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Economic Growth, Health and Poverty: An Exploratory Study for India

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This article analyses the possible links between economic growth, poverty and health, using panel data for the Indian states. The findings indicate that, though growth tends to reduce poverty, significant improvements in health status are also necessary for poverty to decrease. Also, economic growth and health status are positively correlated and have a two-way relationship, suggesting that better health enhances growth by improving productivity, and higher growth allows better human capital formation. Health expenditure is an important determinant of both higher growth and better health status, and is therefore a key tool available to policy-makers. Among other exogenous variables, literacy and industrialisation seem to improve both health outcomes and growth, and to reduce poverty.

1 Introduction

The nexus between poverty and health is an area that has attracted considerable attention from social scientists and economists. A series of research studies based on the World Bank's Living Standard Measurement Surveys have indicated the close links between economic status and poverty, on the one hand, and a whole host of well-being indicators on the other, including education and health (see for example, Behrman, 1990; Glewwe and Twum-Baah, 1991; Strauss, 1988; Thomas, 1991; Ravallion, 1991). The links between economic growth and health, however, have received relatively less attention, partly because of the difficulty in separating cause and effect, and partly because such analyses require much longer-term time series data that are not easily available. However, health economists study the links between health and poverty, and between poverty and growth, from the perspective of the links between the microeconomic and macroeconomic aspects of health. Below, we present a brief theoretical framework of these links based on standard health economics (Zweifel and Breyer, 1997).

At the individual level, there is a complex relationship between 'health' (H), other non-health consumption (C), consumption goods (X) and the amount spent on medical care (M). The relationship between H and C is like that of any two economic goods, with a certain marginal rate of substitution of one for the other; here the individual weighs health against all other aims. Secondly, total income Y (i.e. budget) can be spent on either X or M, but, unlike in the case of other goods, Y itself depends on health, H. This is because the ability to earn income is a function of how healthy an individual is. Finally, H itself is a function of the amount devoted to health care, M. The final

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outcome or the equilibrium C*, H* and M* would depend on the optimisation results, but the important point to note is the interdependence of these variables in the optimisation process.

The same variables, if aggregated, will lead to macroeconomic results. The problem is that one does not observe H and C, only X and M. Thus, it is difficult to estimate the equilibrium levels of health expenditure and consumption expenditure (values of aggregate M and X) spent out of GNP (aggregate Y) that would maximise an underlying social welfare function. However, there has been some discussion around the optimal level of health expenditure in a country; for developed countries the concern is cost containment, whereas for developing countries the issue is much more related to gains in health and well-being.

The three issues of importance in the context of developing countries are the following. (i) Do increases in health expenditure necessarily result in improvements in health indicators? (ii) What effects will improvements in health indicators have on investment and therefore growth? And (iii) what are the links between poverty, on the one hand, and growth and health status, on the other?

To take the last question first: where does poverty fit into all this? There is enough evidence now that indicates that poor standards of living go hand in hand with poor health indicators in general. As the 1993 *World Development Report* indicated, the magnitude of poverty is an especially important reason for differences in health status (World Bank, 1993). Thus, for example, poorer regions or households would show higher infant mortality rates and lower life expectancy, as well as higher morbidity rates. To compensate for high infant and child mortality rates, fertility rates go up, reducing investment per child in terms of education and health, which results in poor human capital formation and deepening of the vicious circle of ill health and poverty.

Secondly, will improvements in health indicators make a significant difference to growth rates at the macro level? Finally, will improved health arise from greater investment in health goods (higher health expenditures) and therefore less investment in other goods, or will it in fact free up resources so that savings and investment will actually increase?

The article examines some of these issues using State-level data for India, and attempts to bring out the key factors that explain the nexus between health, poverty and growth. Panel data for 15 major States are used for the years 1970-71 to 1995. The organisation of the article is as follows. In the following section we present different arguments explaining the links among these variables. We then present the results from cross-sectional and time series (State-wise) analysis of trends in growth, health indicators and poverty. This is followed by econometric analysis explaining these observed trends and plausible explanations for these. Finally, we summarise the major findings and their policy implications.

2 Growth, poverty and health: a framework

As the preceding discussion has indicated, the links between these three variables are many and often circuitous. The literature on growth and poverty is rich and varied, and has shaped policy-making in India significantly over the last three decades. The impact of economic growth on poverty has been a matter of interest for a long time. In the Indian context, when Ahluwalia (1978) demonstrated the effects of agricultural growth

trickling down to benefit the rural poor, critics argued that higher agricultural yields as well as lower incidence of rural poverty were the outcomes of a good monsoon. In fact, some others like Saith (1981) and Gahia (1989) argued that price fluctuations had more impact on rural poverty. Jain and Tendulkar (1990) examined the relative strengths of growth and redistribution in changing the headcount ratio of poverty over the period 1970-71 to 1983. Mitra (1992) showed that the impact of industrial growth on urban poverty was only nominal, which was reconfirmed by Ravallion and Datt (1996) in the case of rural as well as urban areas. Overall, the debate around growth and poverty seems to have arrived at a consensus that growth is necessary, but not sufficient, for poverty alleviation. For example, Minujin, Vandemoortele and Delamonica (2002) bring out the links, based on international data, between growth, monetary poverty and child poverty, and present evidence on the relevance of non-monetary dimensions of poverty and the need for special attention to different aspects of child poverty, as growth alone cannot ensure reduction in poverty.

The concept of pro-poor growth, however, is different from the trickle-down theory of growth. Growth is said to be pro-poor 'when it is labour absorbing and accompanied by policies and programs that mitigate inequalities and facilitate income and employment generation for the poor, particularly women and other traditionally excluded groups' (ADB, 1999). It is defined as what enables the poor actively and directly to participate in and significantly benefit from economic activity (Kakwani and Pernia, 2000). Chen and Ravallion (2000), for instance, have argued that persistent poverty in many countries is the result of persistent inequalities – both economic and non-economic – that prevented the poor from participating in the growth that did occur. Hence, a strategy that is biased in favour of the poor to enable them to benefit proportionally more than the rich needs to be the basis of pro-poor growth. In other words, 'a pro-poor growth strategy entails the removal of institutional and policy induced biases against the poor, as well as adoption of direct pro-poor policies' (Kakwani and Pernia, 2000).

Moving on to the links between health, on the one hand, and poverty and growth, on the other, Over (1991) argues that poor health outcomes – manifested in high fertility, mortality and morbidity rates – affect both quality and quantity of labour, and reduce the number of hours worked, which affects national income adversely. Taking this argument further, ill-health of the population – if sustained over time – is bound to affect the rate of growth of national income. Poor growth, on the other hand, squeezes the resources of the government, forcing it to reduce its expenditure on education, health, food and other developmental fronts. This further exacerbates the vicious circle of ill-health and lower well-being.

It is generally understood that countries with better means and resources provide greater and higher-quality health and health-related services. But as Stark (1995) points out, causality can run in exactly the opposite direction, i.e. longer life expectancy translates into higher per capita income. His contention is that longer life expectancy encourages larger investments in human capital, which in turn accelerates per capita income. The explanation of larger investments in human capital due to longer life expectancy is offered by Stark (1995) in terms of an inter-generational transfer of assets. Earlier, Becker, Murphy and Tamura (1990) had argued that higher fertility behaviour raises the rate of discount in the inter-temporal utility function, thereby discouraging investment in human capital. Stark (1995), however, offers a slightly

different argument, saying that, holding fertility behaviour constant, changes in life expectancy account for changes in human capital investment. If life expectancy is high, children have to wait a longer period of time to receive familial assets, which they can use for productive purposes. This wait necessitates greater investment in human capital formation early in life to enhance earnings potential, as this is the only form of insurance against possible unemployment. Earnings are certain to be higher when assets are transferred to skilled labour rather than to bare labour. Hence, the growth performance of the economy is expected to improve with a rise in the health status of the population.

While the effect of income among other variables like education and medical inputs has been observed to have a positive impact on health indicators like mortality, the effects of improved health status on growth must necessarily be long-term in nature. For example, cross-sectional evidence from 65 countries indicated that child mortality falls faster in countries where per capita income is growing rapidly (World Bank, 1993). However, the links from improved health status to growth are unlikely to show up in cross-sectional data. This is because the positive impact of improved health status that may alter investment decisions at the household level would not be immediately apparent. These effects would take place only over a few generations, and would have to be sustained over a longer term for the effects to be felt on growth rates. For instance, better health outcomes in terms of longer life expectancy encourage entrepreneurs to make larger investments in the production sector. With shorter life expectancy, they have a tendency to invest in the financial market – which may not result in growth, but may in fact be inflationary – as the rate of return is much higher compared with the commodity-producing sector. From an individual point of view too, better health outcomes translate into greater risk-bearing capacity, which in the job market means upward occupational mobility of the worker over his/her lifespan. Also, the technical efficiency of various industries – an important source of growth – has been found to be positively associated with the social infrastructure endowment of the States (Mitra et al., 1998). None of these effects are, however, short-term; they are necessarily medium to long-term, indicating that the effects of health on growth can be gleaned only from long time series data, and a dynamic model may be more appropriate for this analysis.

3 Cross-sectional and time series patterns

Before turning to an econometric analysis of the relationship between poverty, health and growth, we attempt a look at discernible patterns that may exist in these variables across States and over time for each State.

The variables considered for this purpose are the percentage below the poverty line, the rate of growth of national state domestic product (NSDP) and two main indicators of health status – the infant mortality rate and life expectancy. A key policy variable – per capita health expenditure – was also looked at. Various sources were used for the data, and a list of these sources is given in the Appendix.

The choice of health indicators was made from among the following variables: the life expectancy rate, the infant mortality rate, the crude death and birth rates, and the morbidity rate. The morbidity rate – while being the best variable to describe the health of a population – is also the most difficult variable in terms of comparable data over the years. The previous section used this variable to analyse some broad trends. However, it

is often argued (Gumber and Chen, 1996) that this is widely underestimated and not comparable either across time or across States. Furthermore, to get the correct definition of the morbidity rate, one would have to get the denominator correct, which is the total population susceptible to a particular disease or to all those conditions defined as morbid. Unfortunately, this cannot be done for India. A surrogate morbidity rate – which is those who suffer from communicable diseases in the total population – can be used. However, since this is an imperfect variable, we are not going to use it in the analysis.

Of the other four indicators of health status, the birth and death rates are more reflective of the demographic changes taking place in the economy, and have more to do with population policy. The life expectancy and the infant mortality rates are better indicators of the health status of the population and are influenced by changes in health policy, broadly defined to include investment in health and health services. In sum, long-term improvements in the health status of populations are best reflected in infant mortality and life expectancy rates. These are also indicators that are widely used internationally to indicate improvements in health status (see, for example, Planning Commission, 2002).[1]

Two sets of exercises have been attempted: inter-State cross-sectional analysis for selected years, and time series analysis in each of the States. The years considered are 1973-4, 1977-8, 1983-4, 1987-8, 1993-4 and 1999-2000. The reasons for selecting these years had to do with the availability of poverty estimates. Each of the two health indicators is plotted against the incidence of poverty, net State domestic product (NSDP) growth and per capita health expenditures.

What kind of associations do we see from the cross-sectional evidence? While there were considerable year-to-year fluctuations, the associations between poverty and the health indicators seem to be in the expected direction. Table 1 presents a summary of the nature of the relationship between several indicators. Life expectancy (LE) did best in terms of its association with poverty in the right direction. The infant mortality rate (IMR) shows only mild positive associations with the incidence of poverty, apart from one year. From these cross-sectional patterns, it does seem that poverty and the health indicators considered here do move together as one would expect.

What about poverty and growth rates? Plots based on cross-sectional data point to only a mildly negative association of poverty with the five-yearly average rates of growth per annum for some of the years such as 1977-8, 1983 and 1993-4. As for growth rates and health indicators, not surprisingly the various years mostly show no associations, especially in the middle years (1983 and 1987-8). However, growth of net State domestic product (NSDP) and life expectancy does not show any relationship except for 1977-8, when it happens to be positive. Higher growth is associated with lower IMR only in certain years, as can be seen from Table 1.

The relation between per capita health expenditure and the growth rate is mildly positive and that between expenditure and health indicators ambivalent, though for certain years IMR seems to decline across states with higher per capita health expenditure. The incidence of poverty also seems to fall with a rise in per capita health expenditure.

1. In the subsequent analysis, we did consider crude birth and death rates as well as morbidity rates as indicators of health status, and retained only IMR and life expectancy.

Table 1: Pair-wise associations between health, poverty, and health expenditure for the period 1973-4 to 1993-4

Pairs of variables	1973-4	1977-8	1983	1987-8	1993-4
Poverty and health					
Poverty and IMR	Mild positive	Mild positive	Mild positive	Mild positive	Positive
Poverty and life expectancy	Negative	Negative	Negative	Negative	Negative
Poverty and per capita health expenditure	Negative	Negative	Negative	Negative	Negative
Poverty and growth					
Poverty and manufacturing growth rate	Mild positive	No			
Poverty and NSDP	Mild negative	Mild negative	Mild negative	Mild negative	Mild negative
Health and health expenditure					
IMR and per capita health expenditure	Mild negative	Mild negative	Mild negative	Mild negative	Mild negative
Morbidity rate and per capital health expenditure	No	Mild negative	No	Mild negative	No

To analyse whether each State showed some trends over time in these variables, we looked at the same variables plotted against time. The trends gleaned from the graphs (not presented here) indicate that, while health indicators were improving in almost every State, growth rates revealed considerable fluctuations, thus showing no distinct trend over time. Since yearly growth rates were unlikely to have any significant associations with these variables, we used five-yearly averages of growth rates. The picture that emerged was somewhat clearer but not overwhelmingly so.

The strongest association was that between poverty and IMR, both sloping downward in most of the States. Also, with declining poverty, life expectancy improved in most of the States. Another improvement over the cross-section picture was of growth and health indicators, especially IMR. With 5-yearly averages, more States showed an association in the right direction, i.e. IMR was lower when growth was higher. It is interesting to note that in Bihar IMR moved in the same direction as growth. This is mainly because the growth rate appears to taper off over time, while the health outcomes in terms of the indicators mentioned above improved in this State. Growth and life expectancy also do not show any relationship in Bihar.

Growth and per capita health expenditure reveal a positive association, except in Bihar, Rajasthan, Tamil Nadu and West Bengal. Growth and poverty seem to have moved together in the right direction – poverty falling in many States when the rate of growth of NSDP picked up, the exceptions being Assam and Bihar.

On the whole, both inter-State cross-section data and time series data for individual States are indicative of certain definite relationships among growth, poverty and health indicators, though the degree of association may vary largely from State to State or from year to year. Our objective is to delineate these relationships in terms of a

more rigorous framework, which we attempt in the next section with econometric modelling.

4 Models of health, poverty and growth: econometric analysis

While the brief theoretical framework in the first section was useful as a reference point for a general equilibrium model linking health, poverty and economic growth, it still does not offer very good directions for testing the various causalities empirically. The analysis was done using three alternative frameworks. The first considers economic growth, poverty and health in a simultaneous framework, suggesting that they influence each other. Though we expect economic growth to reduce poverty, the possibility of a positive association between the two cannot be ruled out if the immiserisation thesis is to be believed. Similarly poverty can also remain unaffected by growth if the latter benefits only those located in the higher echelons of the socio-economic ladder. The effect of poverty on growth can be justified on the grounds that poor human capital formation results in sluggish productivity growth, which gets translated into sluggish economic growth. Similarly, poor health outcomes reduce the ability to work productively, and thus restrain growth; better health outcomes contribute to stepping up growth – for example, one major explanation can be offered à la Stark (1995), as mentioned above. Higher growth generates a greater volume of resources to be spent on developmental and welfare-related activities, including health. On the other hand, health and poverty can be viewed as two sides of the same coin: poor nutritional status results in poor health outcomes and poor health reduces earnings and, therefore, consumption expenditure, on the basis of which poverty is measured.

The other alternative is to test a model where growth is essentially determined by a set of exogenous variables, which is the common approach taken by macro economists. Poverty, however, is a function of growth among other variables, and finally health status is a function of poverty and other exogenous variables. In this recursive model the feedback effect of poverty or health on growth is not allowed for. Secondly, the impact of poor health status on the ability to earn and thus on consumption poverty is also not delineated. The causation runs from poverty to health: poverty manifested in poor nutritional status and thus resulting in poor health outcomes.

In the third variant of the model, growth and health are taken to influence each other and poverty is taken to be a function of both growth and health. This variant is intuitively more appealing, since the two-way causation seems to be the most realistic representation. This variant suggests that poor growth leaves fewer resources to be allocated for welfare-oriented programmes encompassing health, and poor health outcomes restrict the productive utilisation of labour, resulting in sluggish economic growth. Both poor growth and health status then inflate poverty, as they slacken employment opportunities and the ability to earn respectively. In assessing the impact of health status on wages, Duraisamy and Sathiyavan (1998) pointed out that a 10% increase in body mass index increases the daily wage rate of males by 7 per cent and of females by 2%.

All these models were estimated using the time series and cross-section pooled data. It was also assumed that the variations are affected by State-specific unobserved fixed effects. This is a realistic assumption, because there are other cultural, political

and social factors that are at work and that cannot be measured easily, which in turn make States different from one another. The standard issue of choice between fixed and random effect estimates is resolved to a considerable extent by doing the Hausman test, which is indicated on the last row of the table of results. Two different indices of growth have been considered: one relates to the five-yearly average rate of growth of state domestic product (GROW) and the other is per capita state domestic product (PSDP). Since poverty incidence and health outcomes like the infant mortality rate are point estimates, the first proxy for growth (GROW), which is measured over time, may not be appropriate for studying the inter-relationship. However, the models have been estimated using both the proxies, hence for each variant we have estimated two sets of equations. We have presented results only from the third variant, as this one seems to be a more logical model, and also because the other two do not yield results in addition to the findings of the third variant.

In this variant, both growth and health are said to influence each other. Better performance of the economy leaves greater resources to be spent on welfare activities including health, and better health status improves productivity, and hence economic growth. Finally, poverty is taken to be a function of growth and health status. In the growth equation the variables considered are infant mortality rate (IMR), urbanisation (URBN), infrastructure (INF), industrialisation (IND), and literacy (LIT).[2] On the other hand, IMR is likely to vary with both GROW and per capita health expenditure (PCHE). Literacy has also been included in an alternative specification when GROW is replaced by PSDP.

Finally IMR, GROW and expenditure on poverty (EXPPOV) are taken to have an impact on poverty (POV). In an alternative specification, only IMR and EXPPOV influence poverty, i.e. the effect of growth on poverty is perceived through health outcomes.

To estimate the structural equations, endogenous variables on the right-hand side are replaced by their predicted values obtained from the reduced form equations. Among the exogenous variables, urbanisation and literacy are seen to influence growth positively. The initial value of State domestic product taken in log form is negatively related to the growth rate, suggesting that with a higher initial level of income the growth rate declines; hence the convergence holds. Growth estimated in the form of PSDP is also seen to have the positive effects of industrialisation in addition to urbanisation and literacy. The results are presented in Table 2.

Health status (IMR) has the expected effect on growth. Though the coefficient of IMR is significant only at 20% level in the equation for GROW, it turns out to be highly significant when GROW is replaced by PSDP. PCHE improves the health outcome, and the impact of economic growth on IMR is important to note. As the economy grows richer, health status improves considerably. On the other hand, expenditure on anti-poverty programmes reduces poverty. Though both growth and health status influence poverty, poverty and health seem to be more closely related than growth and poverty.

2. Urbanisations is defined as the percentage of population residing in urban areas; literacy is the percentage literate in the population; infrastructure is the percentage of State domestic product originating from transport, storage and communication; industrialisation is the percentage of State domestic product originating from registered manufacturing.

Hence, for poverty reduction to be attained more emphasis needs to be given to health outcomes than to growth.

Table 2: Estimates of structural form model[3]

	Endogenous variables					
Explanatory variables	GROW	POV	IMR	PSDP	POV	IMR
GROW		-0.73 (-1.62)***	-6.59 (-5.36)*			
PSDP						-0.05 (-2.39)*
POV						
IMR	-0.145 (1.57)***	0.18 (3.52)		-2.70 (-2.81)*	0.04 (2.83)	
INSDP	-15.24 (-2.38)*					
URBN	0.46			26.97 (3.44)*		
EXPPOV		-0.0003 (-3.09)*			-0.0005 (-5.51)*	
LIT	0.21 (1.89)**			17.73 (3.14)*		0.14 (0.2)
INF	0.28 (1.05)			-41.31 (-1.45)***		
IND	0.04 (0.28)			22.99 (1.84)**		
PCHE			-2.20 (-3.74)*			-1.30 (-2.41)*
INTER	373.62 (2.26)*	28.82 (4.58)*	185.55 (10.42)*	559.48 (1.81)**		225.96 (15.18)*
Observations	74	74	74	74	74	74
$R^{2(within)}$	0.65	0.76	0.57	0.41	0.41	0.67
$R2^{(between)}$	0.43	0.03	0.13	0.66	0.002	0.04
Model	FE	FE	FE	RE	RE	FE

Notes: * significant at 5% level; ** significant at 10% level, *** significant at 20% level. The equations for growth (GROW or PSDP) and IMR have been estimated first by applying the standard panel data estimation technique to their reduced form versions and then replacing their observed values by their estimated values on the right-hand side of the structural form equations and applying the standard panel data techniques. The equation for POV has been estimated using the estimated values of growth indicator (GROW or PSDP) and IMR generated from their reduced form versions and then applying the standard panel data techniques.

3. In this model, GROW/PSDP is a function of health, urbanisation, infrastructure, industrialisation and literacy. IMR in turn is a function of GROW/PSDP, literacy and per capita health expenditure. Finally, poverty is a function of IMR, GROW/PSDP and expenditure on poverty.

On the whole, as far as the endogenous variables are concerned, the results are suggestive of a nexus between growth and health outcomes – both interacting and improving each other. Poverty is related to both health and growth; however, the t-ratio corresponding to IMR is highly significant, whereas that of GROW is significant only at the 20% level. Therefore, in the alternative specification, while estimating the equations by replacing GROW by PSDP, growth has not been included in the poverty equation. In other words, this variant states that the issue of poverty reduction can be addressed more effectively by improving the health status of the population rather than by accelerating growth.[4]

The elasticies given in Table 3 show that literacy accelerates the growth rate. It also reduces poverty and improves health status by causing a fall in IMR, the elasticity being around -0.5. Per capita health expenditure, on the other hand, shows a positive effect on health status, as IMR tends to fall by 0.59% with every 1% increase in PCHE. It also reduces poverty, but only marginally, and increases growth. Industrialisation is another variable which shows a promising effect on all the three endogenous variables: growth, IMR and poverty. Expenditure on anti-poverty programmes does not show any strong effect on poverty (-0.05).

Table 3: Elasticity based on reduced form estimates[5]

	Endogenous variables			
Exogenous variables	GROW	PSDP	POV	IMR
URBN	-0.43	0.34	-0.20	0.03
EXPPOV			-0.05	
LIT	2.46	0.51	-0.48	-0.54
INF	-0.09	-0.09	0.04	-0.05
IND	0.62	0.19	-0.03	-0.26
PCHE	0.036	0.09	-0.003	-0.58

4. From the first variant of the model (not reported here), the inter-dependence of growth and health was empirically verified. However, poverty did not seem to affect growth significantly. Some other results from this model indicate that industrialisation and literacy have positive impacts on growth. The net effect of industrialisation on health status is better than that on poverty. Per capita health expenditure improves both the standard of living and health, and also appears to raise growth, though marginally. That employment policy alone cannot take care of both the standard of living and the health condition of the population is reflected in the elasticity measures. This model indicates that policy measures need to be framed carefully so that they can serve both the objectives of poverty reduction and improvement in health status.
5. In the second variant of the model, growth affects poverty, which in turn impacts health status. Except urbanisation and infrastructure, other variables are significant in the equation for growth. Both industrialisation and literacy raise the growth rate of state domestic product. The base year value added reduces the growth rate, lending support to the convergence hypothesis. However, when the equation is estimated replacing growth by state domestic product, urbanisation also turned out to be significant along with industrialisation and literacy, indicating its positive contribution to economic growth. Growth, literacy and expenditure on anti-poverty programmes all seem to reduce poverty. IMR is seen to vary positively with poverty and inversely with per capita health expenditure.

5 Conclusion

Based on data for the 15 major States in India for the years 1973-4, 1977-8, 1983, 1987-8, 1993-4 and 1999-2000, the analysis has covered the 1970s, 1980s and 1990s. Cross-section plots were suggestive of mild associations among growth, poverty and health indicators in the direction that one would expect on an *a priori* basis, i.e., higher growth coincides with lower poverty and a better health status of the population. Time series data made the picture somewhat clearer, especially as far as the relationship between growth and health indicators – especially IMR – was concerned. With five-yearly averages, more States showed that, with higher growth, IMR declined. Other variables, like crude birth rate and crude death rate, also by and large tended to decline with improvements in growth, though in several States the negative association was only moderate. On the whole, both cross-section and time series data tended to suggest certain definite relationships among growth, poverty and health indicators.

These trends and associations were then tested, by controlling for other exogenous variables that could potentially influence each of these three variables. Though three different variants of the model were estimated econometrically – one suggesting that each of the endogenous variables influences the other two, the second demonstrating a causal connection running from growth to poverty to health (a recursive system) – it is the results from the third variant which have been reported here, as the other two do not add to the findings. The third variant is estimated by making growth and health, both of which affect poverty, interdependent on each other.

The results can be summarised in three points. Per capita health expenditure unambiguously and positively affects health status; i.e. higher per capita health expenditure improves health status. Also, the results seem to indicate that poverty declines in response to improved health status. Finally, growth and health status are positively linked and seem to have a two-way relationship. While in cross-sectional data higher per capita income may result in better health status, pooled cross-section and time series data must necessarily consider a two-way relationship between growth in income and health, as attempted here. The results indicate that higher growth leads to better health status, on the one hand, and better health status improves growth, on the other.

What do these results imply? Over the years it has been observed in India that, though poverty has declined to some extent, the health status of the population remained low. These results seem to indicate that further reduction in poverty is probably not possible without significant improvements in the health condition of the population. Secondly, health conditions can be improved by improved investment in health, among other determinants. Health sector investment needs to be made on a large scale, as a rise in health expenditure per capita yields both higher growth and better quality of life. At present India is among the group of countries that invest very little in health: India spends only 0.9% of its GDP on health, which translates into about Rs 165 per capita (World Bank, 2001). Most of these expenditures emanate from the States, and not the centre. The low or moderate value of the elasticity estimates probably arises from the fact that most of the States have a low level of per capita health expenditure.

Among some of the other determinants, literacy and industrialisation seem to improve both health outcome and growth, on the one hand, and to reduce poverty, on the other, as is evident from the elasticity estimates. These results are not surprising; the

role of education in improved heath status is a finding that has been time-tested. Educated labour develops an awareness to remain healthy, contributes to higher growth by enhancing technical efficiency, and at the same time experiences higher earnings owing to the rise in productivity, thus leading to a better standard of living.

Industrialisation also accelerates growth and improves the standard of living both by narrowing the size of the population below the poverty line and generating better health outcomes Higher productivity and higher earnings that are likely to result from industrialisation are possibly the driving force behind this. However, the low/moderate elasticity values may be attributed to the fact that many States have only a limited industrial spread.

What are the policy implications from these results? The main implication seems to be that improved health outcomes are necessary for improved rates of growth of income, especially over time. At the same time, higher growth enables the system to generate better health outcomes. Better health will also lead to lower poverty. Accompanied by improved investment in education and growth-promoting areas like industry, an increased investment in health might be a necessary condition for putting countries on a path of accelerated growth with better levels of living and health status.

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Appendix: Data sources

Reported cases due to communicable diseases include Diphtheria, Poliomyelitis, Tetanus, Whooping Cough, Measles, Enteric Fever, Viral Hepatitis, Dog bites/Rabies, Syphilis, Gonococcal infection, Tuberculosis. Figures have been taken from *Health Information of India* for the years onward from 1985, from different yearly volumes; for

the previous years, figures have been taken from *Health Statistics of India* (different yearly volumes). Morbidity is defined as the number of reported cases to total population (per '000).

Infant Mortality Rate, Crude Birth Rate, Crude Death Rate, Life Expectancy Rate: Figures have been taken from *Compendium of India's Fertility and Mortality Indicators 1971-1997.*

Figures for literacy rates have been taken from *Health Information of India, 1994*, and *Family Welfare Programme in India, 1992-93*.

Employment: usual status (principal and subsidiary) workers are taken from various rounds of NSS.

Poverty figures have been taken from *The Indian Journal of Labour Economics* 40 (1), Jan.-March 1997. For 1999-2000, the figures were obtained from *Times of India*.

Per capita health care expenditure in Rupees (in current prices), share of health care expenditure in total government expenditure (in current prices), share of medical and public health expenditure in total health care expenditure (in current prices), per capita health care expenditure in Rupees (constant prices): Figures have been taken from Reddy and Selvaraju, *Health Care Expenditure by Government, 1974-5 to 1990-1*.

Density, percentage of urban population to total population, sex ratio, schedule caste and schedule tribe population: figures have been taken from Population Censuses 1971, 1981 and 1991.

Figures on expenditure on poverty comprise expenditure on rural development and poverty alleviation programmes. These are plan outlays taken from various Annual Plans, Government of India. The list of programmes taken for various years is as follows:

a) 1974-5: Small Farmers Development Agencies, Tribal Development Agencies, Drought-Prone Area Programme, Pilot plus Intensive Rural Employment Projects.
b) 1977-8: Small Farmers Development Agencies, Drought-Prone Area Programme, Tribal Development Agencies, Hill Area Development Agencies, Pilot Programme of Integrated Rural Development, Desert Development Programme, Food for Work Programme, Rural Links Road Programme.
c) 1983-4: Integrated Rural Development Programme (IRDP), Training of Rural Youth for Self-Employment (TRYSEM), National Rural Employment Programme (NREP), Drought-Pone Area Programme, Desert Development Programme, Community Development and Land Reforms.
d) 1987-8: IRDP, TRYSEM, NREP, Rural Landless Employment Guarantee Programme, Jawahar Rojgar Yojana (JRY) Drought-Prone Area Programme, Development of Women and Children in Rural Areas (DWCRA), Community Development, Land Reforms Special Employment Programmes.
e) 1993-4: IRDP, TRYSEM, DWCRA, JRY, Drought-Prone Area Programme, Desert Development Programme,Land Reforms and Employment Assurance Schemes.