Health, Poverty and Economic Growth in India

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THE IMPORTANCE OF ECONOMIC GROWTH, MEASURED BY INCREASES IN GROSS domestic product (GDP) and GDP per capita, for policy purposes can hardly be overemphasized. Economic growth is commonly used as an indicator of a nation's economic performance, and the level of GDP per capita is a key component of the Human Development Index of the United Nations Development Programme, a popular indicator of national well-being. The benefits of economic growth are so pervasive that it has been a central agenda everywhere and countries have accorded top priority to achieving high rates of growth. Some experts and policy-makers have also argued that it is difficult to achieve declines in poverty rates by relying on redistribution strategies alone, without a concomitant improvement in size of the national economic cake, as reflected in the magnitude of real GDP and real GDP per capita. It is difficult to imagine a sustained decline in poverty unaccompanied by a simultaneous improvement in aggregate economic performance.

There is now a large body of theoretical and empirical research on the determinants of economic growth. Much of the early work highlighted growth in labour and the stock of physical capital as the key determinants of economic growth. However, early empirical work was unable to 'explain' a significant portion of the growth in GDP and GDP per capita, by the growth in labour force and capital alone, and so attention turned to other factors-most notably technological change embodied in capital goods, and on the quality and quantity of labour, referred to as human capital, in promoting economic growth. Two key elements of human capital are the extent to which the labour force is educated, and the level of its health. Recent empirical work has sought to assess the association between human capital and aggregate economic performance and found that, given labour and capital, improvement in health status and education of the population lead to a higher output (Barro and Sala-i-Martin 2004).

The role of health in influencing economic outcomes has been well understood at the micro level. Healthier workers are likely to be able to work longer, be generally more productive than their relatively less healthy counterparts, and consequently able to secure higher earnings than the latter, all else being the same; illness and disease shorten the working lives of people, thereby reducing their lifetime earnings. Better health also has a positive effect on the learning abilities of children, and leads to better educational outcomes (school completion rates, higher mean years of schooling, achievements) and increases the efficiency of human capital formation by individuals and households (Strauss and Thomas 1998; Schultz 1999).

However, more recent research has also established a strong causal association running from health to aggregate economic performance. Thus Bloom, Canning and Sevilla (2004) report evidence from more than a dozen cross-country studies and all these studies, with a single exception, show that health has a positive and statistically significant effect on the rate of growth of GDP per capita. The causal relationship does not run in only one direction-from health to aggregate economic performance-and there is strong case for considering a reverse link, running from 'wealth to health'. Higher incomes potentially permit individuals (and societies) to afford better nutrition, better health care and, presumably, achieve better health. There is some cross-country evidence that such a relationship holds at the national level (Pritchett and Summers 1996; Bhargava et al. 2001). Several experts believe, however, that the causal direction from health to economic performance is stronger.

The previous empirical findings have implications for the role of health improve-

ments among workers in influencing another key policy objective-poverty reduction. First, to the extent that improvements in health result in improvements in national income, poverty could decline on account of both the standard 'trickle-down' effects and an increased financial capacity of nations to set up safety nets. There is a good deal of evidence suggesting that countries that experience a steep rise in growth rates of real GDP per capita also experience impressive declines in poverty (Barro and Sala-i-Martin 2004). Second, improvements in health, when directed at the poor, can contribute more directly to poverty reduction and serve as an element of a 'pro-poor' growth strategy. The poor bear a disproportionately higher burden of illness, injury and disease than the rich. The poor suffer ill health due to a variety of causes, poor nutrition for instance, which reduces the ability to work and weakens their resistance to disease. With their body often being their main income-earning asset, sickness and disability have significant adverse implications in terms of loss of work and incomes, compounded by their inability to obtain adequate health care. Frequently, treatment expenditure and loss of earnings force poor families to exhaust their savings and assets, and take recourse to borrowing, leading to more poverty and poor health status.

This paper contributes to existing analyses of the health-poverty-income nexus by examining these relationships at the State level in India, using the most recent empirical methods available in the literature (Bloom et al. 2004). Our analysis is carried out using a cross-State panel dataset for 14 major Indian States for the years 1970/71, 1980/81, 1990/91 and 2000/01, spanning a thirty-year period.

The analysis of this paper is important for several reasons. First, there is no denying the policy significance of understanding the determinants of economic growth and its relationship with poverty and improvements in health. If health turns out to have significantly influenced India's economic performance, this may call for investing more public funds in health, given that health budgets have been severely resource-constrained in recent years. One way this could happen is by greater emphasis on the commitments India has made to meet the targets set by the Millennium Declaration. These targets include significant improvement in health through reduction in infant and child mortality by two-thirds by 2015 (World Bank 2004). Conversely, this also calls for understanding better the impact of economic growth on health, so that one can assess the improvements in economic performance necessary to achieve the desired goals. Second, unlike the existing literature which relies on cross-national data, our paper examines the interlinkages between health and economic performance within a single country. Intracountry analysis has the advantage of being much better equipped to handle data-comparability issues relating to health, education and economic performance. At the same time, the significant variation in inter-State performance in health and economic achievement means that our estimation procedures yield estimates that are reasonably robust. Third, significant inter-State differences in India's economic performance call for enhanced efforts in understanding these differentials. Unfortunately, there have been only a few recent attempts at examining the relative growth performances of the States in India (Ahluwalia 2001; Sachs et al. 2002), and most of the major studies do not emphasize the role of health in influencing economic performance. The only study that sought to do this in the Indian context was one by Gupta and Mitra (2003), which examined the link between growth, health and poverty in India. While useful, the chief drawback of this paper is that its empirical specification was essentially ad hoc, and not influenced by developments in the economic growth literature. As a consequence, there are legitimate concerns with their model specifications, including the criteria used for the inclusion (or exclusion) of explanatory variables. There are now newer and more powerful methods to assess the links between health, poverty and economic growth. For these reasons, we believe that the estimates reported in their paper are unlikely to be robust.

Economic growth and health: A review of cross-country and regional studies

Modern growth literature includes, in addition to the standard labour and capital variables, indicators of human capital-the stock of education and health-among the determinants. Particularly, the influential works in this area are the cross-country studies by Barro (1991, 1997) and Barro and Sala-i-Martin (2004) and the theoretical framework developed by Mankiw, Romer and Weil (1992). A comprehensive review of empirical evidence on the new macroeconomics of growth is contained in Temple (1999). Barro (1991) used a cross-sectional framework and the human capital variable was restricted to school enrolment rates at the primary and secondary levels. He showed, using cross-section data for 98 countries, that the growth rate of real GDP per capita over the period 1960-85 was positively related to the initial (1960) enrolment rate, and inversely related to the starting (1960) level of real per capita GDP. In subsequent analyses, Barro (1997) and Barro and Sala-i-Martin (2004) used a panel dataset of countries, and included health as a determinant (life expectancy at birth [LEB]) besides years of educational attainment and other factors that could potentially influence the growth of real income per capita. Their results indicate that the log of LEB has a positive and statistically significant effect on growth rate with a coefficient of 0.042, which implies an annual rate of increase of per capita real GDP of 4.2%. Fogel (1994) showed that about one-third of the increase in income in Britain during the nineteenth and twentieth centuries could be attributed to improvements in health and nutrition. Mayer (2001) concluded that improvements in adult survival were causally linked to improvements in growth performance in Brazil and Mexico; and Weil (2001) found that health (indicated by average height and LEB) explained about 17% of the variation in income per capita across countries. Gyimah-Brempong and Wilson (2004) find that 22% and 30% of the growth rate of per capita income in sub-Saharan Africa and OECD countries, respectively, can be attributed to health.

Bloom, Canning and Sevilla (2004) review several studies

that include health as an explanatory variable in growth equations, in addition to presenting new results, based on a cross-national panel dataset for countries. They use a production function model of economic growth with a measure for human capital which takes account of the indicators of health, education and labour market experience. There are two noteworthy findings from their analysis. First, their analysis reconciles microeconomic analyses of the rate of return to schooling with macroeconomic analyses of returns to education. Second, they report a positive and statistically significant effect of health on economic growth. Their empirical findings reveal that an increase of one year in LEB raises the growth rate of GDP by 4%. Bhargava et al. (2001) found that the adult survival rate (ASR) has a positive effect on growth rate of per capita GDP and that a 1% increase in ASR increases the growth rate by 0.05% for the poorest countries.

While there is compelling evidence that health contributes significantly to economic growth, there is also voluminous literature that focuses on causality in the reverse direction-from income to health. Much of this work is based on micro-level data that focus on the impact of income on the health status of households and their members (Behrman and Deolalikar 1988; Strauss and Thomas 1998). There has also been some recent work at the macro-level, using cross-national panel datasets; and much of the current work using cross-country time series data has tended to account for reverse causality and inter-dependence between health, income and economic growth. Thus, Pritchett and Summers (1996) estimate the effect of income on health, measured by infant and child mortality as well as life expectancy. Some authors have also inquired into the distributional aspects of the income-health relationship. For instance, Preston (1975) used cross-country evidence to suggest that the effect of income improvements on health was greater for the poorest countries than for the richest countries. Deaton (2001) argued that income inequality is not a major determinant of health of the population.

How about the relationship between health, income and poverty? In a purely accounting sense, increases in real GDP per capita will be accompanied by simultaneous declines in the number of people living in poverty, provided the distribution of income remains more or less constant. Growth may be essential to reducing poverty and one might presume that policies promoting distributional improvements will prove difficult to sustain in the absence of long-term increases in real GDP per capita-that is, economic growth. Empirically, Barro and Sala-i-Martin (2004) demonstrated that regions of the world that experienced higher growth rates also witnessed steeper declines in poverty. Bourgoignon (2004) cites studies that provide evidence on the poverty-reducing impact of growth given that income distribution remains the same, and of increases in poverty with a worsening of income distribution. In India, poverty levels have declined the fastest over periods that experienced the highest growth rates, during the1990s (Ahluwalia 2001). According to Srinivasan (2003), there was no perceptible decline in poverty in India until growth accelerated in 1980s and hence a necessary condition for eradicating mass poverty is to accelerate average annual rate of aggregate GDP growth to at least 8%-10% and sustain it at that level for a sufficiently long period. Bourguignon (2004) examines theoretically the interrelationship between growth, inequality and poverty, and shows that both growth and changes in inequality contribute to changes in poverty. However, the relative effects of these phenomena may be country-specific and depend on initial income level and inequality.

It was noted earlier that health improvements contribute to income improvements or growth. With much evidence also pointing to the growth-poverty reduction nexus, better health can be seen as a factor that contributes to poverty reduction via some form of trickle-down mechanism. When health improvements are concentrated among people living close to, or below the poverty line, both a trickle-down mechanism and a redistributive one work to reduce poverty. Rough computations by the World Bank, using National Sample Survey (NSS) data, suggest that ill-health and associated economic losses cause as much as 22 lakh Indians, most living marginally above a poverty line standard of living, to temporarily fall below the poverty line each year, owing to a combination of income losses on account of being unable to work and declines in non-medical care consumption. The NSS for India for 1995-96 also reveal that when the poor fall sick, they are often unable to afford treatment, and even when they do decide to get treated, tend to sell off productive assets and rely on borrowing, all of which have the potential of decreasing their long-run earning capacity-and the capacity to take advantage of any trickle-down labour market advantages offered by a growing economy.

There are several studies in India on health status and health-seeking behaviour. In an early attempt Kannan et al. (1991) analysed the linkages between health, development and socio-economic factors in Kerala. Vaidyanathan (1995) examined the measurement issues related to nutritional and health status and the adequacy of currently available data for assessing nutrition-health status. A number of studies examined levels and changes in morbidity and health expenditure using the National Sample Survey 1986-87 health survey data (Visaria and Gumber 1994, Krishnan 1995, Duraisamy 1995, and Gumber 1997). Sundar (1995) studied the levels and changes in health status and health expenditure based on NCAER survey. These studies are mainly descriptive and refer to earlier periods.

The relationship between income, health and productivity has been analysed at the household level based on micro-econometric framework. Duraisamy (1998, 2001) found evidence of a strong negative effect of income or total consumption expenditure on morbidity and household assets emerged as an important determinant of child survival and preventive health care (Duraisamy and Duraisamy 1995). Deolalikar (1988) demonstrated that health was a significant determinant of labour productivity using farm level data. A study on health, wages and labour supply by Duraisamy and Sathiyavan (1998) revealed that a 10% increase in the body mass index of males and females increased their wage rate by 7% and 2% respectively and labour supply by 20% and 11% respectively.

At the macro level, very little is known on the association between income/economic growth and health (Gupta and Mitra 2003, World Bank 2004). Gupta and Mitra (2003) examined the relationship between health, poverty and economic growth in India for the years 1973/74, 1977/78, 1983, 1987/88, 1993/94, 1999/2000 based on data for 15 Indian States. Their econometric analysis showed that per capita public health expenditure positively influences health status, that poverty declines with better health, and that growth and health have a positive two-way relationship. Despite reporting what appear to be significant findings, this study suffers from certain methodological drawbacks as indicated earlier. Identification restrictions in the model specification appear to be arbitrary rather than based on economic theory, or empirical literature. Their empirical specification with growth of net State domestic product (NSDP) as the dependent variable uses NSDP (not per capita NSDP) in the base year as an explanatory variable, a procedure not used previously in the literature, and for which no justification is provided. The same specification omitted population as an explanatory variable, an assumption which appears not to be standard (Bloom and Freeman 1986; Bloom and Williamson 1998). Many of the estimated coefficients in their analysis turned out not to be statistically significant. For example, in the growth equation (growth of NSDP), poverty, infant mortality rate, initial NSDP and literacy are statistically not significant even at the 10% level of significance. In the same equation, the infrastructure (INF) variable has a significant negative effect on growth rate.

In a World Bank (2004) study, the effects of per capita GDP, per capita health expenditure and female literacy on infant mortality were examined using State-level data for the period 1980-99 based on econometric framework. The results show that both per capita public spending on health and per capita GDP are inversely related to IMR, but they are not very robust to alternative specifications of the model. However this study does not examine the effect of per capita income on LEB, an alternative and perhaps better measure of health status of the population.

The lack of consistent findings in the literature, and possibly specification problems in the early works, lend further justification to the empirical analysis that we pursue in this paper.

Database

To empirically examine the linkages between health, poverty and economic growth at the sub-national (State) level in India, we constructed a panel dataset of 14 States, including observations every ten years-1970/71, 1980/81, 1990/91 and 2000/01. This study is confined to the major Indian States for which consistent time series data are available. The States excluded from the study are: Jammu and Kashmir, Goa and Himachal Pradesh, eight north-eastern States, and seven Union Territories. In the year 2000, three of the States included in our sample, Bihar, Madhya Pradesh and Uttar Pradesh, were bifurcated. We have merged the data on the new States (Chattisgarh, Jharkhand and Uttaranchal) with their respective parent States and constructed a comparable series of all the variables for the study period. The States included for the study account for 90% of India's population and 83% of the country's total land area at present.

State-level income and per capita income are represented by the respective State's NSDP and the per capita NSDP (PCNSDP). Data on the NSDP and PCNSDP are produced on a regular basis by the Central Statistical Organisation (CSO) of the Government of India. We obtained these data from publications of the EPW Research Foundation (2002a, 2003) and CSO (2004). The value of NSDP and PCNSDP in these is reported in current prices and this has been converted into constant price series using a GDP deflator.

The poverty variable is the head count measure, i.e. the proportion of the population living below the poverty line. In India, the poverty line is defined as the minimum expenditure required for achieving a basic calorie requirement, plus comparable non-food consumption expenditures. The source of poverty data for this paper is the Planning Commission, which computed poverty levels from the National Sample Survey Organization (NSSO) 'consumer expenditure' surveys using the 'expert group methodology'. Poverty data are available for the years 1972/73, 1983, 1993/94 and 1999/2000, respectively, and for the purposes of our statistical analysis, are taken to correspond to the years 1971, 1981, 1991 and 2001.

The health status of the population is captured through two indicators-LEB and the infant mortality rate (IMR). Data on these two health indicators were obtained from the Registrar General of India (1999) and updated for recent years using the Sample Registration System (SRS) Bulletin published by the Registrar General of India. Data for 1971 for Bihar and West Bengal were extrapolated using the time series data of the concerned States. LEB estimates for 1961 were taken from the estimates published by the Registrar General of India, which is based on the population census of that year.

Apart from health, human capital is measured along two additional dimensions-average years of schooling and work experience. First, we computed years of schooling using census data on completed levels of education by age and sex of the population. The completed years of education for various levels are assumed to be as follows: literate below primary-4 years; primary-5 years; middle-8 years; secondary-10 years; higher secondary/pre-university-12 years; technical and non-technical diploma-13 years; graduate and above-16 years. The variable for average years of schooling is constructed from the census tables on completed levels of education by age and sex of the population given in the Social and Cultural Tables, Census of India, published by the Registrar General of India for various census years, weighted by its appropriate population share. Second, following Bloom, Canning and Sevilla (2004), the years of labour market experience is constructed using the age and gender distribution of workers provided in the General Economic Tables, Census of India, Registrar General of India for various years. The 'years of experience' is defined as age minus years of schooling minus six, the age of entry into schools as used in the micro-studies in labour economics. The average work

experience is the weighted average of the age- and sex-group specific potential experience with the respective group's share of the total. The data on the number of workers for various census years were obtained from the General Economic Tables of the population census (Registrar General of India [various years]). Total workers include both main and marginal workers. The total population in the working age groups of 15-59 years were also collected from the decennial population census for the respective years. As the age distribution of the population for 2001 was not available when this work was completed, projected instead of actual population by age groups was used.

Physical capital is another key explanatory variable in analyses of economic growth. Unfortunately, data on gross capital formation or the level of investment at the State level comparable with the national-level data on physical capital from national accounts statistics are not available. Data on gross fixed capital formation (GFCF) is available only for a few States from 1993-94 onwards. However, data on the value of fixed capital for the industrial sector are available from the Annual Survey of Industries (ASI) published by the CSO and compiled and published by the EPW Research Foundation (2002b). These values were expressed in current prices and have been converted into a constant price series using the GDP deflator.

Public expenditure on health is an important determinant of the health status of the population. State-level government expenditures on health, water supply and sanitation, and family welfare were compiled from the RBI Bulletin for various years. We also constructed two variables to represent political power: (i) the percentage of votes gained by the ruling party at the Centre in the Assembly elections; and (ii) the percentage of votes secured by socialist and communist parties in the respective State Assembly elections. The data for these variables were gathered from the Election Commission.

Using the above data we first present a descriptive analysis to understand the association between some of the variables used in the study. This is followed by the specification of the econometric model and discussion of the results.

Health, poverty and economic growth: Inter–State descriptive analysis

The basic socioeconomic characteristics of the 14 States and for all of India are given in **Table 1**. Clearly, there is large inter-State variation in the level of PCNSDP for the most recent year (2000/01). The richest State is Punjab, with a per capita income of Rs 15,390; with Bihar being the State with the lowest income per capita of Rs 4123.

The estimated growth rates of real per capita income over the thirty-year period 1970-2000, also shown in **Table 1**, reveal similar trends. The range of variation in growth rates is from a low of about 0.9% and 1% respectively in Madhya Pradesh

Table 1

Basic characteristics of the States included in the study

State	PCNSDP 2000/01 (Rs)Life	Annual average rate of real PCNSDP growth 1970-2000 (%)	Life expectancy at birth 1995-99 (years)	IMR 2000 (per 1000 live-births)	Poverty 1999-2000 (% below poverty line)	Population 2001 (in thousands)	Annual average rate of population growth 1971-2001
Andhra Pradesh	9,982	2.6	63.1	55	15.77	75,728	1.8
Bihar	4,123	1.0	60.2	62	42.6	82,879	1.3
Gujarat	12,975	3.6	62.8	62	14.07	50,597	2.1
Haryana	14,331	2.8	61.5	67	8.74	21,083	2.5
Karnataka	11,910	3.5	64.0	57	20.04	52,734	2.0
Kerala	10,627	1.9	73.5	14	12.72	31,839	1.3
Madhya Pradesh	7,620	0.9	56.4	87	37.43	60,385	1.2
Maharashtra	15,172	3.8	65.8	48	25.02	96,752	2.2
Orissa	5,187	1.7	57.7	95	47.15	36,707	1.7
Punjab	15,390	3.1	68.1	52	6.16	24,289	1.9
Rajasthan	7,937	2.5	60.5	79	15.28	56,473	2.6
Tamil Nadu	12,779	3.5	64.6	51	21.12	62,111	1.4
Uttar Pradesh	5,770	1.2	58.4	83	31.13	166,053	2.1
West Bengal	9,778	2.8	63.4	51	27.02	80,221	2.0
India	10,376	2.4	61.7	68	26.1	1,027,015	2.1

Note: 1. Data for Bihar, Madhya Pradesh and Uttar Pradesh include the three newly formed States of Jharkand, Chhattisgarh and Uttaranchal, respectively.
2. The data for India includes all States and Union Territories.
3. Per capita income (PCY) refers to real per capita NSDP.

Sources: PCNSDP from EPW Research Foundation (2003), growth rate in PCNSDP is based on the authors computation, LEB and IMR are from the Sample Registration System Bulletin (2004) published by the Registrar General of India, poverty estimates are from Planning Commission (from www.indiastat.com), population for 2001 is from the Registrar General of India, GOI and the growth rate in population is computed by the authors.

and Bihar to a high of 3.8% in Maharashtra.

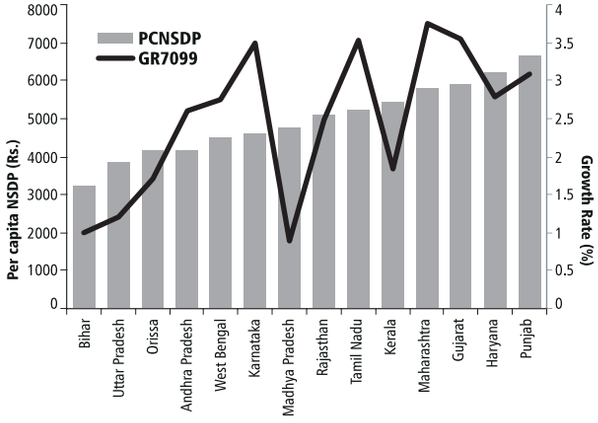
The relationship between initial real per capita income (1970/71) and annual average rates of growth of real income per capita is indicated in **Fig. 1**. In general, States with low initial incomes also witnessed low growth rates except Andhra Pradesh, West Bengal and Karnataka. Conversely, States with higher starting incomes experienced higher growth rates, with the notable exceptions of Kerala and Madhya Pradesh.

Next, we examine the relationship between economic growth and initial per capita income pooling the data for the three periods, 1970-80, 1980-90 and 1990-2000. The computed growth rate is the decadal rate for the periods and the initial income corresponds to the beginning year of the respective decade. The scatter plot with a trend line is exhibited in Fig. 2. It is amply evident that there is a positive association between

Fig 1

Per capita income and growth rate by States, 1970-2000

NSDP: net State domestic product



initial income and growth rate. At first glance, this is at variance with the cross-country results and the regional evidence reported in Barro and Sala-i-Martin (2004). However, the simple association of **Fig. 2** does not control for confounding factors such as human capital stock, and additional analyses are called for to reach firmer conclusions. This issue will be explored further later in the paper.

Figure 3 presents all-India trends in life expectancy at birth (LEB) during the period 1970-2000. It is immediately apparent that India experienced a remarkable improvement in LEB over this period, from 49.7 years during 1970/75 to 61.7 years during 1995/99. The inter-State disparity in LEB in 1995/99 is laid out in **Table 1**. LEB is highest in Kerala (73.5 years) and lowest in Madhya Pradesh (56.4 years), implying a difference of 18.1 years. Bihar, which is one of the States with the lowest per capita income, seems to have fared better than Madhya Pradesh, Orissa and Uttar Pradesh in this health status indicator.

It is instructive to compare the simple association between LEB and per capita income, pooling the three-period data, as shown in the scatter plot **(Fig. 4)**. The positive association between income and life expectancy is vividly brought out in the graph, and the declining slope of the curve indicates that the effect of LEB increases faster at lower than at higher income levels. The relationship is similar to the cross-country evidence

Fig 2

Relationship between initial income and growth rate

NSDP: net State domestic product

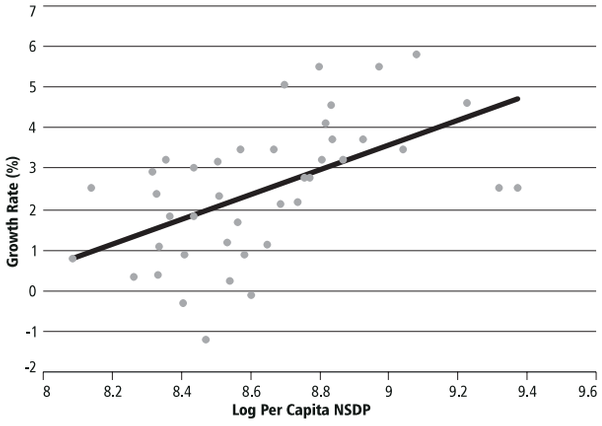
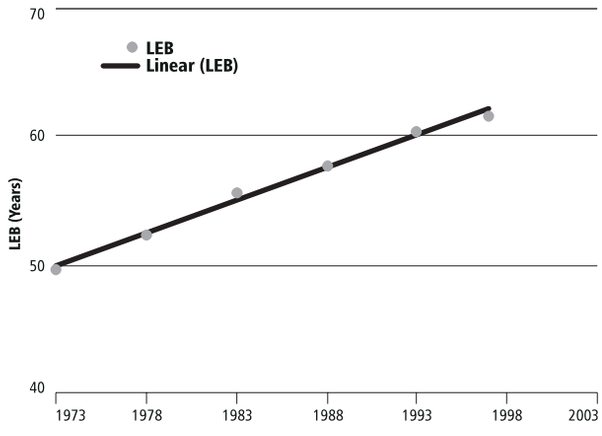


Fig 3

Trends in life expectancy at birth (LEB), 1970-99, India



on the association between LEB and per capita income (in 1985 purchasing power parity (PPP) in dollars) shown by Pritchett and Summers (1996) as well as in Preston (1975). The positive association between LEB and per capita income could be due to (i) increased income causing better health; or (ii) healthier workers being more productive and hence having higher incomes; or (iii) a common factor that leads to both better health and higher incomes. Thus, the simple association between LEB and per capita income cannot tell us exactly what the nature of the relationship is. This issue is further examined below using multivariate techniques.

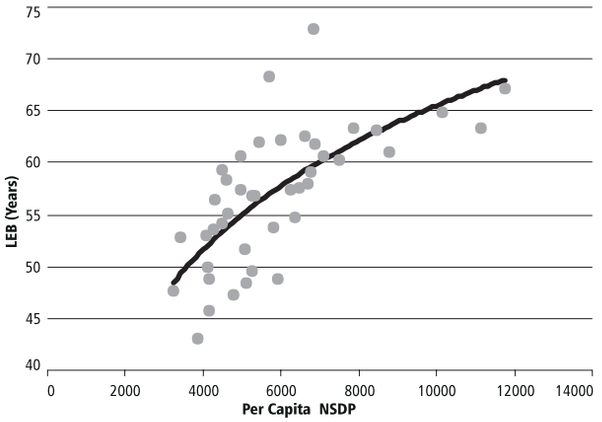
The inter-State variation in the second health status indicator-IMR-is seen in **Table 1**. Kerala again stands out with

the lowest IMR of 14 per 1000 live-births, compared to 95 in Orissa, which has the highest IMR. Interestingly, the second lowest IMR is 48 in Maharashtra, nearly three times higher than Kerala's IMR. This clearly shows that even States with better health status than all of India have a long way to go

Fig 4

Life expectancy at birth (LEB) and per capita NSDP, 1970-2000

NSDP: net State domestic product



to 'catch up' with Kerala.

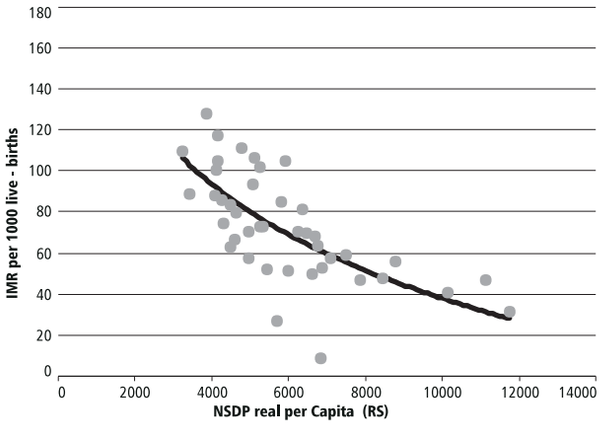
The association between initial per capita income and IMR, pooling the three-period data is shown in **Fig. 5.** Per capita income and IMR are negatively related. The decline in IMR as income increases is not uniform across all income levels. The decline is higher at the low-income levels and lower at high-income levels.

Econometric model and empirical analysis

Fig 5

Infant mortality rate (IMR) and NSDP real per capita

NSDP: net State domestic product



Our discussion on the correlations that exist between indicators of economic growth-income and health-cannot be interpreted as a cause-effect relationship, including also the possibility of two-way causality among the above-mentioned variables.

We now develop an econometric framework to examine the causal or simultaneity relationships among these three variables.

Model specification and estimation issues

Following the cross-country empirical studies on the determinants of economic growth (Barro 1991; Barro and Sala-i-Martin 2004; Bloom and Canning 2004, the growth rate of real per capita income function can be specified as

$$(1)\ G_{it} = \alpha_0 + \alpha_1 \ln Y_{it} + \alpha_2 \ln H_{it} + \alpha_3 S_{it} + \alpha_4 \ln W_{it} + a_5 GW_{it} + u_{it},$$
$$i=1,2,..,N \text{ States}, t=1,2,..T \text{ periods}$$

Here Git =1/m[lnYit+1 - lnYit] is the growth in per capita real income over the period t and t+1, lnY is the natural logarithm of initial real per capita income, lnH is the logarithm of health indicator, namely LEB, S is another dimension of human capital, namely average years of schooling of the adult population, W is the ratio of working age to total population, GW is the rate of growth in W, m is the length of t - (t+1), α_i are parameters to be estimated and uit is the random disturbance term distributed with zero mean and constant variance (see Bloom and Canning 2004 for the theoretical derivation of the model). Several other variables to capture the economic geography and quality of governance such as openness, institutional quality, ethnolinguistic fractionalization, landlocked, tropical area, average government savings rates, access to ports, government consumption ratio, rule of law, etc. were included in the cross-country analysis (Barro 1997); Bloom and Williamson 1998). However, some of these variables are not relevant for a study such as this (e.g. openness) and data on many of the variables such as governance, investment or savings ratio, rule of law, etc. were not available at the State level. Religious and caste composition (percentage of the population belonging to various religions, and schedule caste and schedule tribes), urbanization and population density were considered. Due to high correlation between these and other variables, particularly LEB and schooling, these were not included in the final analysis. In addition to average years of schooling, we also tried including years of labour market experience but due to high collinearity between schooling and labour market experience, the experience variable turned out to be statistically insignificant and hence was dropped in the final analysis.

The coefficient of the initial income variable Yit is an indicator of whether there is a conditional convergence in income per capita or not among countries or regions (States) within a country. The conditional convergence hypothesizes a negative sign of the initial income coefficient. A positive sign would imply increased income dispersion among rich and poor countries (States). A problem with the initial income per capita is that this

variable is potentially endogenous and also measured with error. The procedure adopted in the growth literature is to predict the per capita income using lagged values and the predicted values are used to compute the growth rate as well as for initial income (Barro 1997). We have also adopted this procedure.

Pritchett and Summers (1996), Bhargava et al. (2001) and others argue that health cannot be treated as an exogenous determinant of growth. That is, increased income leads to more investment in health and thus there is strong case for reverse causality. The current level of health status depends upon the initial income per capita and mean years of schooling of the population as specified in Pritchett and Summers (1996). The determinants of health function can be specified as

$$(2)\ \ln H_{it} = \beta_1 + \beta_2 \ln Y_{it} + \beta_3 \ln HExp_{it} + \beta_4 S_{it} + \beta_5 P_{it} + e_{it},$$

i=1,2,..,N States, t=1,2,...T periods where H, Y and S are as defined above, HExp is the per capita State government expenditure on health, water supply and sanitation, and family welfare, hereafter referred to as health expenditure in this study, P is a measure of political power, β_i are the parameters to be estimated and e is the random error term assumed to be distributed with zero mean and constant variance. Increases in per capita income of the people and public expenditure are expected to improve the health status of the population. The political power factor should influence public spending in a welfare state. Two variables are considered. One is the percentage of votes gained by socialist and communist parties in the elections in the decade. The larger the share of votes gained by the socialist and communist parties, the greater their influence on public policy decisions such as government spending on welfare measures like health. Hence it is expected that political power will exert a positive effect on health status. Another political variable considered is the percentage of Assembly seats gained by the ruling party at the Centre. The higher the number of Assembly seats won by the ruling party at the Centre in the State, the more likely the State to get a higher share in central fund allocation. This variable is thus expected to have a positive effect on health. Given that elections are held once every five years under normal conditions, there were at least two elections in a decade. Hence we assigned a weight equal to the number of years a particular government stayed in power in a decade.

The initial income per capita is likely to be endogenous and researchers have instrumented initial income using lagged values of the per capita income variable (Barro 1997). However, Bhargava et al. (2001) argue that lagged variables should be treated as endogenous. Pritchett and Summers (1996) experimented with alternative instruments-terms of trade shocks, investment/GDP ratio, black market premium and price level distortions in their cross-country study. These variables are probably less relevant within a country, and information on these is not available at the State level in India.

In the above formulation, initial income is used to control for the transitional dynamics induced by factor accumulation. If, on the other hand, data on factor inputs are available, it is possible to formulate a model in which the change in output is regressed on changes in inputs. Let the aggregate production function be of Cobb-Douglas form:

$$(3)\ Y_{it} = A_{it} K^{\alpha}_{it} L^{\beta}_{it} H^{\gamma}_{it} S^{\delta}_{it} E^{\lambda}_{it}$$

where Y is aggregate output, A is a technology parameter, K is physical capital stock, L is labour force, H is health (life expectancy), S is mean years of schooling, E is an experience vector (experience and experience squared) and , , , , and are the parameters.

Taking logs of the Cobb-Douglas aggregate production function (3), we can obtain the following model

$$(4)\ \ln Y_{it} = \mu_{it} + \alpha \ln K_{it} + \beta \ln L_{it} + \gamma \ln H_{it} + \delta S_{it} + \lambda E_{it}$$

where μit is lnAit. The inputs K, L and H are endogenous and also measured with errors. To overcome these problems, the practice adopted in literature is to instrument the inputs using their lagged values and this approach has been used in this study for capital stock, total workers and LEB. Some limitations in the data should be noted. For instance, the definition of 'workers' has changed between 1961 and 1981. The SRS provides data on LEB only from 1970-71 and hence the LEB for the year 1960-61 is based on the estimates of the population census of 1961.The estimation methodology depends upon the assumption we make about the technology parameter μit. If μit is assumed to be the same for all States over a period of time, then the production function (4) can be estimated by the OLS or by instrumental variables (IV) methods.

On the other hand, if all the States are at an identical technology level but that technology itself changes over time as shown below

$$(5)\ \mu_{it} = \mu_t + w_{it}$$

where wit is the random disturbance, μt is the time-specific constant. Under this assumption, the equation can be estimated by the 'fixed effects' (time) method or by including a set of dummy variables for time. However, if the technology remains the same over a period of time but varies across States, then the assumption about the technology parameter can be stated as

$$(6)\ \mu_{it} = \mu_t + w_{it}$$

Specification (6) of the model can be estimated by introducing a set of dummy variables for States or by the 'fixed effects' (states) method. The fixed effects method enables us to control for unobserved time-specific or State-specific fixed factors such as genetic factors, climatic conditions, region-specific health problems, etc. An alternative approach is the random effects model that can be estimated by the feasible GLS method (Bloom et al. 2004). We have tested for the fixed versus random effects specification of the model using Hausman's (chi-sqaure) specification test.

Empirical results: Estimates of economic growth and health equations

Table 2 contains the OLS and two-stage least squares (2SLS) estimates of the Barro-type growth equation (1). The depend-

ent variables are the growth rates of real per capita income over the three periods 1970-80, 1980-90 and 1990-2000, and the explanatory variables are initial levels of income, LEB, years of schooling, ratio of working age population to total population and the growth rate in the ratio of working age over total population. The first column provides the OLS estimates of the initial levels of log per capita income and log LEB. The effect of initial income on growth is positive but not statistically significant even at the 10% level. The positive sign of the coefficient of initial income implies that Indian States do not converge to a steady-state growth of per capita income. This is largely at variance with the cross-country evidence that supports the conditional convergence hypothesis. However, similar findings emerge from a study by Sachs et al. (2002) using panel data on Indian States for the period 1980-98. In the case of China, there are marked differences in findings, with convergence and divergence in various subperiods, due to major shifts in economic policy (Sachs et al. 2002). The effect of log LEB on economic growth is positive and the coefficient is statistically significant at the 5% level. In the second specification, we include years of schooling and we observe that the effect of both log LEB and schooling turns out to be statistically insignificant. The high correlation between these two variables (r=0.87), indicates that there is a problem of multicollinearity. Education is expected to influence health and the relationship is apparently quite strong at the macro level. Hence, the schooling variable was excluded in the remaining specifications of the model.

The 2SLS estimates are reported in column 3. The effect of log LEB is positive but the coefficient is significant only at the 10% level. The last specification includes two demographic variables-ratio of working age over total population and its growth rate over the decade. The effect of working age over total population is positive and statistically significant at the 5% level. An increase in the share of working age population increases the potential labour force which in turn increases the growth rate. However, the growth in the share of working age over total population is negative and not statistically significant.

The IV estimates of the effect of income on health are reported in **Table 3**. The estimates, given in column 1, show that both log per capita income and per capita health expenditure have a positive and statistically significant effect on LEB, as expected. A 10% increase in per capita income would increase the LEB by about 2% while a thousand rupee increase in per capita health expenditure would lead to 1.3% increase in LEB. Next, the average number of years of schooling is added in the specification and the results reported in column 2 reveal that a substantial effect of per capita income and health expenditure is taken away by the schooling variable. Its effect is positive and highly significant (at the 1% level or better). The next specification (column 3) includes the percentage of votes gained by the socialist and communist parties in the Assembly elections. The effect of the political factor variable is positive but not significant. The other measure of the political variable, namely the per cent of Assembly seats won by the

Table 2

The effect of health on economic growth in India, 1970-2000

Dependent variable: Growth rate in per capita NSDP over the decade

Explanatory variable	OLS 1	OLS 2	2SLS 3	2SLS 4
Log initial per capita NSDP	1.534	1.519	1.419	2.875
	(1.58)	(1.53)	(1.27)	(2.63)
Log initial LEB	5.567	5.172	5.990	-1.801
	(2.23)	(1.29)	(1.86)	(0.43)
Initial average years of schooling		0.463		
		(0.13)		
Log initial working age over total population				14.162
				(2.47)
Growth of working age over total population				-9.837
				(1.37)
Constant	-33.223	-31.659	-33.690	-5.880
Adjusted R2	0.346	0.329	0.377	0.304
Number of States	14	14	14	14
Number of observations	42	42	42	42

NSDP: net State domestic product; LEB: life expectancy at birth; OLS: Ordinary least squares; 2SLS: two-stage least squares.
Note: 't' values are given in parentheses
Source: Authors' calculation

Table 3

The instrumental variable (IV) estimates of the effect of per capita income and health expenditure on LEB, India, 1970-2000

Dependent variable: Log of life expectancy at birth (LEB)

Explanatory variable	1	2	3
Log per capita NSDP*	0.174	0.078	0.820
	(3.01)	(1.85)	(1.77)
Per capita health expenditure (in thousands)	1.265	0.156	0.179
	(2.35)	(0.39)	(0.42)
Average years of schooling		0.069	0.0671
		(6.74)	(5.17)
Average percentage of votes secured by socialist and communist parties in the Assembly election			0.000170
			(0.21)
Constant	2.480	3.123	3.092
Adjusted R2	0.521	0.776	0.770
Number of observations	42	42	42

NSDP: net State domestic product
Note: 't' values are given in parentheses
* Instrumented using lagged values of per capital NSDP
Source: Authors' calculation

ruling party at the Centre, also had a positive effect on LEB but the effect was not statistically significant.

Panel data estimates of the aggregate Cobb–Douglas production function

The effect of health on output at the State level is examined by estimating a production function as specified in equations (4-6). Output is measured by the real NSDP. To overcome the problem of measurement errors and year to year fluctuations in NSDP, predicted rather than actual values of NSDP are used. The NSDP for a particular year is predicted using its lagged values. Two conventional inputs-capital and labour-are used in the production functions. At the State level, there is no information on capital stock or investment, even though data on these two variables are available at the national level over a period of time. In this study, we use the value of fixed capital net of depreciation for the manufacturing sector to capture the capital input. The capital stock should include public sector investment as well as private investment in other sectors also. In the absence of such comprehensive data, the capital measure used in this study captures only the partial and not the full effect of capital on aggregate output. The labour input refers to the total number of workers including main and marginal workers. The measure of health-LEB-and average years of schooling are as defined in the previous section. Potential experience and its squared term were also computed and included but due to the small variation in these variables and high collinearity between the two variables, the parameter estimates turned out to be imprecise and hence were dropped from the final analysis. The input variables-log capital, log labour and log LEB-are instrumented using their lagged variables as in Bloom, Canning and Sevilla (2004). As there is high correlation between the two human capital variables of LEB and schooling, all the models are estimated with and without the schooling variable.

The OLS and IV estimates of the aggregate production function (4), based on the assumption that the technology is constant over time and across States, are reported in **Table 4**. The OLS and IV results reported in columns 1 and 3 indicate that the conventional inputs-labour and capital-and health (LEB) exert a positive and statistically significant effect (1% level) on output. The magnitude of the coefficient of LEB is high, which is puzzling. The average number of years of schooling is included in specification 2. The effect of the schooling variable is positive and statistically significant at the 1% level. However, once the schooling variable is included, the effect of LEB on output became statistically insignificant, which is due to the high correlation between the two variables as discussed above. The coefficient estimates from the OLS and IV methods are similar in sign but the standard errors of the coefficients are somewhat higher in the case of IV estimates.

The estimates of the fixed effects model under the assumptions made in equations (5) and (6) are reported in **Table 5**. The Hausman specification test statistic suggests that the error terms are correlated with the inputs and thus the null hypothesis that the random effects model is appropriate stands rejected.

Table 4

Estimates of the aggregate production function, India, 1970-2000
Dependent variable: Log (NSDP)

Inputs	OLS (levels) 1	OLS (levels) 2	IV (levels) 1	IV (levels) 2
Log Labour	0.461	0.475	0.678	0.686
	(7.15)	(7.74)	(10.86)	(11.11)
Log Capital	0.414	0.384	0.355	0.341
	(7.58)	(7.23)	(5.66)	(5.46)
Log LEB	1.134	0.163	1.960	1.250
	(4.51)	(0.37)	(5.74)	(2.27)
Years of schooling		0.105		0.0718
		(2.60)		(1.64)
Constant	-7.639	-3.905	-13.793	-11.064
R2	0.934	0.941	0.909	0.915
F statistics	244.00	204.89	180.48	140.40
Number of States	14	14	14	14
Number of observations	56	56	56	56

NSDP: net State domestic product; OLS: Ordinary least square; IV: instrumental variable; LEB: Life expectancy at birth
Note: 't' values are given in parentheses.
The input variables (log labour, log capital and log LEB) in IV (levels) columns are instrumented using lagged values of their values.
Source: Authors' calculation

We begin the discussion with specification 1. The effect of the changes in the two conventional inputs-labour and capital-and LEB on the change in output is positive and statistically significant (1% level) on output. The results suggest that a 1% improvement in LEB would result in a 1%-2% increase in output. The effect of health on output is much higher than the effect of the two conventional inputs. Specification 2 includes the average years of schooling along with health and other conventional inputs. Schooling exerts a positive and statistically significant effect at the 10% level. Both the magnitude and significance of the health effect on output are reduced due to inclusion of the education variable.

Economic growth, poverty and health: Theory and empirical evidence

Poverty is a measure of income that indicates inadequate command over material resources. The level of poverty in a country or region depends upon the level of income as well as its distribution. Any policies or programmes which alter the distribution of income would affect poverty. In a country or State with a large income inequality there would be a relatively large number of poor people or people with a low income (below a fixed poverty line), even if the country/State has a high per capita income. A higher rate of economic growth would reduce poverty if growth affects the distribution of income in ways that pulls up the bottom tail of the distribution. Countries that pursue a growth-oriented strategy firmly believe that

Table 5

Estimates of the aggregate production function, India, 1970-2000

Dependent variable: Log (NSDP)

Inputs	Fixed effects (States) 1	Fixed effects (States) 2	Fixed effects (time) 1	Fixed effects (time) 2
Log labour	0.910	0.787	0.607	0.612
	(6.82)	(5.41)	(8.24)	(8.46)
Log capital	0.318	0.202	0.451	0.405
	(4.91)	(2.27)	(4.78)	(4.21)
Log LEB	1.510	1.026	1.817	0.870
	(2.71)	(1.70)	(3.73)	(1.19)
Years of schooling		0.154		0.079
		(1.84)		(1.72)
Constant	-15.317	-10.992	-13.344	-9.248
R2	0.883	0.905	0.910	0.916
F statistics	197.91	158.52	85.37	67.35
Chi-square (p value)	3.05	3.80	3.23	3.71
(fixed vs. random effects)	(0.38)	(0.43)	(0.36)	(0.45)
Number of States	14	14	14	14
Number of observations	56	56	56	56

NSDP: net State domestic product; LEB: life expectancy at birth
Notes: 't' values are given in parentheses.
The inputs variables (log labour, log capital and log LEB) are instrumented using lagged values of their values.
Source: Authors' calculation

growth will have its trickle-down effects that will help reduce poverty.

Bourguignon (2004) argues that while rapid elimination of poverty (absolute poverty) is a meaningful development goal, attainment of the goal also requires that the growth strategy be combined with distribution measures that are country-specific. Poverty reduction at a given point in time in a country is fully determined by the rate of growth of mean income and changes in income distribution in the population. A change in income distribution can be decomposed into a 'growth effect' (the effect of a proportional change in all incomes with the distribution of relative income remaining unchanged) and a 'distributional effect' (change in relative incomes). He also points out that there is a case for strong interdependence between growth and distribution. What do empirical verifications suggest? The studies reviewed in Bourguignon (2004) point to ambiguous and contradictory results. Cross-sectional studies have come out with the finding that countries with more inequality in income distribution have experienced sluggish growth. But when country specific (regions) effects were controlled for, the inequality effect turned insignificant. Decadal country data, on the other hand, found a positive relationship between growth and inequality.

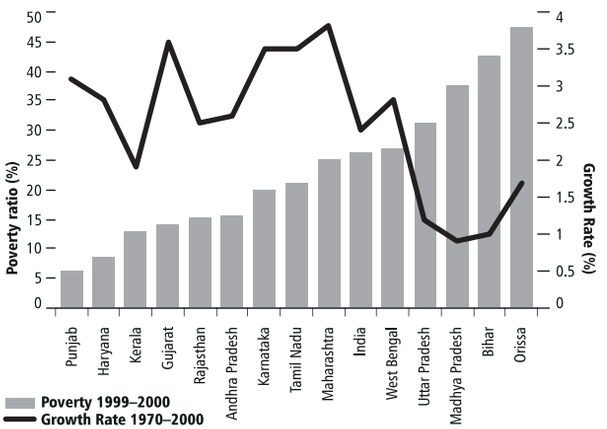
On the poverty-health link, some argue that poverty can cause poor health while others maintain that low income and poor health are caused by some common factor such as genetic endowments or education. Poverty can have an adverse impact on health because of malnutrition and also due to poor sanitation, unsafe drinking water supply, etc. Much of the disease burden in developing countries is due to the intake of an inadequate diet. Since expenditure on food forms a major portion of the budget of the poor, eradicating poverty could be instrumental in reducing malnutrition and the resulting ill health (Wagstaff 2001).

The association among growth rate of PCNSDP, level of per capita income and poverty is first examined using data pertaining to 14 major States over a period of 30 years (1970/71-1999/2000). The relationship between long-run growth of per capita income and level of poverty is shown in **Fig. 6.** The poverty level is above the all-India average in the BIMARU States (with the exception of Rajasthan), Orissa and West Bengal. It is interesting to note that States which experienced higher levels of growth over the thirty-year period witnessed a lower level of poverty except Kerala. Similarly, in States where the long-run growth rate is lower, the current level of poverty is higher. A notable exception here is West Bengal. It is worth mentioning that the two 'exception' States have many similarities, particularly in respect of political ideology and policy decisions. The growth-poverty link seems to suggest that rapid growth of per capita income may be required for States to achieve poverty reduction. Such growth would be able to generate productive employment and thus increase per capita incomes.

The simple association between per capita income and poverty across the States over a period of time is displayed in **Fig. 7.** As one may expect, increase in per capita income and the percentage of population living below the poverty line are negatively related and the decline in poverty is sharp, especially at lower levels of per capita income. Possibly the growth in income in the past three decades has had the desirable trickle-down effect.

Fig 6

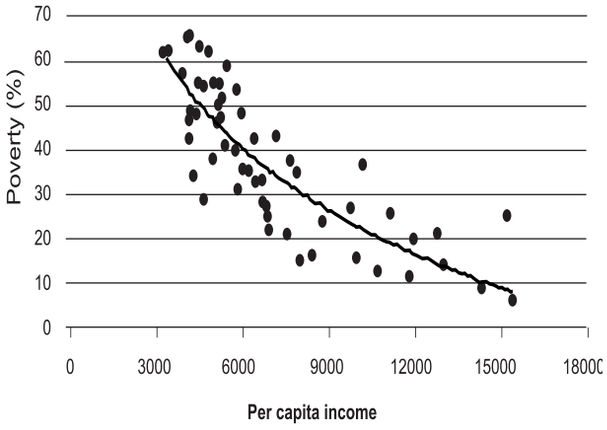
Growth rate and poverty by States, India



Next, we turn to the association between poverty for the periods 1972/73, 1983, 1993/94 and 1999/2000, and five-year average life expectancy corresponding to the above years at the national level. As shown in **Fig. 8**, the percentage of

Fig 7

Per capita income-poverty association, panel data, 1970-71 to 1999-2000



population living below the poverty line has considerably declined over the period and there is a negative relationship between poverty and LEB, which shows a small increase during the period.

The scatter plot in **Fig. 9**, constructed using State-level information on poverty and LEB clearly points to the inverse relationship between the two variables. An important question in this context is whether poverty is the cause or consequence of poor health status. Both may be interdependent.

Conclusion and policy suggestions

This study examines the determinants of economic growth and health using a panel data of 14 major Indian States for the period 1970/71-2000/01. The association between initial per capita income, growth rate, and health across the Indian States has been explored using scatter plots and charts. The interesting findings are as follows:

- A strong positive association is observed between initial per capita income and long-run economic growth in per capita income across the States. That is, States with a higher initial income have grown faster than States with a lower initial income. This has the effect of widening the gap between the rich and poor States.
- There is also a strong association between per capita income and health status (LEB and IMR) of the population.

The nexus between growth, poverty and health based on cross-sectional data of Indian States over a period of time point to the following:

- States that have experienced higher (lower) levels of growth over the thirty-year period witnessed a lower (higher) level of poverty, except Kerala and West Bengal.
- Per capita income and the percentage of the population living below the poverty line are negatively related; possibly the growth in income in the past three decades has had the desirable trickle-down effect.
- There is an inverse relationship between poverty and LEB.

The descriptive analysis indicates only associations between the variables and it is not possible to infer any cause-effect or simultaneous relationships among them. We have formulated an econometric framework based on the recent developments in growth theory and this is applied to inter-State panel data for the years 1970-71, 1980-81, 1990-91 and 2000-01. The following important findings emerge from our econometric analysis:

- There is a two-way causation between economic growth and health status. The effect of health measured by life expectancy is positive and significant on economic growth even after controlling for initial income levels.
- There is evidence of a significant effect of per capita income and per capita public expenditure on health on LEB. Average number of years of schooling emerges as the most sig-

Fig 8

Trends in poverty and life expectancy at birth, India 1972/73-1999/2000

LEB: life expectancy at birth

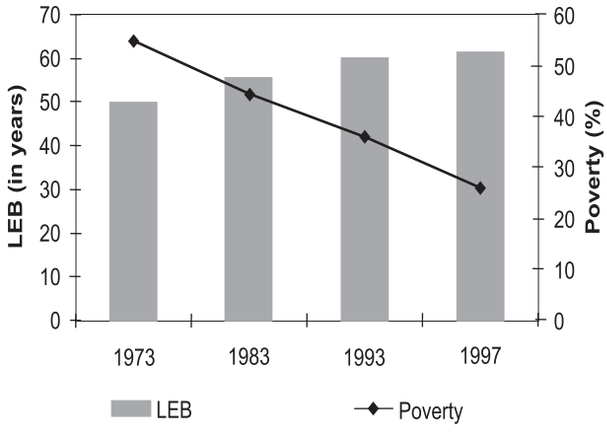
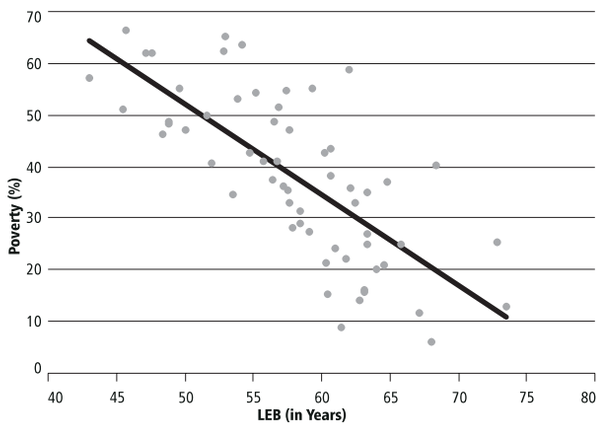


Fig 9

Health-poverty nexus, India, panel data, 1970-71 to 1999-2000

LEB: life expectancy at birth



nificant determinant of LEB.

- Our analysis shows that a thousand rupee increase in per capita health expenditure would lead to a 1.3% increase in LEB, while a 10% increase in per capita income is required to increase the LEB by about 2%.
- The production function estimates indicate that the effect of health (LEB) on NSDP is very high, in fact, much higher than the effect of the conventional inputs of capital and labour.

The following policy suggestions are made based on the empirical findings of our study:

- Increasing investment in health is a required policy intervention for accelerating the economy's growth rate.
- Growth-oriented policies would result in bringing about improvements in the health status of the population.
- Policies promoting growth would also have the desirable effect of reducing poverty. Overall, there is a compelling reason for stepping up both public and private investment in health which would pay off in the long run.

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