time dimension or cross-section dimension (or both) of the data is severely limited. For example, the measure of transport infrastructure (used, for example, in Purfield (2006)) would reduce the number of observations from 76 to 29. We, therefore limit attention to variables whose introduction does not reduce the sample size to below 50 observations.[14] The variables studied are:

- *Social and economic expenditure per capita:* The Indian census reports data on capital expenditure by state governments on social infrastructure (categories such as education, water supply, sanitation and medical and public health), and on economic infrastructure (expenditures on transportation, power and electricity, telecommunications and irrigation projects). Taken together, these expenditures comprise "development expenditure." Aiyar (2001) found evidence that these expenditures, measured on a per capita basis, promoted human capital development and private investment, thus contributing indirectly to economic growth.

- *Scheduled commercial bank credit per capita:* While there are no state-level data available on investment rates or other direct measures of capital accumulation, some studies have used credit extended by scheduled commercial banks as a proxy. The measure should also proxy for financial deepening. Aiyar (2001) and Purfield (2006) found a significant impact of this variable on income growth. Data are sourced from several issues of the Reserve Bank of India's *Statistical Tables Relating to Banking.*

- *Land concentration:* This variable measures inequality in agricultural land holdings. It is only partially a measure of policy, since it is also likely to reflect initial conditions. A priori land inequality could have a positive or negative impact on income growth, with different theories yielding different relationships. Data are taken

[14] We are grateful to Catriona Purfield for sharing the policy variables' data used in Purfield (2006).

from the Besley-Burgess (2000) database, which are originally sourced from various rounds on the National Sample Survey (NSS).

- *Cumulative land reform index:* This variable directly measures and aggregates different categories of legislative reforms undertaken at the state level. Besley and Burgess (2000) classify land reforms into 4 categories: tenancy reforms, abolishing intermediaries, establishing land ceilings and consolidation of disparate land holdings. Their paper finds no impact of land reform legislation on state per capita income; a positive impact of land consolidation legislation on agricultural income, and a negative impact of tenancy reform on agricultural income.

- *Cumulative labor reforms index*: Besley and Burgess (2004) examine state amendments to the Industrial Disputes Act of 1947, and code all amendments as being pro-worker, pro-employer or neutral. The index rises in the degree to which cumulative legislation has been pro-worker.[15] They find that labor reforms are uncorrelated with per capita income, but negatively related to manufacturing output (i.e. they find that pro-labor reform is bad for manufacturing growth). Their data is extended to include amendments implemented post-1992 reported in Malik (2003).

Tables 7 and 8 below report the results of introducing these policy variables. There is some evidence that development expenditure—particularly economic expenditure—by state governments can spur growth. And land reforms appear to be negatively related to per capita growth. Of relevance, however, is the robustness of the demographic variables to the introduction of these diverse control variables. The point estimate of the coefficient on the initial working age ratio is significant in every specification and quantitatively fairly stable. The growth rate of the working age ratio is significant in six out of seven specifications, and falls within a narrow numerical range.

[15] The method classifies Andhra Pradesh, Karnataka, Kerala, Madhya Pradesh, Rajasthan, and Tamil Nadu as pro-employer states. Gujarat, Maharashtra, Orissa, and West Bengal are pro-worker states. India's six other large states did not implement any amendments to the Industrial Disputes Act over the period.

Table 7. Controlling for Core and Policy Variables (Part 1)

Dependent variable: Annual per capita income growth				
	(1)	(2)	(3)	(4)
Log initial income per capita	-0.104***	-0.121***	-0.13***	-0.084***
	0.018	0.0131	0.018	0.025
Log initial working age ratio	0.246**	0.196**	0.243***	0.188*
	0.114	0.075	0.07	0.105
Growth rate of working age ratio	2.281	2.549***	2.925***	3.14**
	1.51	0.841	0.878	1.426
Core controls				
Log literacy rate	-0.007	-0.029	-0.017	0.047
	0.032	0.033	0.033	0.034
Log hospital beds per 1000 residents	-0.002	-0.002	-0.002	0.009
	0.011	0.009	0.011	0.007
Log sex ratio (females / males)	0.094	0.073*	0.057	0.451***
	0.086	0.039	0.044	0.146
Policy controls				
Log social expenditure per capita	0.001			
	0.019			
Log economic expenditure per capita		0.029**		
		0.014		
Log development expenditure per capita			0.035*	
			0.017	
Log scheduled commercial bank credit per capita				-0.004
				0.006
R-squared	0.76	0.82	0.80	0.81
Observations	58	58	58	57
Groups	16	16	16	21

Table 8. Controlling for Core and Policy Variables (Part 2)

Dependent variable: Annual per capita income growth			
	(1)	(2)	(3)
Log initial income per capita	-0.113***	-0.121***	-0.104***
	0.0196	0.009	0.016
Log initial working age ratio	0.241***	0.304***	0.24***
	0.072	0.068	0.0809
Growth rate of working age ratio	2.945**	2.928***	2.272*
	1.124	0.88	1.187
Core controls			
Log literacy rate	0.025	-0.034	-0.007
	0.047	0.036	0.032
Log hospital beds per 1000 residents	0.004	-0.007	-0.002
	0.013	0.008	0.01
Log sex ratio (females / males)	0.132*	0.184**	0.101*
	0.076	0.078	0.059
Policy controls			
Log land gini co-efficient	0.092		
	0.074		
Cumulative land reforms index		-0.003**	
		0.001	
Cumulative labor reforms index			-0.001
			0.003
R-squared	0.78	0.82	0.76
Observations	55	58	58
Groups	15	16	16

We also tried various specifications with age-structure variables interacted with the control variables (see Bloom and Canning (2004)). Significant interaction terms would suggest, for example, that the impact of demographic change is enhanced by the presence of a well educated and healthy labor force, or by a lack of gender bias. But, surprisingly, no significant role for such interactions was found. While this result should be regarded as tentative, the implication is that the health and educational preconditions that make the demographic dividend possible are also sufficient conditions for the exploitation of the dividend.

This explanation, however, is less likely to account for the lack of significant interaction terms with policy variables. Here it seems more plausible that the variables examined in this paper do not adequately capture the kinds of institutions and policies that are complementary to demographic change. For example, three of the key elements of the economic reforms of the 1980s and 1990s were the dismantling of industrial licensing, trade policy reforms, and greater exchange rate flexibility. All these reforms were applied at an all-India level. The absence of state-level variation may be one reason why there is no evidence of interacting effects. However, in principle, reforms at the all-India level could have a differential impact by state if one state's industrial base contains many more deregulated industries than another, or if it engages in more international trade than another. Such policy complementarities constitute a worthwhile future research agenda, and could possibly provide the counterpart to the interaction between economic openness and the demographic dividend found in cross-country panels.

VI. Extra Growth from Demographic Change: Some Simulations

We now apply the point estimates from our regression to assess the past and likely future magnitude of the growth dividend. Let t=0 for some base year. In any period $t > 0$, per capita income growth *inclusive* of changes in age structure between period *t* and period *t+1* is defined by equation (5) from Section 3:

$$g\_y_{i,t} = \rho \ln y_{i,t} + \beta_1 \ln w_{i,t} + \beta_2 g\_w_{i,t} + \gamma' X_{i,t} + f_i + \eta_t + \varepsilon_{i,t} \qquad (5)$$

Now consider a counterfactual in which the working age ratio remains fixed at the level of the base year, that is, there is no change in the age structure between period 0 and period t. In this case, $w_{i,t} = w_{i,0}$ and $g\_w_{i,t} = 0$. It follows that:

$$g\_y_{i,t} = \rho \ln y_{i,t} + \beta_1 \ln w_{i,0} + \gamma' X_{i,t} + f_i + \eta_t + \varepsilon_{i,t} \qquad (6)$$

The demographic dividend, DD_t is the difference between (5) and (6):

$$DD_t = \beta_1 (\ln w_t - \ln w_0) + \beta_2 (\ln w_{t+1} - \ln w_t) \qquad (7)$$

Thus DD_t represents the average annual increment in per capita income growth over the decade starting in year t that can be attributed to changes in the age structure from period zero onwards. It consists of two terms, which have an intuitive interpretation. The first term represents the boost to income growth from the increase in the working age ratio that has already occurred (relative to the base year). The second term represents the boost to income growth from the growth in the working age ratio that will occur over the ongoing decade.

A. The Dividend thus Far

Applying this formula to historical working age ratios, Table 9 shows calculations of the dividend by decade, against a counterfactual of no demographic change since 1961. We use the point estimates from the baseline specification in column 1, Table 5 ($\beta_1 = 0.188; \beta_2 = 2.478$).

Table 9. India's Past Age Distribution and Demographic Dividend 1/
(in percent)

Age group	1961	1971	1981	1991	2001
0-14	41.0	42.0	39.6	37.3	35.4
15-59	53.3	52.0	53.9	56.7	57.1
60+	5.6	6.0	6.5	6.0	7.5
	1960s	1970s	1980s	1990s	
Demographic dividend	-0.61	0.42	1.46	1.34	
Per capita income growth 2/	1.24	0.91	3.16	3.44	
Net of demographic dividend	1.85	0.49	1.70	2.10	

1/ Demographic dividend calculated as the increment to annual per capita income growth relative to a counterfactual in which the working age ratio stays fixed at the 1961 level.
2/ Growth in per capita net domestic product in constant 1993–94 prices.

India's working age ratio rose—from a very low level—after 1971, with the share of children in the population falling more rapidly than the rise in the share of the old. Moreover, the working age population accelerated in the 1980s. The demographic dividend mirrored these trends in the age distribution. From small and negative in the 1960s and small and positive in the 1970s, the dividend became substantial in the 1980s and 1990s.

Thus, a considerable fraction of India's growth acceleration since the 1980s may be attributed to the shift in the structure of the country's age distribution. This vital contributor to growth has been missed even in comprehensive accounts for India's growth (e.g., Rodrik and Subramanian (2005)). Thus, the dramatic increase in per capita income growth dating from the 1980s is less dramatic—although still substantial—after netting out the demographic dividend. Indeed, the most striking characteristic of the demography-adjusted per capita income growth series is that the 1970s appear to be a "lost decade", surrounded on either side by much higher growth regimes.[16]

B. The State-Wide Distribution of the Dividend

We revisit the experience of the selected states examined in Section 2, to highlight the role played by the demographic dividend. Table 10 illustrates the pivotal role played by the evolution of the age distribution in the economic performance of leaders and laggards among Indian states. Tamil Nadu, Karnataka and Gujarat, among the best performing Indian states in recent times, have also reaped an enormous demographic dividend: in the 1980s the increment to per capita income growth generated by the age distribution was 2.4 percent per

[16] The 1970s were a turbulent decade, encompassing a war with Pakistan in 1971 and the imposition of emergency rule by Prime Minister Indira Gandhi from 1975-77 (see Guha (2007)). Even before netting out the demographic dividend, the lower rate of growth in this decade stands in stark contrast to the 1960s and 1980s.

annum, rising to 3 percent in the 1990s. Meanwhile, the laggards of the Hindi Heartland reaped a meager dividend, averaging only 0.6 percent in the 1980s and zero in the 1990s. This discrepancy explains a substantial part of the divergence between leaders and laggards from 1981–2001, as illustrated by the bottom panel containing growth rates net of the demographic dividend.

Looking ahead, the states in the south and west of India have already undergone the major part of their demographic transition, while the laggards have not. We are unaware of any state-wise projections of the evolution of the age-distribution over the next few decades. But considering that the average 2001 working age ratio among the leaders was 62.1 percent versus 53.4 percent in the laggards, it seems very likely that the bulk of the projected large increments to India's working age ratio will come from the laggards. Sustained growth acceleration in India's poorest states may now be feasible.

Indeed, the process may already have started. Consider Bihar, the worst of the laggard states. From 2001 through 2009, Bihar's per capita income grew at an average rate of 6.2 percent per annum, representing a tremendous acceleration from about zero in the previous decade, and well above the median growth rate in our sample for this period.[17] This impressive economic performance has been attributed, especially in the later part of the decade, to the good governance and developmental focus of state's administration.[18] While the reforms implemented have undoubtedly been instrumental in Bihar's turnaround, it is also likely that Bihar's working age ratio has risen from the very low level of 52.5 percent in 2001 and hence contributed to the growth acceleration. The Census of 2011 will reveal the extent of such an increase.

[17] Among the four big Hindi Heartland states, Rajasthan also registered above-median growth of 6.1% per annum, while Uttar Pradesh and Madhya Pradesh registered much lower average growth rates of 3.2% and 2.7% respectively. The median growth rate was 5.7%.

[18] Chief Minister Nitish Kumar's efforts to improve the law and order in the state, combined with efforts to build infrastructure and expand health and education services have drawn favorable comparisons between his administration and that of the previous Chief Minister Laloo Prasad Yadav.

Table 10. Demograpic Dividend: Selected States

		1960s	1070s	1980s	1990s
Demographic dividend	Leaders (South and West)				
	Tamil Nadu	-0.1	0.8	2.2	2.7
	Karnataka	-0.3	0.9	2.4	3.2
	Gujarat	-0.2	1.5	2.6	3.0
	Simple Average	-0.2	1.0	2.4	3.0
	Laggards (Heartland)				
	Bihar	-0.3	-0.2	0.8	0.0
	Madhya Pradesh	-1.7	-0.4	0.7	0.3
	Uttar Pradesh	-0.9	-0.6	0.4	-0.4
	Simple Average	-0.9	-0.4	0.6	0.0
Per capita income growth rate	Leaders (South and West)				
	Tamil Nadu	0.4	0.1	4.1	5.1
	Karnataka	2.0	0.7	3.0	6.0
	Gujarat	1.9	0.9	3.1	3.6
	Simple Average	1.4	0.5	3.4	4.9
	Laggards (Heartland)				
	Bihar	0.3	0.6	2.7	-0.1
	Madhya Pradesh	-0.5	0.6	2.2	1.1
	Uttar Pradesh	0.7	0.7	2.6	0.8
	Simple Average	0.2	0.6	2.5	0.6
Per capita income growth rate net of demographic dividend	Leaders (South and West)				
	Tamil Nadu	0.5	-0.7	1.9	2.4
	Karnataka	2.3	-0.2	0.6	2.8
	Gujarat	2.1	-0.6	0.5	0.6
	Simple Average	1.7	-0.5	1.0	1.9
	Laggards (Heartland)				
	Bihar	0.6	0.8	1.9	-0.1
	Madhya Pradesh	1.2	1.0	1.5	0.8
	Uttar Pradesh	1.6	1.3	2.2	1.2
	Simple Average	1.1	1.0	1.9	0.6

C. What May the Future Hold?

Finally, we calculate the demographic dividend for the next five decades, relative to a counterfactual in which the working age ratio stays at its 2001 level. Table 11 shows a range of projections for India's age distribution.[19] The Census of India 2001 provides projections through 2026, while the United Nations Population Division (UNPD) and the International

[19] The standard method for projecting forward the age distribution is the cohort-component method (the U.S. Census Bureau (2010) has a useful summary). This tracks cohorts of individuals belonging to the same age- and sex-group through their lifetimes. Typically 5-year age groups are used. An initial or base year population, disaggregated by age and sex, is exposed to estimated age- and sex-specific chances of dying as determined by estimated and projected mortality levels and age patterns. Once deaths are estimated, they are subtracted from each age, yielding the next older age in the subsequent time period. Fertility rates are projected and applied to the female population of childbearing age to estimate the number of births every year. Each cohort of children born is also followed through time and survivors are calculated after exposure to mortality.

Data Base (IDB) of the US Census Bureau provide projections through 2050. Differences in projections arise because of different assumptions about age-specific fertility and mortality, which are themselves based on patterns estimated from past data and international comparisons.[20]

Table 11. Demographic Projections for India 1/

			Census of India			
Age group	2001	2011	2021	2026		
0-14	35.5	29	25.1	23.4		
15-59	57.8	62.7	64.0	64.3		
60+	6.9	8.2	10.7	12.5		
			United Nations Population Division 2/			
Age group	2001	2010	2020	2030	2040	2050
0-14	35.5	30.8	26.7	22.8	19.7	18.2
15-59	57.8	61.6	63.5	64.8	64.6	62.2
60+	6.9	7.5	9.8	12.4	15.6	19.6
			IDB, US Census Bureau 2/			
Age group	2001	2010	2020	2030	2040	2050
0-14	35.5	30.1	26.3	23.5	21.4	19.8
15-59	57.8	61.7	63.5	63.3	61.9	60.1
60+	6.9	8.2	10.2	13.2	16.7	20.1

1/ All numbers are in percent of total population
2/ Estimates for 2001 are from the Census of India.

All projections show rapid growth in India's working age ratio from 2001 through 2021, as the reduction in the country's population of children outstrips the increase in the ranks of the old. The Census of India shows a further (albeit decelerating) increase in the working age ratio through 2026, and the UNPD through 2030. The IDB shows the working age ratio leveling off in 2030. From this point on, there are no further projections from the Indian Census. The UNPD projects a leveling-off of the ratio through 2040 and then a decline in the decade leading to 2050, while the IDB shows the decline starting from 2030 onwards.

Table 12 reports the calculations. The demographic dividend is projected to peak over the next two decades—adding about 2 percentage points to annual per capita income growth over the period. Subsequently the dividend should begin to decrease gradually (though remaining positive) based on the UNPD projections, and decrease rapidly according to the IDB projections. The calculations also suggest that over the current decade, the increment to per capita income growth from demographic change has been between 1.5 to 2 percent points per annum.

[20] The UNPD projections, for example, have eight variants corresponding to parametric assumptions: low fertility; medium fertility; high fertility; constant-fertility; instant-replacement-fertility; constant-mortality; no change (constant-fertility and constant-mortality); and zero-migration. Here we show the medium fertility variant, highlighted in United Nations (2009)

Table 12. India's Coming Demographic Dividend by Decade 1/
(in percent)

	2000s	2010s	2020s 2/	2030s	2040s
Using projections from					
Census of India 2001	2.02	2.04	2.16		
United Nations Population Division	1.60	1.95	2.27	2.10	1.17
US Census Bureau	1.62	1.93	1.69	1.15	0.57
Average	1.74	1.98	2.04	1.62	0.87

1/ Calculates the increment to annual per capita income growth relative to a counterfactual in which the working age ratio stays fixed at the 2001 level.
2/ 2021-2026 for projections from the Census of India.

VII. Conclusion

The level and the growth rate of the working age ratio have both exercised a large impact on India's economic growth. This result is robust to a correction to account for inter-state migration, to endogeneity concerns, and to the introduction of a range of control variables. Our results suggest that there have *already* been considerable gains from changes in the age structure, and that a substantial part of India's growth acceleration since the 1980s can be attributed to demographic change. Looking ahead, the continuing demographic transition will yield a growth dividend of about 2 percent per annum over the next two decades. Also, while the largest expansions in the working age ratio to date have occurred in southern and western states that have led India in terms of recent economic growth, the bulk of the remaining demographic transition will be concentrated in lagging states, thus raising the prospect of substantial income convergence among rich and poor states.

We find little empirical evidence of complementarities between demographic variables and various facets of social development or the policy environment. It is possible that some of the social preconditions for a demographic transition may themselves generate the ability to benefit from it. We conjecture that the economic policies and reforms most complementary to demographic change were those applied at the national level. Research into such complementarities could shed further light on the likely trajectory of economic growth not just in India but also on the larger global stage, as the ongoing demographic transition transforms economic and political relationships over the next few decades.

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