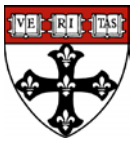

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Population Dynamics in India and Implications for Economic Growth

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Population Dynamics in India and Implications for Economic Growth[1]

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Abstract

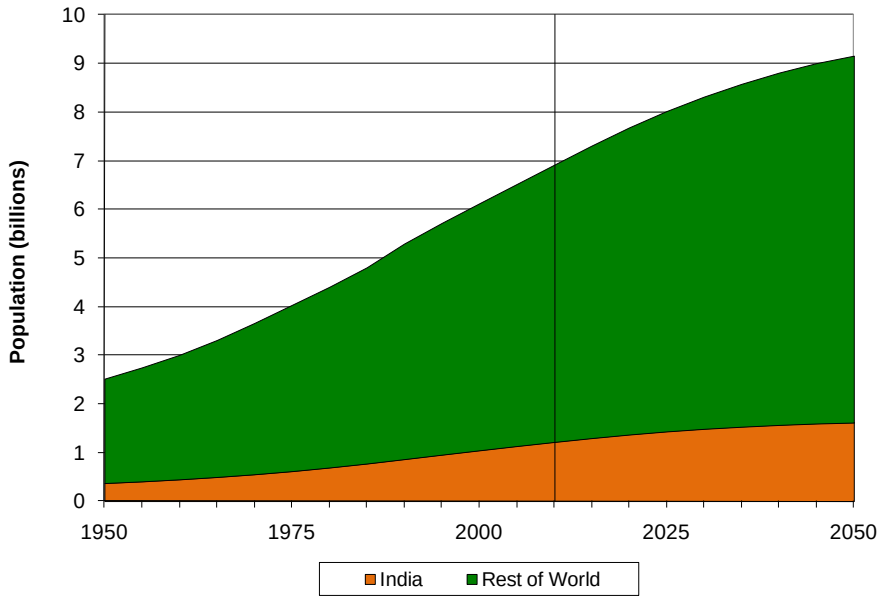
Demographic change in India is opening up new economic opportunities. As in many countries, declining infant and child mortality helped to spark lower fertility, effectively resulting in a temporary baby boom. As this cohort moves into working ages, India finds itself with a potentially higher share of workers as compared with dependents. If working-age people can be productively employed, India's economic growth stands to accelerate. Theoretical and empirical literature on the effect of demographics on labor supply, savings, and economic growth underpins this effort to understand and forecast economic growth in India. Policy choices can potentiate India's realization of economic benefits stemming from demographic change. Failure to take advantage of the opportunities inherent in demographic change can lead to economic stagnation.

[1] This chapter has been prepared for *The Handbook of the Indian Economy* (Chetan Ghate, Ed., Oxford University Press, forthcoming 2011). An earlier version of this chapter was presented at the March 2010 *India Today* Conclave in New Delhi. The author is indebted to Larry Rosenberg and Marija Ozolins for valuable assistance in the preparation of this chapter, and to David Canning, Chetan Ghate, and Ajay Mahal for helpful discussions and comments. Support for this work was provided by a grant from the William and Flora Hewlett Foundation and by the Program on the Global Demography of Aging at Harvard University, funded by Award Number P30AG024409 from the National Institute on Aging. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute on Aging or the National Institutes of Health.

Introduction

The world experienced dramatic population growth during the twentieth century, with the number of inhabitants doubling from 3 to 6 billion between 1960 and 2000. India, too, saw very rapid population growth during this period – from 448 million to 1.04 billion – and to 1.21 billion in 2010. The effects of past and projected future demographic change on economic growth in India is the main focus of this chapter. Figure 1 plots world population from 1950 to 2050, and shows the share of world population attributable to India; post-2010 data are United Nations (UN) projections.

Figure 1
India's share of world population



Source: United Nations (2009).

Global population grew at roughly 2% per annum from 1960-2000, a level that is unsustainable in the long term, as it translates into population doubling every 35 years. India's population is currently growing at a rate of 1.4% per year, far surpassing China's rate of 0.7%. The differential between India and China will result in India surpassing China with respect to population size in less than 20 years.

While a cause for concern, global population growth has not met Malthus' pessimistic predictions of human misery and mass mortality. During the past few decades, rapid population growth has been accompanied by an unparalleled decline in mortality rates and by an increase in income per capita, both globally and in India.

This chapter reviews the size, growth, and structure of India's population in historic and comparative perspective. The main emphasis is on features of India's demography that have been, and will likely be, relevant to economic growth and the improvement of living standards. Section 1 analyzes UN data on population dynamics in India, covering fertility, mortality, migration, and age structure. This section also provides a non-technical introduction to the

salience of demographic patterns and trends for macroeconomic performance. Section 2 reviews theoretical and empirical literature on the effect of demographics on labor supply, savings, and economic growth and explores the application of the models and results in this literature to understanding and forecasting economic growth in India. Section 3 examines India's economic prospects through a demographic lens and discusses policy issues related to the realization of alternative demographic scenarios and to capturing the economic potential they create.

Section 1: Demographic change and economic growth

During the past decade, there have been two significant breakthroughs regarding the impact of demographics on national economic performance. The first has to do with the effect of the changing age structure of a population. The second relates to population health.

Section 1.1: Age structure and some cross-country evidence

The age structure of a population can have a large effect on economic growth, especially when it shifts as a result of baby booms and busts and their echo effects.

Demographers use the "demographic transition" as a starting point for explaining this effect. The demographic transition refers to the nearly ubiquitous change countries undergo from a regime of high fertility and high mortality to one of low fertility and low mortality. As this phenomenon tends to occur in an asynchronous fashion, with death rates declining first and birth rates following later, countries often experience a transitional period of rapid population growth. This period has traditionally been the main focus of economists interested in demographics.

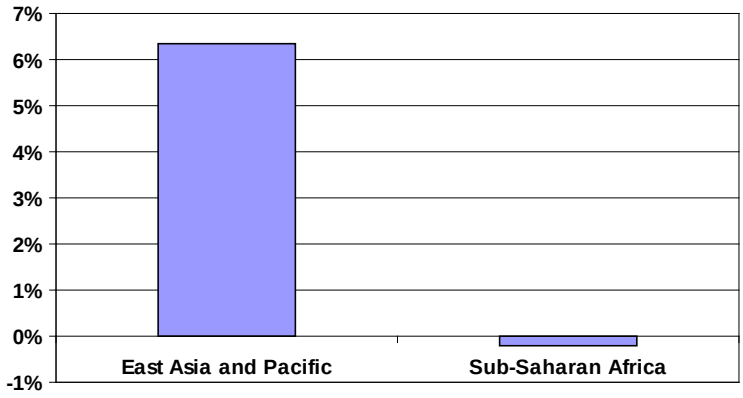
But population growth is not the only major consequence of the demographic transition. The age structure is also transformed. This happens initially as a consequence of a baby boom that occurs at the beginning of the transition. The baby boom is not caused by an increase in births, but rather by the sharply reduced rates of infant and child mortality that are characteristic of the beginning of a demographic transition, mainly due to increased access to vaccines, antibiotics, safe water, and sanitation. This type of baby boom starts with higher survival rates and abates when fertility subsequently declines as couples recognize that fewer births are needed to reach their targets for surviving children, and as those targets are moderated.

Baby booms are very consequential economically, because the presence of more children requires that there be more resources for food, clothing, housing, medical care, and schooling. Those resources must be diverted from other uses such as building factories, establishing infrastructure, and investing in research and development. This diversion of resources to current consumption can temporarily slow the process of economic growth. Of course, babies born in such a boom will invariably reach working ages within a period of 15-25 years. When this happens, the productive capacity of the economy expands on a per capita basis and a demographic dividend may be within reach.

Demographic dividends are a composite of five distinct forces: The first is the swelling of the labor force as the baby boomers reach working age. The second is the ability to divert social resources from investing in children to investing in physical capital, job training, and technological progress. The third is the rise in women's workforce activity that naturally accompanies a decline in fertility. The fourth has to do with the fact that the working ages also happen to be the prime years for savings, which is key to the accumulation of physical and human capital and technological innovation. And the fifth is the further boost to savings that occurs as the incentive to save for longer periods of retirement increases with greater longevity.

Figure 2 demonstrates the practical importance of these combined forces by comparing the economically and demographically most extreme regions of the developing world: East Asia and Sub-Saharan Africa.

Figure 2
Average annual growth rate of GDP per capita, 1975-2005

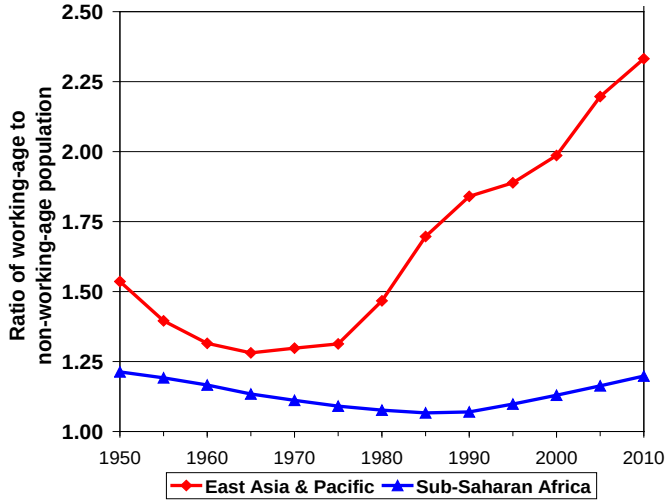


Source: World Bank World Development Indicators, 2009.

When analyzing the chart above from a purely economic perspective, the bar on the left can be termed "the East Asian miracle," a moniker chosen by the World Bank in the mid-1990s to describe a phenomenon that seemed to defy explanation. Never before had such a large group of countries experienced such rapid growth in average incomes for such a long period of time. Within this period, East Asian gross domestic product (GDP) per capita grew at an annual average rate of 6.4%, from $212 to $1,475. In contrast, Sub-Saharan Africa experienced essentially zero growth, with average per capita GDP growth falling at an annual average rate of -0.2%, from $587 to $578.[1]

Approaching this puzzle from a demographic perspective reveals some of the causes underlying the dramatic differences in growth between East Asia and Sub-Saharan Africa. Figure 3 plots the ratio of the working-age to the non-working age population in both regions, where the working-age population is defined as the population aged 15-64, and the non-working-age population (for simplicity, "dependents") is defined as the population under age 15 or aged 65 and over.

Figure 3
Changing age structure, 1950-2010



Source: United Nations (2009).

This chart illustrates several critical points. First, the ratio of working-age people to dependents has been lower in Sub-Saharan Africa than in East Asia throughout the entire period shown. This means that East Asia has had higher numbers of people in the prime years for working and saving. The difference between the two lines is primarily a reflection of a relatively high burden of youth dependency in Sub-Saharan Africa, due to its long history of high fertility. By contrast, East Asia, with a precipitous decline in fertility, experienced the most rapid demographic transition in history. Today, East Asia has more than 2.3 workers for every non-worker, dwarfing Sub-Saharan Africa's 1.2 workers per non-worker. This difference translates into households having an entire extra worker for every non-worker, which in turn results in a commensurately large increase in income per household, ultimately aggregating upward to increased country-level growth.

Fertility decline lowers youth dependency immediately, but does not appreciably affect the working-age population for 20-25 years. But when the working-age population does increase as a share of the total population, there is an opportunity for economic growth. Figure 3 suggests that the superior economic performance of East Asia since the mid-1970s is related to East Asia's demographics.

Indeed, using rigorous theoretical and statistical tools and appropriate data,[2] economists have spent the past decade garnering evidence that East Asia's rapid economic growth was spurred by its demographic transition, during which East Asia's age structure has evolved in a way that has been highly favorable for economic growth. The resulting body of work suggests that demographic change accounts for approximately 2 percentage points of the growth rate of income per capita in East Asia, representing one-third of the supposed miracle. Labeling the economic growth East Asia as a miracle, therefore, was partly a reflection of a failure to consider the implications of demographics.

However, demography is not destiny; growth of the working-age share of the population does not automatically lead to an acceleration of economic growth. Demographic change may provide a boost to economic growth, but appropriate policies are needed to allow this to happen. Without such policies, a country may instead find itself with large numbers of unemployed or underemployed working-age individuals. This scenario would be a "demographic disaster", instead of a demographic dividend, in some instances promoting state fragility and failure, potentially with adverse political, social, economic, and ecological spillovers to other countries.

Section 1.2: Population health

The second significant breakthrough in thinking is often summarized by the phrase "healthier means wealthier." In other words, health and longevity are very consequential for economic performance. Although macroeconomists and economic policymakers have traditionally viewed population health as a social indicator that improves only after countries become wealthy, new thinking views health itself as an instrument of economic growth, not simply a consequence of it.

Health is believed to drive economic growth for four main reasons. First, a healthier workforce is a more productive workforce. Second, healthier children tend to have better records of school attendance, and stay in school longer, ultimately resulting in a more educated workforce. Healthy children also have better cognitive function, and avoid physical and mental disabilities that may be associated with childhood illness. Third, healthy populations have higher savings rates, as people save more in anticipation of longer lives post-retirement. And finally, healthy populations attract foreign direct investment. In recent years, analyses of the proposition that "healthier means wealthier" have abounded, with the vast majority of them concluding that health is a strong driver of economic growth.

Recent findings suggest that healthier countries experience faster growth in average income, and that a 10-year gain in life expectancy translates into as much as 1 additional percentage point of annual growth of income per capita. This 1 percent is significant in the context of a world economy in which per capita income typically grows at 2-3 percent per year. This potential 1 percentage point gain is also meaningful, as a 10-year gain in life expectancy is well within the reach of many countries. This gain corresponds roughly with the gap between India – where life expectancy is currently about 64 years – and today's developed countries, currently at 78 years. It also corresponds roughly to the magnitude of the increase in life expectancy that many demographers project for developed countries in the next four to seven decades.

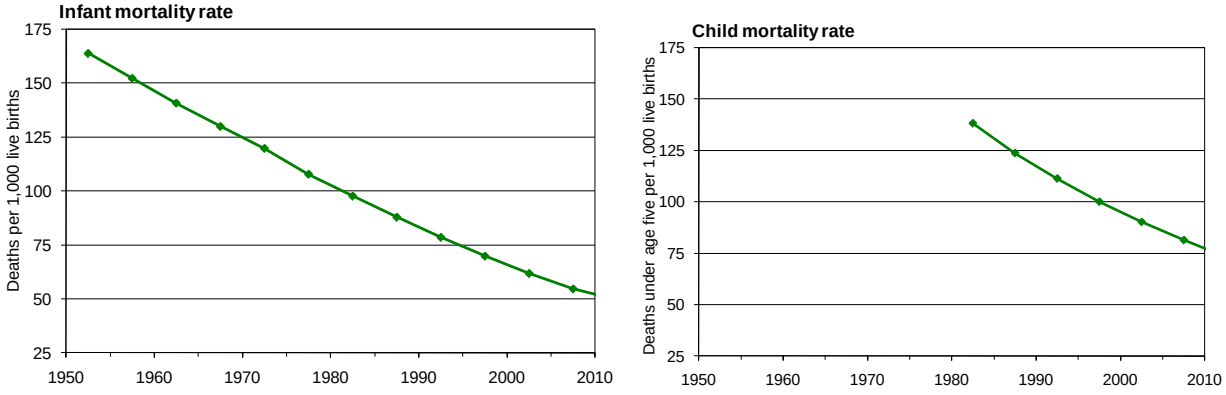
Researchers have also focused on the central importance of health in the alleviation of poverty: the main asset poor people possess is their labor, and the value of that asset is crucially determined by their health. This explains why health figures so prominently in plans to halve the global poverty rate, which has emerged as the central imperative of the entire global development community.

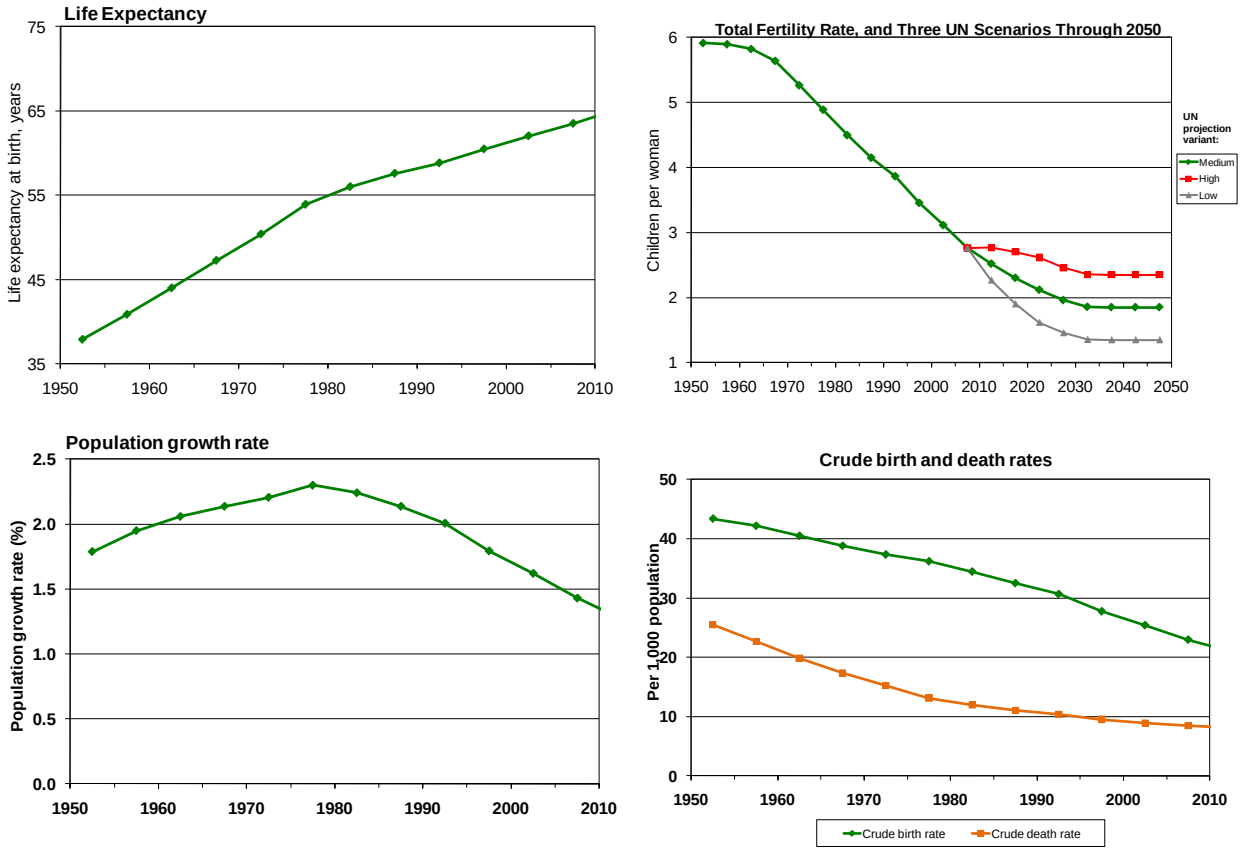
Section 1.3: Key facts about India's population

In the past, India's population has grown very rapidly and has imposed a substantial burden of youth dependency on the Indian economy. But in recent years, India's demographic profile has begun to evolve in a way that is potentially more favorable to economic growth.

Figure 4 plots several aspects of India's demographic profile over time, revealing significant improvements in basic health indicators. The interplay of these mortality and fertility changes implies sizable changes in the age structure of India's population. Since 1950, India has experienced a 70% decline in the infant mortality rate, from over 165 deaths per thousand live births in the 1950s to around 50 today. India's child (i.e., under age 5) mortality rate has fallen from 138 deaths per thousand in the early 1980s to 75 today. Life expectancy has increased at an average pace of 4.5 years per decade since 1950. The fertility rate has declined sharply from approximately 6 children per woman in the 1950s to 2.7 children per woman today. Figure 4 shows three trends that fertility may follow in the future, based on the assumptions the United Nations makes in publishing low-, medium-, and high-fertility scenarios. The population growth rate, after peaking in the late 1970s at about 2.3% per year, has fallen to 1.4% in 2010. In spite of the decline in fertility and the population growth rate, India's population is still projected to increase (based on the UN's medium-fertility scenario) from about 1.2 billion today to an estimated 1.6 billion by 2050 due to population momentum (i.e., the large cohort of women of reproductive age will fuel population growth over the next generation, even if each woman has fewer children than previous generations did). Finally, the decline of crude birth and death rates shows that India is well along in its demographic transition.

Figure 4
India's changing demographic profile





Source: United Nations (2009).

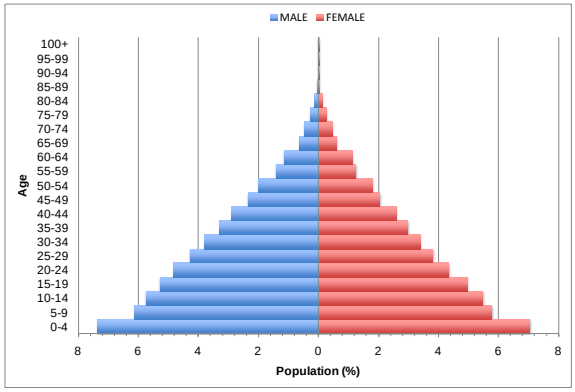
The sex ratio at birth in India is 1.12 males for each female – one of the highest ratios in the world. The corresponding figure for 2003 was 1.05 (United States Central Intelligence Agency, 2010). Sex-selective abortions, although illegal, are thought to be a prime reason for this high ratio. Indian families have long shown favoritism toward boys, and new technologies are allowing that preference to be expressed in differential birth rates.

As in virtually all countries, life expectancy at birth in India also differs by sex. In the period 2005-2010, female life expectancy was 65.0 years, and male life expectancy was 62.1 years – very similar to the differences that are seen in developing countries as a whole and in the world. However, India differs from the world and from developing countries as a whole in the manner in which sex differences in life expectancy have evolved since 1950. In most countries, women lived longer than men in 1950, whereas in India female life expectancy, at 37.1 years, was 1.6 years less than that of men. This differential has reversed in the intervening years. (United Nations, 2009)

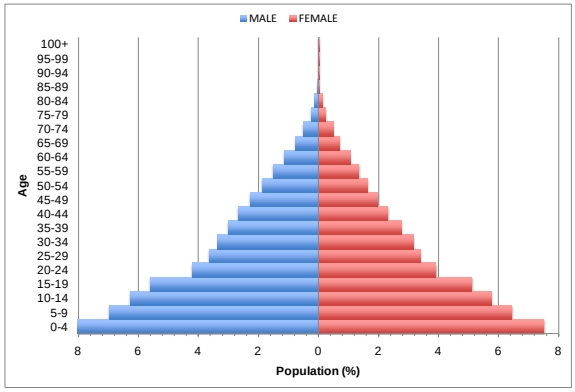
India's demographic changes are also manifest in its age structure. The population pyramids of Figure 5 show the share of population in each age group, separately for males and females. In 1950, India had a very young population, with many children and few elderly; this gave India's age distribution a pyramidal shape. Moving forward in time, the base of the population pyramid shrinks as the number of working-age individuals increases relative to children and the elderly.

Figure 5. India's population pyramid, 1950, 1970, 1990, 2010, 2030, and 2050

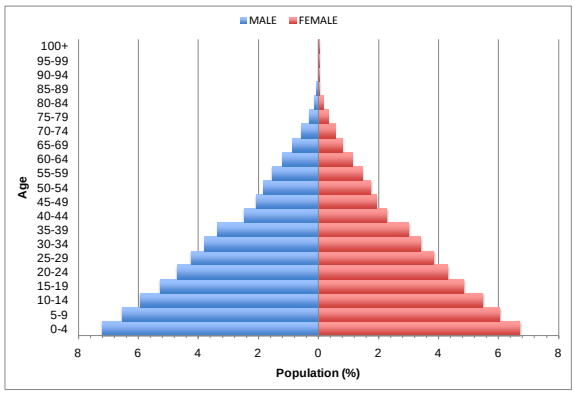
1950:



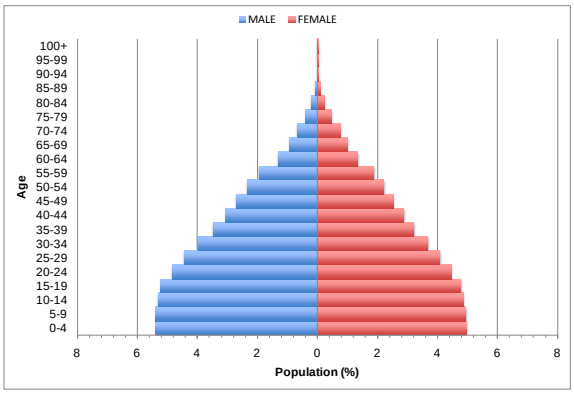
1970:



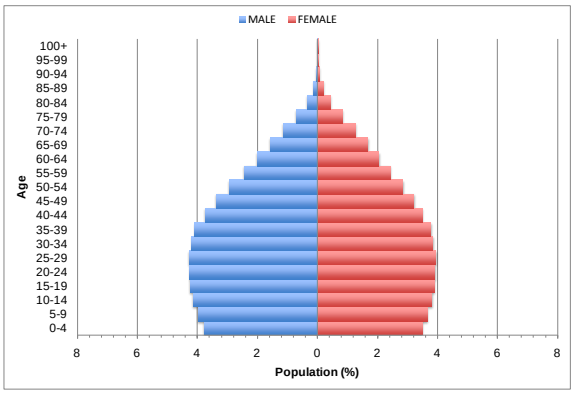
1990:



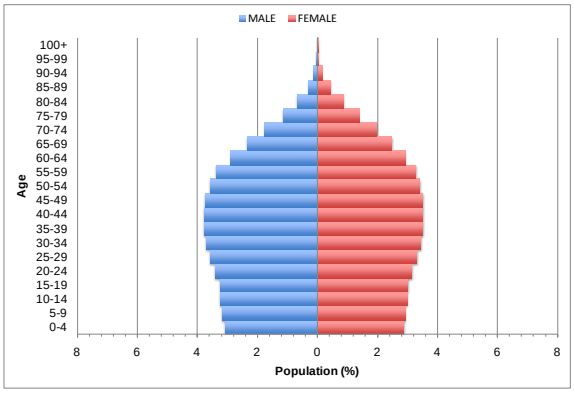
2010:



2030:



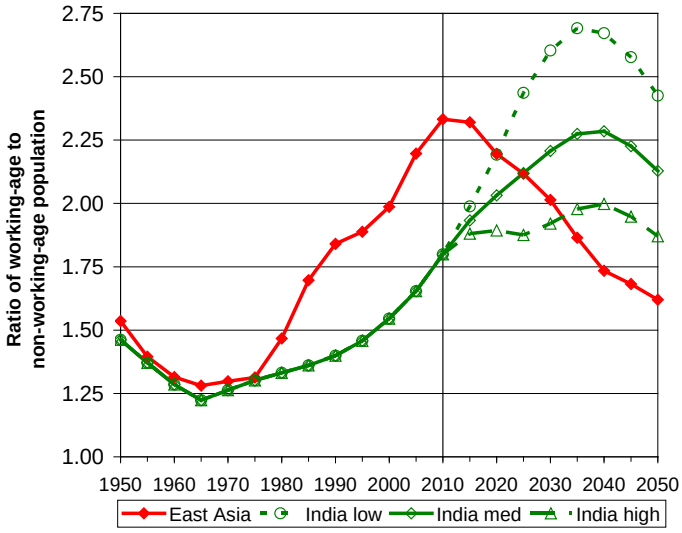
2050:



Source: United Nations (2009).

Figure 6 shows an alternative representation of the changing age structure of India's population: the ratio of the number of working-age Indians to the number of non-working-age Indians under three UN fertility scenarios.[3] The graph also plots the ratio for East Asia, for comparison.

Figure 6
Growth of the working-age to non-working-age ratio in India, 1950-2050



Source: United Nations (2009).

The ratio of working-age to non-working-age people in India mirrored the corresponding ratio in East Asia from 1950 to 1975. Since then, it has been lower than that of East Asia – corresponding to a higher burden of youth dependency. Indeed, India's demographic cycle now lags roughly 25 years behind that of East Asia. A purely demographic perspective suggests that the next three decades will be a period of catching up for India with respect to per capita income in East Asia.

While these fertility scenarios have very different implications for the future age structure of India's population, all three suggest further growth in the working-age share. Under the low-fertility scenario, according to which the total fertility rate will drop to 1.4 by 2030, India is expected to reach a higher working-age ratio than ever seen in East Asia. The medium scenario shows India reaching a ratio nearly as high as East Asia's high point, and the high scenario shows a very modest increase over today's ratio in India. In sum, the medium- and low-fertility scenarios bode well with respect to India's potential for realizing a sizable demographic dividend, representing what could amount to an additional percentage point or more of per capita income growth, compounded year after year. This is not an insignificant amount, given that the annual rate of growth of India's real income per capita averaged a little over 4% during the past three decades (World Bank, 2010).

As an aside, it should be noted that India's demographic indicators are similar to those of the South Asian region as a whole. Compared with the two other large South Asian countries, it is ahead of Pakistan in the demographic transition, but behind Bangladesh.

An additional demographic fact deserves mention: there are an estimated 11.4 million Indians living outside of India. The countries to which Indians have emigrated in largest numbers, as of 2010, are United Arab Emirates (2.2 million), the United States (1.7 million), Saudi Arabia (1.5 million), and Bangladesh (1.1 million). In 2000, 57,000 Indian physicians were living overseas.

In 2010, Indian emigrants are estimated to be sending home remittances totaling $55 billion, the most of any country, constituting about 4.5% of GDP. (Ratha, Mohapatra, and Silwal, 2011) The number of Indian immigrants in the United States has grown rapidly in recent years (there were 1.0 million in 2000). Their median age is 37, and just over half are female. Nearly three-quarters have at least a bachelor's degree, and nearly half work in professional occupations. Mean personal income (in 2008 dollars) is $53,000, and median household income is $92,000. (United States Bureau of the Census, International Data Base (2008 midyear estimates). As political, economic, and social conditions change over time in India and its neighbors, the number of migrants, the skills they take to other countries, and the value of the remittances they send may change significantly.

One final point: the demographic indicators presented here apply to India as a whole. Section 3, below, discusses the extent of demographic heterogeneity across Indian states, and some implications of that heterogeneity.

Section 2: Review of technical literature

Economists have devised a number of distinct approaches to studying the determinants of economic growth. For example, Bloom and Freeman (1986) and Bloom, Canning, et al. (2009) employ a simple shift-share analysis to decompose the growth of income per worker into a portion attributable to the reallocation of labor from low- to high-productivity sectors and a portion attributable to the growth of labor productivity within sectors. An alternative and more sophisticated approach is to calibrate a production function using parameters estimated from micro data (see, for example, Young 1994, Young 1995, and Weil 2007).

This section focuses on estimates based on yet another common approach that makes use of cross-country panel data to estimate the parameters of an empirical growth model. This approach assumes that fundamental influences on economic growth such as education, geography, and demographics can be measured, and that non-measured influences such as weather fluctuations and economic shocks are adequately reflected in a random error term. The approach also assumes a degree of cross-country commonality in the fundamental determinants of economic growth.

This regression-based approach lends itself naturally to an examination of the influence on growth of a range of demographic, economic, geographic, institutional, and policy variables. The demographic factors emphasized herein are mortality, fertility, age structure, and population growth.

Mortality is typically measured using life expectancy, and is hypothesized to have a number of potential economic effects. First, insofar as mortality is a proxy for population health, it is presumed to affect labor quality and productivity. Gains in life expectancy are thus expected to promote higher GDP per worker. Along these lines, Fogel (1994) researches the contribution of health and nutrition improvements to the Industrial Revolution. Bloom, Canning, and Sevilla (2004) estimate a sizable effect of health as a form of human capital in a production function-based cross-country study of economic growth rates.[4] Bhargava et al. (2001) and Bleakley (2003

and 2006) reach similar conclusions based on different empirical analyses. These conclusions on the positive effect of health on economic growth are not supported by Acemoglu and Johnson (2007), but they are supported by reanalysis of the Acemoglu and Johnson data by Bloom, Canning, and Fink (2009), Bleakley (forthcoming 2010), and Aghion et al. (2009). Second, increased longevity can lead to increased savings for longer expected periods of retirement (Bloom, Canning, and Graham (2003); Bloom, Canning, Mansfield, and Moore (2006)), higher rates of foreign direct investment (Alsan, Bloom, and Canning (2006)), and higher rates of domestic investment, savings, and school enrollment (Lorentzen, McMillan, and Wacziarg (2005)).

As discussed above, fertility typically declines after a fall in mortality. As a result of the asynchronous nature of the changes in mortality and fertility, the rate of population growth tends to increase and then decrease over the course of the demographic transition. In addition, changes in the age structure take place as a "bulge" generation makes its way through the population pyramid. In general, when relatively large generations reach the prime ages for working and saving, a country will experience a demographically induced economic boost, provided the generation is productively employed.

Bloom and Williamson (1998), Bloom, Canning, and Malaney (2000), Bloom and Canning (2003 and 2008), and Mason (2001) have investigated the nature and magnitude of this contribution of age structure to economic growth (i.e., the “demographic dividend”). For example, as discussed earlier, East Asia’s demographic transition is predictive of its trajectory of income per capita (Bloom and Williamson (1998), Bloom, Canning, and Malaney (2000), Bloom and Finlay (2009)). Demographic change also helps account for a large portion of Ireland’s economic miracle of the 1990s (Bloom and Canning, 2003), whereas the sluggishness of Africa’s fertility transition helps explain its chronically poor macroeconomic performance (Bloom, Canning, and Sevilla (2003); Bloom and Sachs (1998); Bloom, Canning, Fink, and Finlay (2007); Bloom, Canning, Fink, and Finlay (2010)). The results of these analyses are inconsistent with the view that factors idiosyncratic to East Asia or Sub-Saharan Africa account for their different profiles of economic growth. These regions appear to obey common principles of economic growth once age structure dynamics are introduced into the economic growth model (Bloom, Canning, and Malaney (2000); Bloom and Canning, (2008), Bloom, Canning, Fink, and Finlay (2010)). Other interesting empirical treatments of the effect of age structure dynamics on economic growth include Crenshaw, Ameen, and Christenson (1997) and de la Croix, Lindh, and Malmberg (2007).

The literature in this area also makes clear that there is nothing automatic about the effects of demographic change on economic growth (i.e., that “demography is not destiny” (Bloom, Canning, and Sevilla (2003), Bloom and Canning (2003), Bloom and Canning (2008)). Changes in age structure simply affect the supply-side potential for economic growth. Capturing that potential depends on numerous other factors such as governance, macroeconomic management, the depth and efficiency of financial markets, and policy in the areas of trade, education, health, and labor.

More formally, consider the following accounting identity that links income per capita (Y/N) to income per person of working age (Y/WA)

$$\frac{Y}{N} = \frac{Y}{WA}\frac{WA}{N} \tag{1}$$

where N represents total population and WA represents the population of working age (i.e., 15-64 years old, by convention). Taking the natural logarithm of both sides of (1) and differentiating the equation with respect to time (t) yields

$$\dot{y} = \dot{z} + \dot{w} \tag{1}$$

where

$$y = \log\frac{Y}{N},\ z = \log\frac{Y}{WA},\ w = \log\frac{WA}{N}$$

and the dot over each variable indicates the time derivative.

Equation (2) shows that the growth rate of income per capita, $\dot{y}$, equals the growth rate of income per member of the working-age population, $\dot{z}$, plus the growth rate of the working-age share of the population (which itself equals the growth rate of the working-age population minus the growth rate of the total population).

Following Barro and Sala-i-Martin (1995), one may express the growth rate of income per member of the working-age population, $\dot{z}$, as

$$\dot{z} = \lambda(z^* - z_0) \tag{3}$$

where z* is the steady-state level of income per worker, and z_0 is the initial level of income per worker. λ is the speed of convergence to the steady state, which may depend on factors (assumed to be exogenously predetermined and captured by the vector X) that affect labor productivity such as life expectancy, educational attainment, and the capital stock.

$$z^* = X\beta \tag{4}$$

Since the initial condition is given by $y_0 = z_0 + w_0$ we have

$$\dot{y} = \lambda(X\beta + w_0 - y_0) + \dot{w} \tag{5}$$

Note that Equation (5) is a conditional convergence model that relates the growth rate of output per capita to (1) the variables in X that are posited to influence the steady-state level of output per worker, (2) the initial level of income per capita, y_0, (3) the log of the initial ratio of working-age to total population, (4) the growth rate of the working-age population, and (5) the growth rate of the total population. Equation (5) implies that output per capita will grow faster

when steady-state income is high relative to current income, and when the growth rate of the working-age population is high relative to the growth rate of the total (or dependent) population.

This equation suggests two sets of testable restrictions: first, that the coefficients of w_0 and y_0 are equal in absolute value to λ, and second that the coefficients of $W\dot{A}$ and $\dot{N}$ are +1 and -1 respectively. The parameters of equation (5) (i.e., λ and β) are typically estimated using country-level panel data for the past several decades assembled from the UN Population Division, the World Bank, the Penn World Tables, and other specialized sources.

Insofar as income can influence many of the right-hand side variables in equation (5), the inference of causality is an important issue that arises in this approach to studying economic growth. This issue is typically addressed, at least in principle, in two ways: first, by treating the variables measured before or at the start of the growth period being explained as predetermined and exogenous; and second, by using lagged values to instrument right-hand side variables that are measured during the growth period. These solutions assume that growth shocks are not correlated over time (see Easterly, Kremer, Pritchett, and Summers (1993)), and that control variables are not affected by the expected rate of economic growth, which is more difficult to justify.

Table 1 summarizes selected cross-country studies that focus on the effect of demographic change on economic growth using the conditional convergence model (and variants thereof) described above. The studies vary in a number of dimensions, including the underlying theoretical framework that justifies the empirical specification, the vector of control variables, the variables instrumented and the instruments used, assumptions about functional form, the nature of the standard errors, data availability, time frame, and the choice of econometric estimator.

Table 1

Summary of regression results on the effects of demographic change on economic growth, selected studies based on conditional convergence models

				Coefficient (reported std error)		
Study	Time frame	Number of observations	Estimator and specification	Growth rate of economically active population (1)	Growth rate of total population (2)	(1) - (2)
Bloom and Williamson, 1998	1965-1990, single cross-section	78	OLS, Table 3, spec 1b	1.46 (0.34)	-1.03 (0.4)	1.68 (0.35)
		70	OLS, Table 4, spec 1b	1.41 (0.37)	-0.97 (0.43)	1.60 (0.38)
		70	IV, Table 4, spec 1b	1.37 (1.71)	-0.92 (2.12)	2.96 (0.75)
Bloom and Sachs, 1998	1965-1990, single cross-section	77	OLS, Table 6, spec 3	1.25 (0.54)	-1.01 (0.67)	1.49 (0.47)
Bloom, Canning, and Malaney, 2000	1965-1990, 5-yr panel	391	OLS, Table 2, spec 2	1.27 (0.38)	-0.98 (0.46)	NA
		391	IV, Table 2, spec 3	1.75 (0.50)	-1.30 (0.54)	1.55 (0.47)
Bloom and Canning, 2001	1965-1990, single cross-section	80	IV, Table 7.3, spec 1.2	2.83 (0.72)	-3.01 (0.69)	2.93 (0.63)
Bloom, Canning, Fink, and Finlay, 2007	1960-2000, 5-yr panel	610	OLS, Table 2, spec 1	NA	NA	0.80 (0.27)
		554	IV, Table 2, spec 2	NA	NA	1.54 (.48)
Bloom and Canning, 2008	1965-1995, 5-yr panel	507	OLS, Table 1, spec 1	NA	NA	1.00 (0.33)
		507	IV, Table 1, spec 2	NA	NA	1.39 (0.56)
Bloom and Finlay, 2009	1965-2005, 5yr panel	658	OLS, Table 4, spec 6	0.54 (0.17)	-0.16 (0.22)	NA
		657	IV, Table 4, spec 7	1.67 (0.45)	-1.70 (0.50)	NA
Bloom et al, 2010	1960-2000, 5-yr panel	647	OLS, Table 5, spec 2	NA	NA	0.87 (0.27)
		571	IV, Table 5, spec 3	NA	NA	0.56 (0.40)

Notes:

The dependent variable in all of these studies is the average annual growth rate of real GDP per capita (PPP).

See the tables noted for a list of control variables (including in some cases other demographic variables), the nature of the standard errors, and a list of instruments where relevant.

See the studies for a list of countries included.

The results reported in Table 1 are generally consistent with the view that age structure is important to economic growth. The inclusion of the growth rate of the working-age population adds significantly to the explanatory power of nearly every regression. The coefficient of this variable is always negative, almost always statistically significant, and often turns the coefficient of the growth rate of population from statistically insignificant to negative and significant. In addition, several of the studies cited show that the effect on economic growth of a growing working-age population share tends to be larger in "good" policy environments.

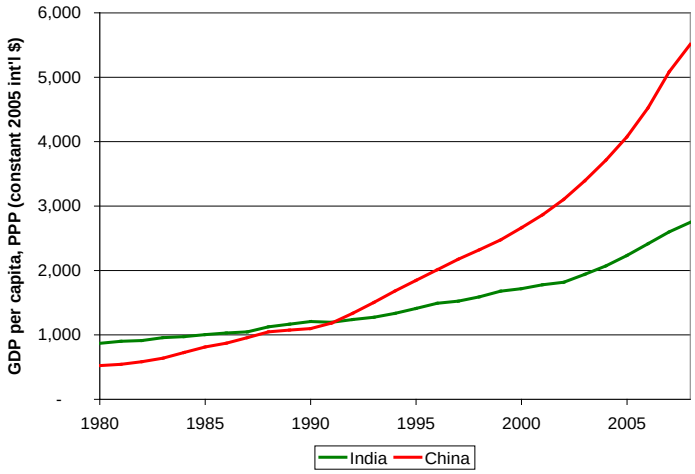
This literature highlights the importance of age structure dynamics as a determinant of economic growth. However, it does not provide irrefutable evidence on this point. In addition to the usual critiques of cross-country regression analyses (e.g., Durlauf (2009), Hoebink (2008), Rodrik and Rodríguez (2001), and Rodrik (2005), one may raise questions about reverse causality that cannot be easily dismissed on the basis of the instruments used in these studies. Further analysis is needed to explore the importance and the appropriateness of different modeling decisions and empirical practices. Two useful steps in this direction are Kelley and Schmidt (2001) and Kelley and Schmidt (2005).

Papers that focus explicitly on the implications of demographic change for India's economic growth and development include Acharya (2004), Bloom et al (2010), Chandrasekhar, Ghosh, and Roychowdhury (2006), James (2008), Krueger (2007), Kurian (2007), and Prskawetz, Kögel, Sanderson, and Scherbov (2007).

Section 2.1: Comparing India to China

Figure 7 offers another perspective on economic growth in India by comparing it with that of China. India had 66% higher income per capita than China in 1980, but by the early 1990s China overtook India. In 2008, the situation was decisively reversed, with income per capita in China double that of India.

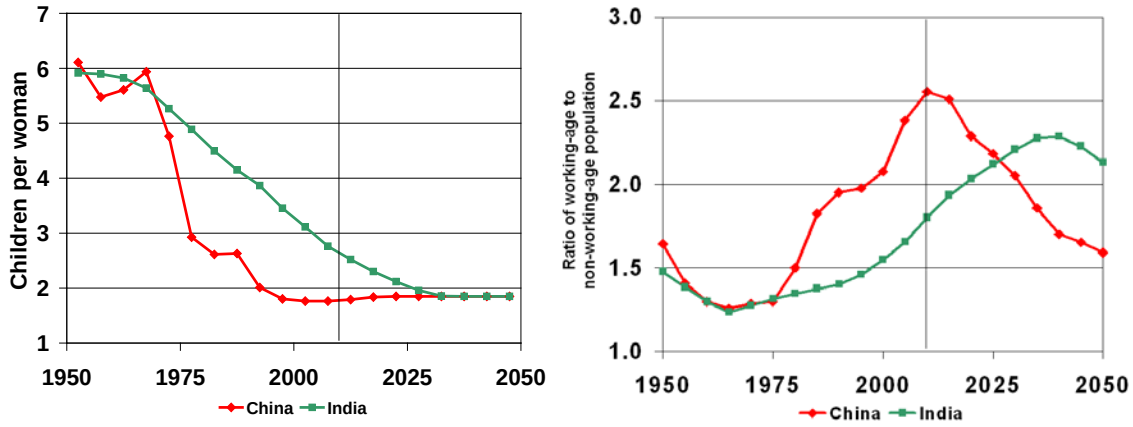
Figure 7
Real income per capita in China and India



Source: World Bank World Development Indicators, 2009.

This income crossover can be traced in no small measure to the very different demographic trajectories experienced by China and India, as demonstrated by the dissimilarities in TFR and the ratio of the working-age to the non-working-age population between the two countries (Figure 8).

Figure 8
Demographic changes in China and India



Source: United Nations (2009).

India and China are credited with establishing the world's earliest national family planning programs, in 1952 and 1956, respectively. In strictly demographic terms, China's campaign of "later, longer, fewer"[5] and its one-child policy (beginning in 1979) led to a precipitous decline in fertility and a sharp rise in the working-age share of the population (Attane 2002, Robinson and Ross 2007). Meanwhile, India's family planning program led to political backlash that ultimately set back its family planning efforts and pushed India's demographic trajectory out of phase with China's. Demographics are one powerful driver of economic performance, and India and China's economic trajectories began to diverge.

As previously mentioned, the difference between India's and China's economic trajectories may begin to narrow as India's working-age share continues to rise, positioning India to recoup some of the income per capita ground it lost relative to China in the past two decades. The very rapid rise in the ratio of China's working-age to non-working-age population contributed significantly to its extremely fast economic growth since 1980. The corresponding population ratio in India has grown more slowly, which fits well with the slower increase in India's rate of economic growth. If India follows the UN's low-fertility projections in the coming decades, its ratio will reach roughly the same level that China has in 2010, with, potentially, a concomitant boost in its income per capita and rate of economic growth. This fertility scenario for India seems, however, implausibly extreme.

Numerous researchers have explored the China-India comparison in great detail, spurred by China having emerged as a major economic power while India has experienced a much slower economic transformation. Bloom, Canning, Hu, Liu, Mahal, and Yip (2010) track key features of economic growth in China and India since 1980, and find that higher rates of economic growth in both countries are attributable to rises in longevity, increased trade or openness of the

economy, and a higher share of the working-age population. Notably, the authors predict that moving forward, economic growth in China will be slowed by flattening increases in life expectancy and a rising dependency rate due to a rapidly aging population. In contrast, the authors predict that the effects of a fertility decline and rising longevity in India will create a rise in the working-age share of the total population in that country, allowing for higher growth rates in India over the next 30 years.

Similarly, DaVanzo et al (2010) compare demographic conditions and their implications in China and India, finding that in the short run China holds more of the prerequisites needed to take full advantage of its demographic dividend: "more flexible labor markets; higher rates of female labor force participation, more highly educated women, and more open attitudes about women working; less illiteracy in general (and especially for women); better infrastructure; more internal migration…and a higher degree of urbanization, more openness to foreign trade, and slightly higher rates of coverage by public pensions." However, in the long run the authors find that in comparison to India, China's prospects for sustained economic growth might be curtailed by shifting demographics. A rapidly aging population will create new demands and strains, resulting in wealth transfers from working-age populations to the elderly. In this respect, India will have a demographic and economic advantage over China in the decades to come.

Bosworth and Collins (2008) use a simple growth accounting framework to compare the recent economic performance of China and India, and produce estimates of the contribution of labor, capital, education, and total factor productivity (TFP) for individual sectors and the economy as a whole. The authors find that India has grown at a rate comparable to the industrializing economies of East Asia (not including China), with growth strongest in various service-producing industries, while India's manufacturing sector remains weak. In terms of labor, physical capital, and other supply-side prospects, the authors conclude that India is well-equipped for continued rapid growth assuming that it strengthens its infrastructure and expands its trade beyond the current emphasis on services.

Nicholas Eberstadt (2010) considers the implications of demographic change in Asia for the evolving cross-country strategic balance, noting that economic strength has a major effect on military strength. He finds that China's forthcoming demographic changes are likely to pose a barrier to its continued rise, whereas he sees a moderate boost to India's strength because of its demographic picture. He cautions, however, that disparities in human development across different regions of India may slow the growth of India's influence. Inadequately educated labor in the northern parts of the country may be particularly problematic.

Bloom et al. (2010) study economic growth in China and India between 1965-70 and 1995-2000 and find that increases in the working age population share during that period boosted the rate of economic growth in India by an annual average of 0.7 percentage points. Bloom, Canning, and Rosenberg (2010) find that, if India adopts policies that allow the working-age population to be productively employed, India may receive a demographic dividend of roughly 1 percentage point growth in GDP per capita, compounded year by year.

For a growth model that looks at the divergent growth paths of China and India, particularly in terms of the relative importance of physical and human capital, see Chapter 31 in this volume, by Yong Wang and Kamhon Kan.

Examining projected changes in the size of the labor force in China and India provides a straightforward way of considering the interaction of population growth, changing age structure, and the supply of labor. India will add roughly 9 million people each year to its labor force over the next decade, while China will add virtually none. With growing competition for young, skilled workers, China will see rising wages. This is beneficial for Chinese workers, but may hinder the growth of China's exports. India's new workers are not as well educated as China's, and if they are employed, their wages are likely to remain low. Although this will aid in the growth of labor-intensive manufacturing, sooner rather than later India will need to significantly raise the educational level of its workforce if its industries are to produce higher-value goods more efficiently. On a separate note, China's population is aging more rapidly than India's, with consequences for the relative level of resources that will need to be directed toward care of the elderly.

In summary, India's demographic evolution over the coming decades will provide a potential boost to its rate of economic growth – at a time when China will be losing the demographic impetus that has helped spur its economy. But the process is not automatic. Policy choices in the areas of governance, macroeconomic management, trade, and human capital formation can have a significant effect on realization of the demographic dividend. Central to capturing the dividend is providing an economic environment in which working-age people are productively employed. Failure in this endeavor could result in a demographic disaster rather than a demographic dividend.

Section 3: India's economic prospects

Thus far, this chapter has discussed salient features of India's demographic profile and examined the implications of that profile for economic growth in India. Consideration of these demographic realities may help Indian policymakers adopt measures that can accelerate India's demographic transition and magnify India's demographic dividend. Alternatively, India could experience a demographic drag on its economy if the country falls prey to potential demographic threats to its economy.

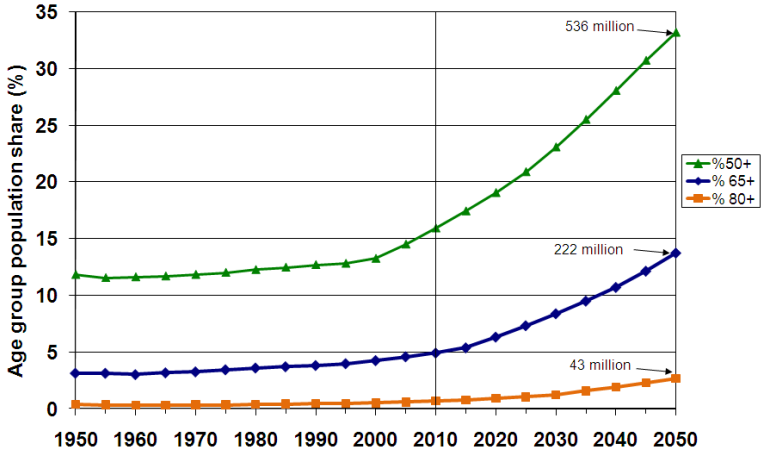
Policymakers may also consider three demographic- and health-related potential threats to India's future prosperity: population aging, population heterogeneity, and the effects of urbanization on health.

Section 3.1 Population aging

Today's large cohorts of working-age individuals will be large cohorts of elderly dependents in the future. Figure 9 shows that the share of India's 50+ population today is relatively small, accounting for only 16% of India's population. Going forward however, India will witness rapid

growth among this age group. By 2050, over 33%, or roughly 536 million people, will be aged 50 or over; the share of those aged 65 and over will increase from 5% to 14%; and the share of those aged 80 and over will rise from 1% to 3%. The main force driving India's changing age structure are the maturing of past birth cohorts, upward trends in life expectancy due to increasing survival rates at older ages, and falling fertility.

Figure 9
Share of older Indians



Source: United Nations (2009).

There has been significant inquiry into the population aging phenomenon, especially concerning its implications for economic growth. Much of the existing commentary contains alarmist tones, with concern expressed that many countries will be flooded with elderly individuals who will endeavor to consume more than they contribute, leading to dramatically altered asset values and income trajectories.

However, India's 65 and over population currently represents only one-fourth the number of its adolescents and young adults, and will not come to outnumber the younger group for nearly four decades. Enacting policies to meet the education and training needs of India's youth can ease the process of caring for growing numbers of older Indians in the future. While it is true that adult labor force participation rates will eventually decrease as the population ages, the burden of old-age dependency will be substantially offset by the decline in youth dependency associated with declining fertility. In addition, behavioral and policy responses to population aging – including higher labor force participation of women, higher savings for retirement, and later age of retirement – suggest that population aging will not necessarily significantly impede economic growth.

Notwithstanding its likely modest effect on economic growth in India in the coming decades, population aging is creating a significant challenge for India, given its current reliance on private family networks to provide the elderly with care, companionship, and financial support. That system will not be able to withstand the increased number of older Indians, especially given increased female labor force participation, smaller numbers of more mobile children, widening

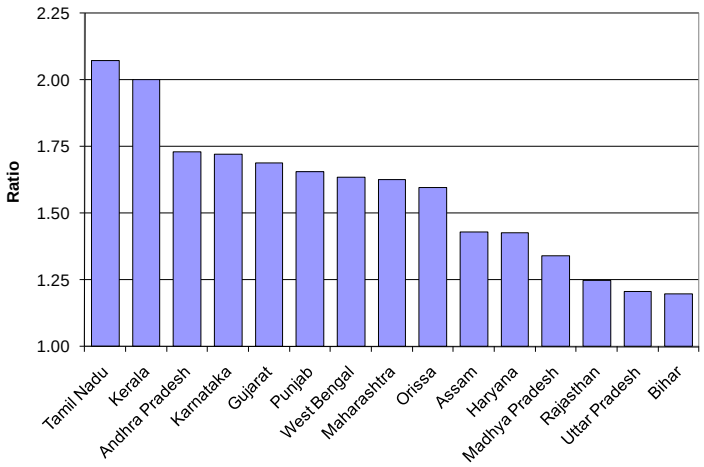
generation gaps, and increasing burdens of costly-to-treat non-communicable disease such as diabetes, cancer, and stroke.[6]

There is currently a vacuum with respect to institutions and policies to address these challenges in India; less than 10% of the Indian population currently has health insurance (either public or private) and 90% of the elderly have no pension. India will likely benefit from building an evidence base of high-quality data on population aging, and using it to devise a related set of public institutions (see Lee 2010).

Section 3.2: Population heterogeneity

A second potential threat to India's future prosperity is the reality that India encompasses numerous sources of powerful heterogeneity in the form of culture, education, income, language, religion, and social status, among others. India is a particularly heterogeneous country demographically, with most demographic indicators varying enormously across states. For example, Figure 10 shows cross-state differences (for the year 2001) in the main indicator of potential for a demographic dividend, namely, the ratio of the working-age population to the non-working-age population. Here, the comparison of Tamil Nadu and Bihar shows as great a disparity as the current difference between Ireland and Rwanda – giving the economy of Tamil Nadu a much larger potential demographic lift than that of Bihar.

Figure 10
Ratio, working-age to non-working-age population, by Indian state, 2001



Source: Office of the Registrar General and Census Commissioner, Ministry of Home Affairs, India, 2001

Other demographic indicators show a similarly large range of heterogeneity. For example, the total fertility rate (TFR) varied across the states of India by a factor of more than 3 in 2001. Fertility in Kerala was well below the long-run replacement level of 2.1 children per woman, whereas it was more than twice the replacement level in Uttar Pradesh; this disparity corresponds roughly to the current difference in fertility between Japan and Kenya. India's states also exhibit a large variation in life expectancy, with a range from 73 years in Kerala to 59 years in Madhya Pradesh.

While heterogeneity can be a source of constructive synergy, it can also cause or contribute to social and political unrest and instability, particularly when it is accompanied by economic inequality. Moreover, insofar as demographic cycles induce economic cycles, the extraordinary degree of demographic heterogeneity within India suggests economic trajectories that are as different as those seen above between East Asia and Sub-Saharan Africa. Although it hardly represents decisive evidence on this point, it is worth noting that, within India, the cross-state correlation between the ratio of the working-age to the non-working-age population and income per capita was +0.64 in 2001. Duraisamy and Mahal (2005) examine India's cross-state heterogeneity and find "a strong association between per capita income and health status . . . of the population." Their econometric analysis finds that health status and economic growth affect each other: "a 10% increase in per capita income is required to increase [life expectancy at birth] by about 2%"; they also find that the effect of life expectancy on the net domestic product for Indian states is "much higher than the effect of the conventional inputs of capital and labour." It is critical for researchers and policymakers to consider demographic differences within India, as differences in economic growth rates by state could exacerbate inequality and political frictions within India.

Section 3.3: Urbanization and health

India, like virtually every country in the world, is becoming more urbanized: the fraction of people living in urban areas grew from 18% in 1960 to 30% in 2008 (World Bank 2010). During this period, it has been confronting a surge in chronic diseases – accounting for 53% of all deaths in India in 2005 (Reddy et al 2005) – that are related to a decline of infectious disease mortality, tobacco consumption, patterns of nutrition, and urban living and a more sedentary lifestyle. People living in cities are typically exposed to greater pollution levels than rural dwellers. They often have more sedentary lives, and they may be subject to more stress. Some chronic illnesses, such as hypertension and diabetes, tend to be positively correlated with wealth (and hence with urban living), whereas others, such as anemia, tend to be negatively correlated. Left unchecked, the increased prevalence of chronic diseases will pose serious threats for India's future economic and physical well-being.

Despite urbanization's negative effects on health and the possible follow-on effects that poorer population health can have on economic growth, there are clearly other aspects of urbanization that may promote economic growth. In general, work opportunities are more plentiful, fertility rates are lower so more women enter the labor force, industries can capture the benefits of economies of scale, enterprises can readily learn from each other, and transportation of people and goods is easier than in rural areas. Even in the arena of health, greater availability of healthcare, combined with lower fertility rates, means that increased urbanization may offer some advantages that can help propel economic growth. However, based on a cross-country analysis during 1970-2000, Bloom, Canning, and Fink (2008) find no effect of urban share on economic growth.

Section 3.4: Capturing India's economic potential

India is poised to reap economic benefits from the favorable demographics discussed earlier, but this windfall is not guaranteed. India has several opportunities to increase its chances of success, the first being to make wider and deeper investments in health. Insofar as investing in health can help stimulate development, India has considerable potential to promote higher income through programmatic and financial commitments to health. India has taken a significant step in this direction by establishing the Public Health Foundation of India and the National Rural Health Mission, which seek to fill India's pressing need for a wide range of further investments in the promotion and protection of health, including the training and wide deployment of medical and public health professionals who focus on disease prevention, treatment, and care.

India's second great demographic opportunity involves the acceleration of fertility decline. In general, there are three main approaches to promoting fertility decline, and India has scope for improvement with respect all three. The first is the expansion of family planning services in a way that is respectful of people's reproductive rights. Currently, approximately 13% of Indian women (10% in urban areas and nearly 15% in rural areas) report unmet need for contraception, meaning that many currently married women who desire to postpone or forego childbearing are not using contraception. Overall, 56% of married women in India (64% in urban areas and 53% in rural areas) report that they use contraception (either modern or traditional methods), with female sterilization by far the most common method. (Government of India, 2005-2006) Satisfying India's unmet need for contraception will help it achieve its stated goal of bringing TFR down from its current level of 2.7 to the long-run replacement fertility level of 2.1.

A second proven approach to lowering fertility involves efforts to promote infant and child survival. Vaccines against childhood disease are one potent way to realize an improvement in child survival, which leads to more than proportionate fertility reductions. Such an approach might include expanding coverage of established and inexpensive vaccinations such as those against diphtheria, tetanus, pertussis, polio, and measles; or it might include introducing a new schedule of more expensive vaccinations against rotavirus, pneumococcal disease, and *Haemophilus influenzae* type b (Hib), thereby addressing several leading causes of child death in India.

Childhood vaccines also have the virtue of promoting better school attendance, better cognitive function, and better adult health, all of which tend to make vaccinated children more productive, and therefore higher-earning, adults. India stands to benefit greatly from initiatives to increase vaccination coverage; its coverage rates are currently well below world averages. DTP3 vaccination rates are a common indicator of national immunization coverage; the coverage rate for India was 66% in 2008, nearly 20 percentage points lower than for the rest of the world (WHO 2010).

Third, girls' education can serve as both an indicator of development and an instrument for promoting fertility decline. Educated mothers tend to have fewer children, as education raises the cost of having children by improving the work opportunities that most women are forced to forgo by having children. Education also empowers women to express their views on lifestyle and fertility decisions. Having fewer children allows families to invest more in the health and

education of each child, thereby raising the productive capacity of future generations. The effects of education, and girls' education in particular, are extremely powerful. Education also has a major role to play in India's ability to capitalize on the demographic dividend: education, especially secondary and tertiary education, will equip India's youth with the skills they need to be productive in a fast-moving and unforgiving global economy in which knowledge and skill rule.

Although India has made progress since the early 1990s, there is considerable scope for continued progress in this area, mainly at the secondary and tertiary levels. At the same time, policymakers must ensure that they are not misled by statistics, as enrollment in school does not guarantee attendance. Furthermore, attendance does not guarantee that a student is receiving an education of sufficiently high quality to substantially augment their knowledge, skills, and productivity. In Chapter 13 of this volume, Anjini Kochar examines the challenges facing the Indian primary and secondary education systems and efforts to overcome those challenges. In Chapter 14 Shyam Sunder addresses similar issues in the realm of higher education.

Indian policymakers will also need to recognize that realization of the demographic dividend depends on an economy's capacity to absorb workers into productive employment. This capacity is strengthened by:

- good governance (effective avenues for citizen input, well-functioning institutions, respect for the rule of law, low level of corruption, respect for property rights, sanctity of contracts);
- efficient infrastructure (reliable roads, railways, telecommunications, water supply, sanitation, and agricultural needs);
- prudent fiscal and macroeconomic management (policies that keep inflation reasonable, promote inclusive economic growth, avoid severe trade imbalances);
- well-developed and competitive financial markets (institutions that facilitate mobilization of savings, safeguards to ensure that banks and other financial institutions serve the public interest) and labor markets (a negotiated balance of power between employers and workers); and above all,
- investments in education and training (strength in all levels of schooling for females and males of all income levels and castes, job training for workers to keep up with new types of services and industries).

While these are all excellent policies independently of demographics, the stakes are much greater when a large cohort is poised to enter the working ages. Given its high levels of internal heterogeneity, India needs to consider a combination of these approaches and policies to catalyze and speed its demographic transition, and to capture a demographic dividend.

For example, some Indian states are in a much better position than others to benefit from demographic change. In some of the poorest states, such as Bihar and Uttar Pradesh, a large portion of the young population is extremely poorly educated and cannot engage productively in the type of work that would provide them a good income and that would help propel India forward economically. For that reason, even as these states experience falling fertility rates and consequently a rising share of working-age people, they are not poised to capture a demographic

dividend. Further discussion of regional disparities appears in Acharya (2004), James (2008), and Kurian (2007).

Conclusion

In conclusion, demographics matter to the pace and process of economic growth and development – in India and elsewhere. While many factors influence economic growth, few are more important and reliable than demography. India's changing demographics are creating a strong impulse for economic growth, and policymakers have several options for making this potential demographic dividend a reality.

Future research on the economic impact of demographic change in India could shed light on the following topics and suggest policy options that might further spur economic growth:

- Cross-state variation in demographic and economic indicators could be usefully exploited to estimate, for each state, the size of the demographic dividend (if any) to date. Demographic projections could shed some light on the potential size of the dividend in the coming decades.
- Previous research on the impact of working-age share has used the 15-64 age range as the definition of "working age". This cohort might usefully be divided into subgroups to see whether particular subgroups (e.g., prime-age workers) can be identified as being particularly responsible for the positive economic effects of the demographic transition.
- Most analysis to date has treated dependents (those under 15 and older than 64) as a single group. Treating these groups separately may clarify whether the demographic dividend in particular circumstances is driven by low numbers of one or the other.
- More broadly, it would be useful to analyze the effect of labor force participation rates, as distinct from working-age share.
- To better establish causality, it would be useful to develop and implement better treatment of the endogeneity of population variables. For example, it might be possible to examine the economic impact of changes in age structure that result from unanticipated and exogenous shifts in immigration policy or infectious disease mortality.
- This chapter identifies five different channels through which the demographic dividend can arise. Further macroeconomic studies and the use of micro-data could aim to distinguish the causative effects more carefully.
- Because the demographic dividend does not arise automatically, it would be useful to carefully test the interaction of demographic change with policies, especially in the areas of governance, trade, labor market conditions, and capital markets.
- To date there has been insufficient theoretical and empirical analysis of whether and how the demographic dividend can arise in an economy characterized by widespread underemployment. Since a productively employed population is key to realization of the dividend, it is not clear that a higher working-age share can have the desired results in such a situation.
- The relative contributions of men's and women's output to economic growth are insufficiently understood. In light of the prospect of increased female participation in the labor force, research might contribute to further understanding of policies that can promote realization of the demographic dividend.

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[1] As World Bank purchasing power parity (PPP) figures only go back to 1980, these figures are exchange-rate-based constant 2000 USD. PPP figures post-1980 show a similar trajectory.
[2] This type of research is discussed in more technical terms in Section 2.
[3] The United Nations makes several separate forecasts of population size, including ones based on low-, medium-, and high-fertility assumptions. This chapter uses the United Nations' medium-fertility scenario except where otherwise stated.
[4] See also Bhargava et al. (2001).
[5] China's 1972 campaign emphasized later ages for marriage and childbearing, longer intervals between births, and smaller families.
[6] These issues and India's efforts to address the economic security of the elderly are discussed in Bloom, Mahal, Rosenberg, and Sevilla (2010). Lee (2010) reviews past and current data collection efforts throughout the world that aim to characterize the financial, health, and social conditions of the elderly.