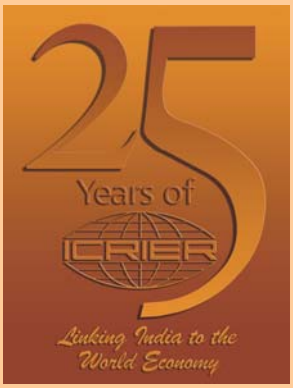

Working Paper No. 185

AN EXAMINATION OF THE RELATIONSHIP BETWEEN HEALTH AND ECONOMIC GROWTH

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INDIAN COUNCIL FOR RESEARCH ON INTERNATIONAL ECONOMIC RELATIONS

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ABSTRACT

This paper attempts to examine the relationship between health and economic growth. The rate of growth is measured using gross national income (GNI) and health status is measured using infant mortality rate, life expectancy rate and crude health rate. The above relationships are measured using a multivariate framework controlling for other background variables. Thus we have modelled the macroeconomic impact of health. A theoretical framework has been developed to model this linkage between health and growth and this is further tested using a regression model which tests the causality between these variables of interest. These models are tested using pooled data. We have also assumed in this analysis that these variables are affected by state-specific unobservable fixed effects, since there are other cultural, political and social factors at work here.

Key Words : Health, Economic Growth

JEL Classification : 112, C21, 040

FOREWORD

Good health is an asset that allows poor households to emerge from poverty. During the nineties, there has been a significant development in the conceptualization of the impact of changes in the health status of the population on demographic changes and long term economic performance. Health has been found to have strong linkages with individual welfare and overall economic development. Thus, policy attention should be directed to ensure equity in access to health services and also to improve the delivery of public health services. The paper deals with the channels through which health affects human capital and income generation and also examines the devastating effects of AIDS on populations. The study also discusses health and HIV prevention measures that need to be built in to development programmes.

As Indian industry faces increased competition it will be important to ensure that a skilled labour force does not suffer from low participation rates and low productivity due to a lack of awareness of prevention measures or poor access to needed health services. The paper contributes to this important emerging discussion in the country.

Rajiv Kumar
Director and Chief Executive
ICRIER

September 6, 2006

1 INTRODUCTION

It has been seen that economic growth and health status are interdependent and both affect poverty. It is our aim in this current analysis to examine this two-way relationship. We have further examined the growth variables, health status and income variables. These findings are validated by research in the public and private sectors. Better health will lead to better growth outcomes. The greatest challenge of the twenty-first century is to provide every human being on the planet with a long, healthy and fulfilling life, free of poverty and full of opportunities to participate in the activities of their community. The Millennium Development Goals—signed by 189 countries in 2000—set clear targets for reducing poverty and other causes of human deprivation and for promoting sustainable development. But how far are we from meeting these goals? And what are the resources needed to help those countries that are not on track?

2 LITERATURE REVIEW

In poor countries people are much less healthy than people living in rich countries. This analysis contributes to the growing body of literature on health and economic growth, health and economic development and the relationship between health and income inequality. This is important for evaluating policies aimed at improving health in developing countries and more generally to provide an explanation of why some countries are rich and some poor. There have been serious efforts to raise the level of health in developing countries by governments and international organizations. The aim of these policy initiatives is to reduce suffering and premature death among the affected population. According to a report by the WHO's Commission on Macroeconomics and Health:

Improving the health and longevity of the poor is an end to itself, a fundamental goal of economic development. But it is also a means to achieving the other development goals relating to poverty reduction. The linkages of health to poverty reduction and to long-term economic growth are powerful, much stronger than is generally understood. The burden of disease in some low-income regions, especially sub-Saharan Africa, stands as a stark barrier to economic growth and therefore must be addressed frontally and centrally in any comprehensive development strategy.

The present analysis examines the impact of poor health on income. We can use data on three of the most common causes of ill health in developing countries. The first is malnourishment or undernourishment. FAO defines undernourishment as 'food intake that is insufficient to meet dietary energy requirements continuously'. Thus we examine some of the determinants of health—that is, the relationships between health status and several socio-economic and health-system factors. A study by Weil (2005) uses microeconomic estimates of the effect of health on individual outcomes to construct macroeconomic estimates of the proximate effect of health on GDP per capita. In order to explain income differences between rich and poor countries Weil examines the role that

health differences play in productivity and also assesses how much would be the gain in income for poor countries as a result of an improvement in the health of the population.

There are various channels through which health affects productivity. It is argued by many studies that healthy people are better workers. They can work longer and harder and also think clearly. This is a direct channel by which health influences output. The other channel is the indirect effect of health on output. Improvements in health raise the incentive to acquire schooling. Healthy students have a lower rate of absenteeism and higher cognitive functioning, and thus receive a better education for a given level of schooling. Also, improvement in mortality levels could lead to people saving for retirement—thus raising the levels of investment and physical capital per worker.

A healthy person will be more productive than an unhealthy one, not only in paid work but also in the maintenance of a home and the raising of healthy children. The research points to a clear link between improvements in people's health and economic growth. This research compares the performance of different countries over time, using indicators such as mortality rates and gross domestic product. There has been more attention given to education levels than to health status. The trends in the 1990s and 1980s reveal that a clear relationship exists between a nation's burden of disease and its income. A key indicator of a population's health status is life expectancy, that is, the age to which a newborn baby can survive. Life expectancy at birth has increased sharply worldwide over the last few decades but in poorer countries the situation is as grim as ever. This can be attributed to the fact that in many of the world's poorest countries the burden of infectious diseases remains heavy. Recent studies have shown that life expectancy is a powerful predictor of income levels and of economic growth. A study by Ahuja and Jutting (2003) examines the design of incentives in community-based health insurance schemes. According to the study the best way of providing incentives depends very much on the context, that is, the characteristics of the target population and the health risk profile. The study states that 'Health security is increasingly being recognized as integral to any poverty reduction strategy'. The state has not been able to fulfil the health care needs of the poorer sections of its population. The shrinking budget support of health care services, inefficiency in public health provision, unacceptably low quality of public health services, and the recent imposition of user charges all indicate that the state is unable to meet the health care needs of the poor.

According to the World Development Report poor people in most countries have the worst health outcomes. They are pushed further into poverty due to ill health. They are also excluded from support networks that enhance the social and economic benefits of good health. Several authors have analysed data between 1965 and 1990 and have shown that the improvement in life expectancy was responsible for about 8 per cent of total growth. According to these studies there are three broad mechanisms responsible for this effect:

(i) improvements in productivity due to a healthy workforce and less absenteeism;

(ii) increased incentives to invest in human and physical capital as life expectancy increases; and

(iii) increase in savings rates as workers have an incentive to save for retirement.

According to the old neoclassical growth theories the lower the starting level of per capita gross domestic product (GDP) the higher is the predicted growth rate. The convergence property derives in the neoclassical model from the diminishing returns to capital. Economies that have less capital per worker tend to have higher rates of return and higher growth rate. Thus the production function needs human capital as well as the physical capital which enter as inputs. However, while schooling is often used as an input into human capital, health is not used in production function. The contribution of health to economic growth has been neglected compared to the importance given to education.

Thus this study aims to provide an understanding of the effects of health on economic growth. The population's overall health status is measured by life expectancy. The results are, however, similar to some alternative aggregate indicators of health such as the infant mortality rate, the mortality rate up to age five, or life expectancy at age five. Unlike education, health and nutrition outcomes of poor people are produced by households. And health and nutrition services contribute to human welfare such as protecting people from catastrophic health spending.

Another health indicator that is correlated with economic performance across countries is the total fertility rate, or birth rate. As a population's health improves more of the infants and young children are likely to survive. In the world's poorest countries the burden of infectious diseases and malnutrition remains heavy and falls disproportionately on children. A study by Cole and Neumayer (2005) shows how poor health can have adverse effects on total factor productivity. As stated by this study disease and poor health represent a great burden to affected individuals. Also the welfare losses of sickness are difficult to quantify but are significant especially in developing countries where social security provision and health care is absent. At a more aggregated level it seems likely that a high disease burden may have an adverse impact on a country's productivity, growth and, finally, economic development. The studies that attempt to explain cross-country differences in economic growth and productivity rates have suggested that education, trade openness, savings, inflation and the initial level of income are the key explanatory variables (Barro 1991; Barro and Sala-i-Martin 1995). There is sufficient evidence to suggest however that health is also an important determinant. While the burden of disease may be a function of poverty, a high disease burden is also likely to adversely affect a nation's development prospects.

In comparison to education, the impact of health on growth and productivity has not received the same attention. It is only in very recent times that a number of studies have started looking at health and tried to estimate the burden of disease. The Cole and Neumayer study, instead of focusing solely on life expectancy as the measure of health, also takes into account incidences of malaria, malnutrition and waterborne diseases. According to the study, these are the main diseases afflicting the population and should be taken into account while examining the effect of health on morbidity and mortality.

Malaria ranks among the major health and development challenges facing some of the poorest economies. There is also the HIV/AIDS epidemic which is now set to become one of the biggest killers of the next decades. If these diseases have a fatal effect then it will lower the amount of labour supplied by reducing the proportion of able-bodied people. In situations where the diseases have non-fatal consequences the affected population continues in the labour force but their productivity is severely impaired.

In a study by Schultz (2005) various household survey indicators of adult nutrition and health status are analysed as determinants of individual wages. However, survey indicators of health status may be heterogeneous, or a combination of health and human capital formed by investment behaviour and variations due to random shocks and measurement error which are uncontrolled by behaviour. This study examines the impact of health on total factor productivity using a measure of total factor productivity. According to this study some of the world's lowest life expectancies—less than 50 years—are experienced in those sub-Saharan African countries that typically also suffer from extremely low levels of per capita income and often negative economic growth rates. Although underdeveloped countries often lack the resources needed to invest in health care systems it also seems likely that poor health will itself retard growth and, hence, income. Developing countries would therefore appear to be in a vicious cycle resulting in persistent underdevelopment. However, the economic impact of diseases like malaria extends beyond the direct impact on labour productivity. A high malaria burden is likely to increase labour turnover resulting in increased hiring and training costs and reduced profitability for enterprises. Furthermore, a high malaria incidence within a particular area would reduce tourism, deter profitable foreign and domestic investment and prevent the use of land and other natural resources.

Lack of access to sanitation and, particularly, to safe drinking water is a strong determinant of waterborne diseases such as diarrhoea, amoebiasis, cholera, dysentery and typhoid fever. Despite significant effort, access to safe water and sanitation has not improved over the last two or three decades.

The data on different indicators of health also includes undernourishment. FAO defines undernourishment as 'food intake that is insufficient to meet dietary energy requirements continuously'—dietary energy requirements being 'the amount of dietary energy required by an individual to maintain body functions, health and normal activity'. This study examines the effect of health on total factor productivity.

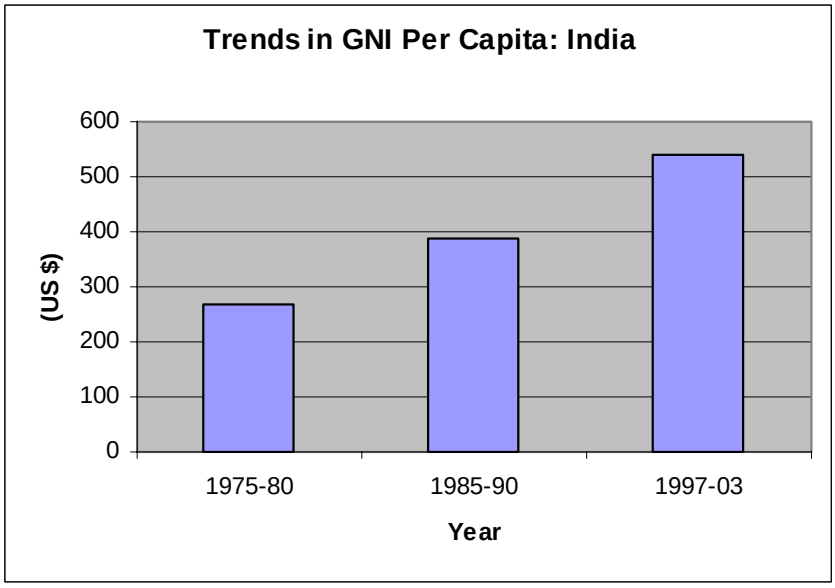
According to Bloom and Sevilla (2001) we use measures of life expectancy and infant mortality as the measures of health which affect gross domestic product. While identifying labour quality as a factor contributing significantly to human capital and, consequently, to economic growth, most studies stress on education instead of health. Thus this practice ignores the reasons for considering health to be a crucial aspect of human capital. While health measured by life expectancy has appeared in many cross-country regressions and found a positive and significant effect on the rate of economic growth this does not establish that health directly benefits growth. According to their results they show that a one-year improvement in a population's life expectancy

contributes to a 4 per cent increase in output. They have extended production function models of economic growth to account for two additional variables that microeconomists have identified as fundamental components of human capital: work experience and health. Thus they have shown that good health has a sizable, positive and significant effect on aggregate output.

3 DATA TRENDS IN DISEASES AND HEALTH INDICATORS

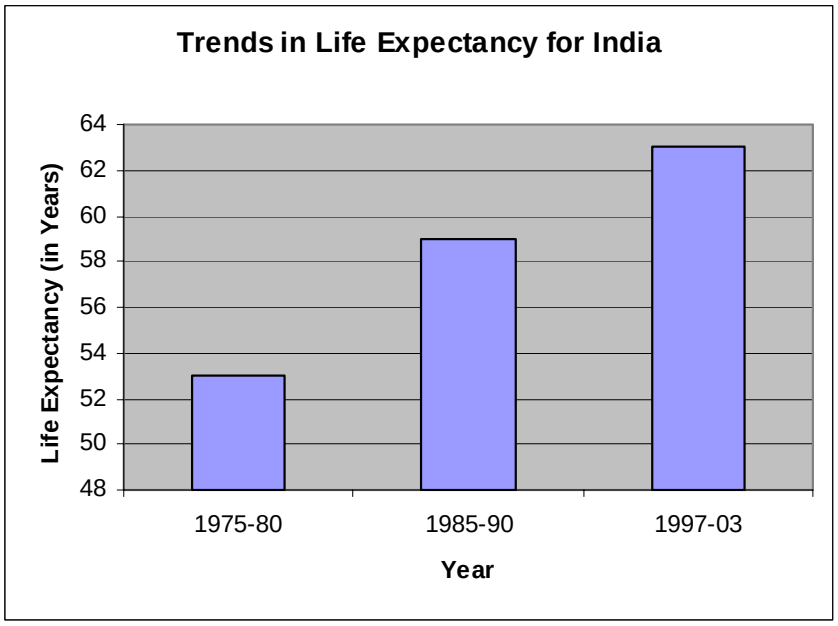
Data for this study comes from the World Development Indicators (2005) data files and the World Health Report (WHO 2002). These databases had some missing values for some explanatory variables. So these values were imputed from the World Development Report (World Bank 2005) and Human Development Report (UNDP 2004). The data which we are using are arranged in five-year averages to allow time for the effects to occur and to reduce the effects of long-run disturbances due to such events as destructive weather, business cycles or election years. The final dataset has 1975-80, 1985-90 and 1997-2003 and the trends are given below for these years.

The gross national income per capita is seen to be rising consistently into the 1990s (see Figure 1). The life expectancy of the population is also seen to be rising through the late 1980s and the 1990s (see Figure 2). The infant mortality of the population is seen to be declining (see Figure 3).



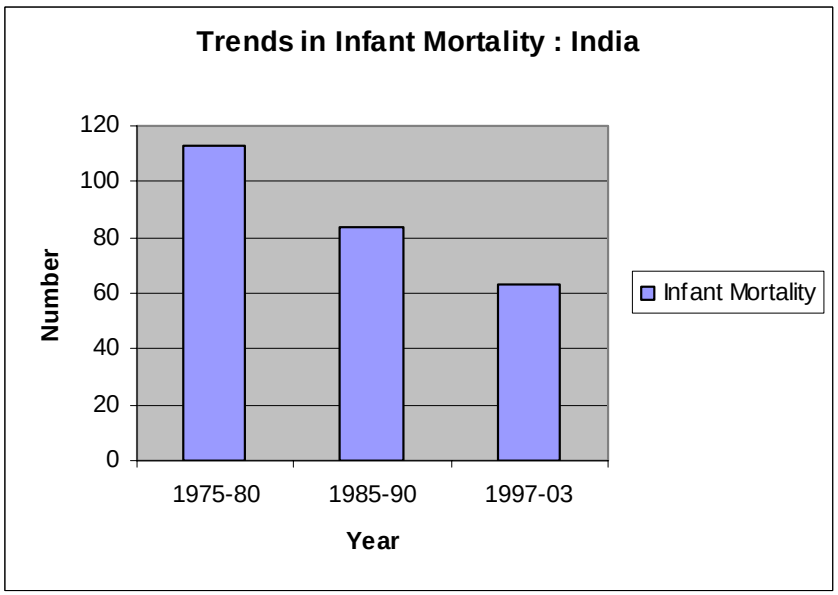
Source: WDI Indicators

Figure 1: Trends in GNI Per Capita



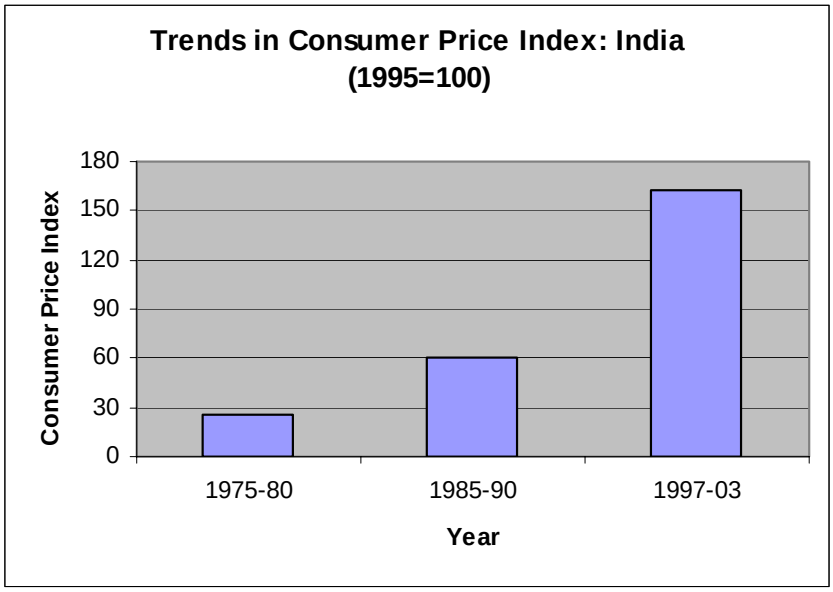
Source: WDI Indicators

Figure 2: Trends in Life Expectancy for India



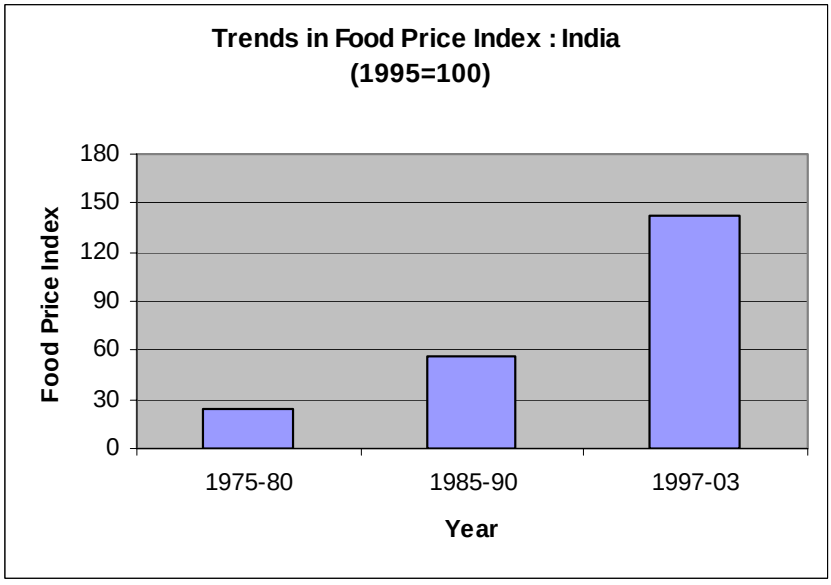
Source: WDI Indicators

Figure 3: Trends in Infant Mortality for India



Source: WDI Indicators

Figure 4: Trends in Consumer Price Index for India



Source: WDI Indicators

Figure 5: Trends in Food Price Index for India

Table 1 : Cross-country Income Comparison

(Per capita growth rate in brackets)

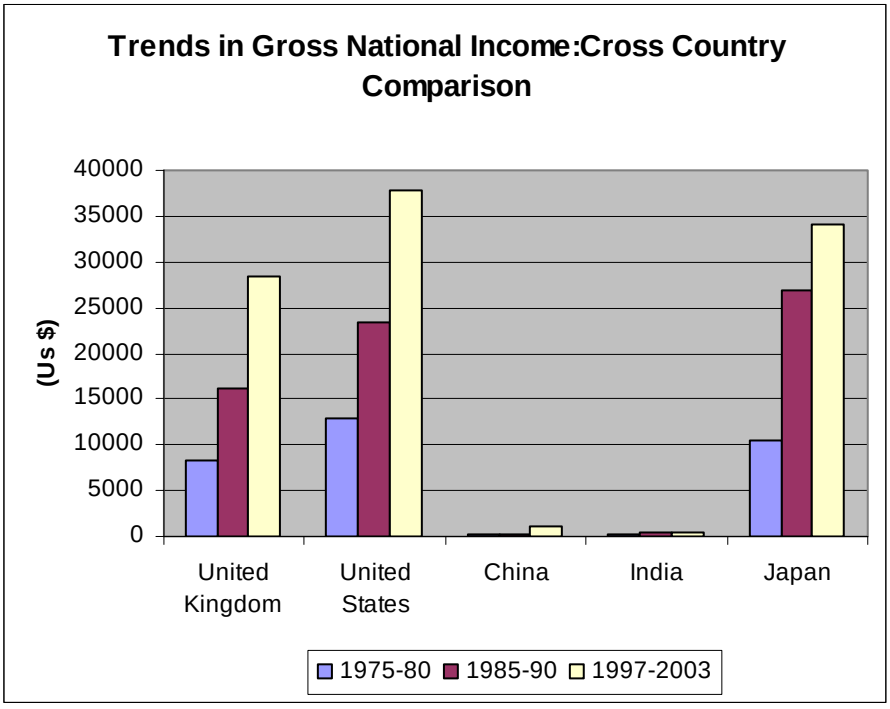
Country	**1975-80**	**1985-90**	**1997-2003**
France	12,760 (12.0)	19,620 (14.3)	24,730 (-0.6)
Germany	12,340 (11.3)	20,160 (15.7)	25,270 (-1.9)
United Kingdom	8,410 (14.4)	16,190 (13.4)	28,320 (4.9)
United States	12,980 (9.4)	23,330 (5.6)	37,870 (3.9)
Bangladesh	210 (4.8)	280 (5.6)	409 (2.4)
Sri Lanka	280 (0.2)	490 (5.5)	930 (2.6)
China	220 (1.8)	320 (3.9)	1,100 (8.6)
India	270 (7.7)	390 (3.6)	540 (4.1)
Sweden	16,050 (9.4)	25,750 (14.7)	28,910 (0.5)
Norway	15,450 (11.7)	25,670 (10.1)	43,400 (3.3)
Canada	11,170 (7.4)	19,840 (7.2)	24,470 (3.0)
Japan	10,430 (13.9)	26,960 (17.4)	34,180 (-2.6)

Table 2 : Cross-country Life Expectancy Comparison

Country	**1975-80**	**1985-90**	**1997-2003**
France	74	77	79
Germany	72	75	78
United Kingdom	74	76	78
United States	74	75	77
Bangladesh	47	55	62
Sri Lanka	67	70	74
China	65	69	71
India	53	59	63
Sweden	76	78	80
Norway	76	77	79
Canada	75	77	79
Japan	76	79	82

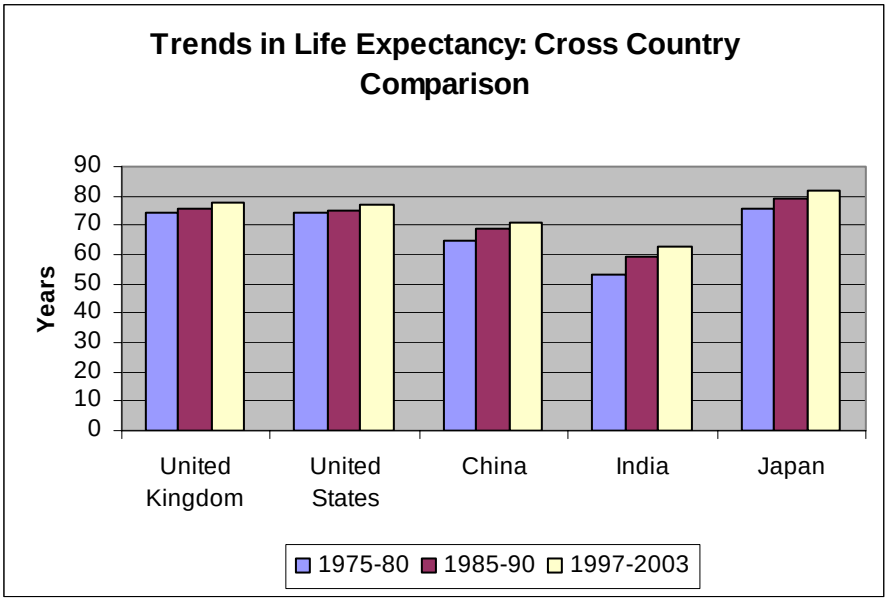
Table 3 : Cross-country Infant Mortality Comparison

Country	1975-80	1985-90	1997-2003
France	10	7	4
Germany	12	7	4
United Kingdom	12	8	5
United States	13	9	7
Bangladesh	129	96	46
Sri Lanka	36	26	13
China	49	38	30
India	113	84	63
Sweden	7	6	3
Norway	8	7	3
Canada	10	7	5
Japan	8	5	3



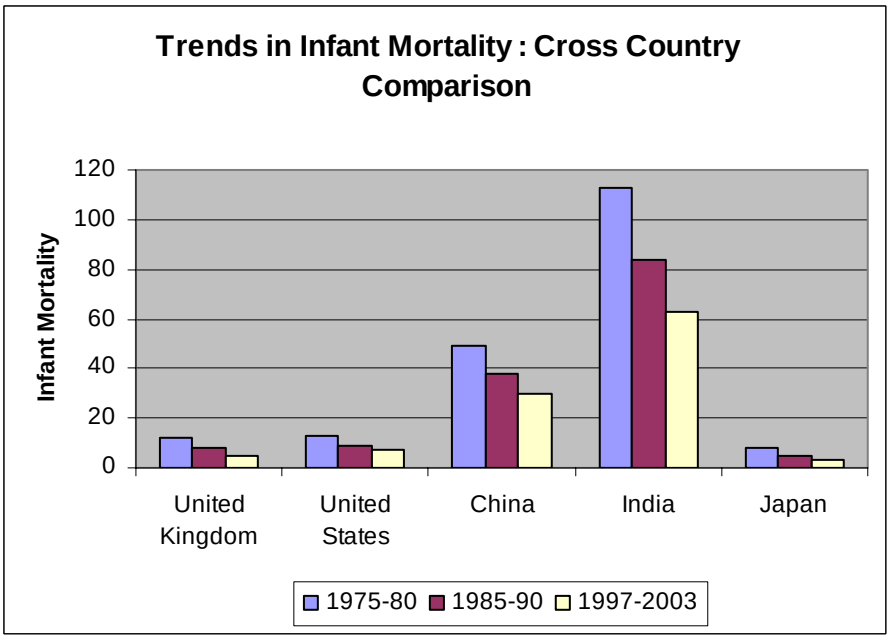
Source: WDI Indicators

Figure 6 : Trends in Gross National Income



Source: WDI Indicators

Figure 7 : Trends in Life Expectancy—Cross-country Comparison



Source: WDI Indicators

Figure 8 : Trends in Infant Mortality—Cross-country Comparison

Table 4 : Correlations between GDP per capita growth rate and Health Indicators

Particulars	Life Expectancy	Fertility Rate	Infant Mortality Rate	Under-five Mortality Rate
Gross Domestic Product Per Capita growth rate	0.9840	-0.9822	-0.9878	-0.9876
Population living in an urban area (%)	0.9873	-0.9857	-0.99707	-0.9885

4 HEALTH AND GROWTH - THEORETICAL MODEL

The first model in the area of growth was given by Solow (1966). In order to examine the impact of poor health on total factor productivity, some studies use total factor productivity. There are other studies which use data on three of the most common causes of ill health in developing countries. The first is undernourishment or malnutrition. However, in this study, we examine gross national income in the model instead of total factor productivity. The health indicators used are life expectancy, infant mortality and other health status indicators. Measures such as calorie, protein or fat supply are not used because the need for calorie and protein intake depends partly on climatic conditions as people living in cold countries are in greater need of them than those living in warmer climates. There are models such as Bloom and Sevilla (2001) which use the growth in inputs (physical capital, labour and human capital) and growth in total factor productivity. Also we consider life expectancy in combination with other health status indicators like infant mortality, annual population growth rate and total fertility rate, instead of using undernourishment directly.

According to Barro and Sala-i-Martin (1995), a nation's economic growth is dependent on the current gdp and the gdp in steady state:

$$Dy=f(y, y^*) \qquad \textit{(Equation 1)}$$

where Dy is the rate of growth of gdp;
y is the current gdp;
y* is the steady state gdp.
Dy is declining in y and increasing in y*.

This follows from the diminishing returns to capital. An implication of this model is that as y increases the rate of growth will be lower in the long run in the absence of new innovations and ideas and technology not being constant. According to this model the countries which start at low levels of initial gross national income will be on higher growth paths as compared to the countries which are at higher levels of initial income. Thus countries which have less capital per worker tend to have higher rates of return and

higher growth rates. In the neoclassical model as well the concept of capital is broadened to include human capital in the form of education and health for a broader definition of capital. These models also predict that growth must eventually cease unless there are improvements in technology.

The endogenous growth theories introduced by Aghion and Howitt (1992) do however predict that growth rates can be sustained in the long run due to technological advances resulting from R&D activity. As long as new ideas and new innovations are generated the economy will continue to have positive growth rates. For given values of the steady state y* for a developing country a higher starting level of per capita output, y implies a lower per capita growth rate. We can also see that the correlations between the level of gross national income and growth rates are not high.

4.1 Empirical Estimation

First we describe the data using summary statistics (see Table 6) and simple linear regressions (see Table 7) and correlations of GNI with other variables (see Table 5). The correlation matrices reinforce the findings of the scatter diagrams, that is, most of the health-system and socio-economic determinants of health are not highly correlated. Assume that our structural (or causal) equation of interest is the following. In the empirical specification a linear regression method is used to examine the effect of life expectancy on gross domestic product. (see Table 4). The system of equations is:

$$Y = \alpha + \beta . S + \varepsilon \qquad \textit{(Equation 2)}$$

where Y is gross national income;
S is the measure of health;
ε is the unexplained variation.

Health Indicator = life expectancy, infant mortality, fertility rate.

Therefore Equation 1 is the theoretical model and Equation 2 represents the empirical equation we need to estimate. β represents the causal effect of S on Y. We aim to get an unbiased estimate of β. A sufficient condition for OLS to yield an unbiased estimate of β is that the conditional expectation of ε given S is zero. $E(\varepsilon \mid S)=0$. Thus ε and S must be uncorrelated. However, this assumption can be violated under two conditions. First, there may be reverse causality. If Y also causes S then ε will be correlated with S as the other factors causing Y must be working through ε. Second, if both Y and S are caused by a third factor—for example, X—then the influence of X must be captured by ε. This also implies a correlation between ε and S. Third, if the variables are measured with error, this will also induce correlation. We estimate this equation using a two-stage least squares estimation in reduced form since the linear regression method and three-stage least squares estimation would give inconsistent estimates.

The solution of this problem is to apply an Instrument Variables approach. The idea is to find one or more variables—the instruments—which are correlated with S and

uncorrelated with ε. Then we need to use these instruments to get an unbiased estimate of β. The way to do this is to first regress S on X and then use the predicted values of S from this regression instead of the original values of S in the regression of Y on S. The intention for this approach is as follows: By using the predicted values of S from a regression on X, we use only that part of S which is explained by X, and which we know is not caused by the factors working through ε. In the second stage, if we find a correlation between Y and the predicted S from stage 1, then we can attribute this to the effect of S on Y.

The results from the two-stage least squares regression are given in Tables 7 and 8. First, we regress gross national income on life expectancy in Table 7. The coefficient for life expectancy indicates that an increase in life expectancy would increase gross national income by 932.82. Next, we regress gross national income growth rates on infant mortality and find that an increase in infant mortality would reduce gross national income by 793.68 (see Table 7). Finally, we observe that an increase in fertility rate will reduce gross national income by 1.19. These effects come out to be significant in all three regressions.

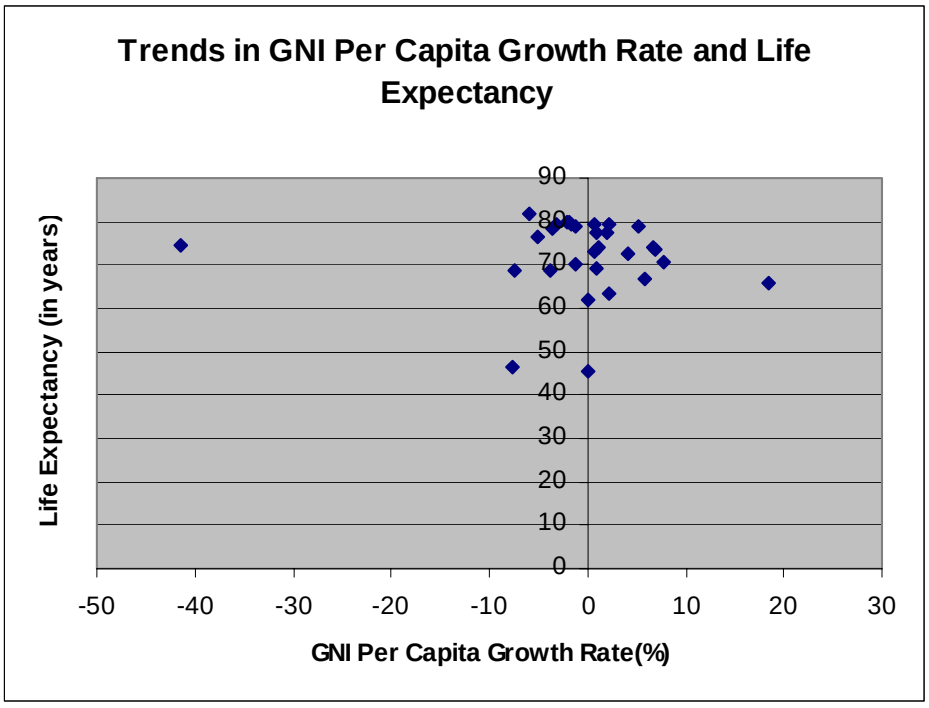
We use population growth rate as the instrument. We can make a reasonable assumption that population growth rate is correlated with life expectancy since the increase in population would imply that more people are growing older and have better health and improved lives thus leading to higher life expectancies. This variable may not, however, be correlated with gross national income per capita as population growth rate may not have a direct effect on gross national income. Additionally, the other health indicators can also be used as instruments since they satisfy the restriction. Thus we obtain results by running the instrumental variables.

Table 5 : Correlations between GDP per capita and Health Indicators

Particulars	**Life Expectancy**	**Fertility Rate**	**Infant Mortality Rate**	**Under-five Mortality Rate**
Gross Domestic Product Per Capita	0.6445	-0.4801	-0.6800	-0.6251
Population living in an urban area (%)	0.5138	-0.4801	-0.6877	-0.6601

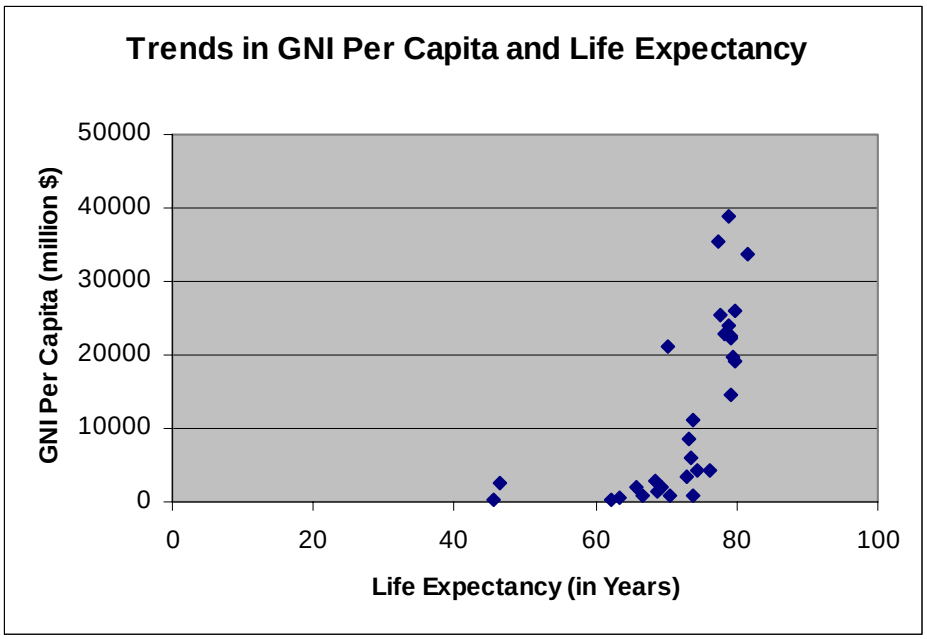
Table 6 : Descriptive Statistics for Select Countries in 2002

Variable	Means (Standard Deviation)
Gross National Income (in millions)	12613.67 (12168.97)
Gross National Income growth rate (in %)	-0.6766667 (9.321228)
Life Expectancy	72.14367 (8.865318)
Infant Mortality	19.12267 (20.09269)
Under-five Mortality Rate	25.35667 (29.45402)
Fertility Rate	2.164 (0.9791608)
Percentage of Urban Population	66.72467 (22.74594)
Total Population	142000000 (287000000)
Growth Rate of Population	0.9713333 (0.7044868)
Number of observations	30



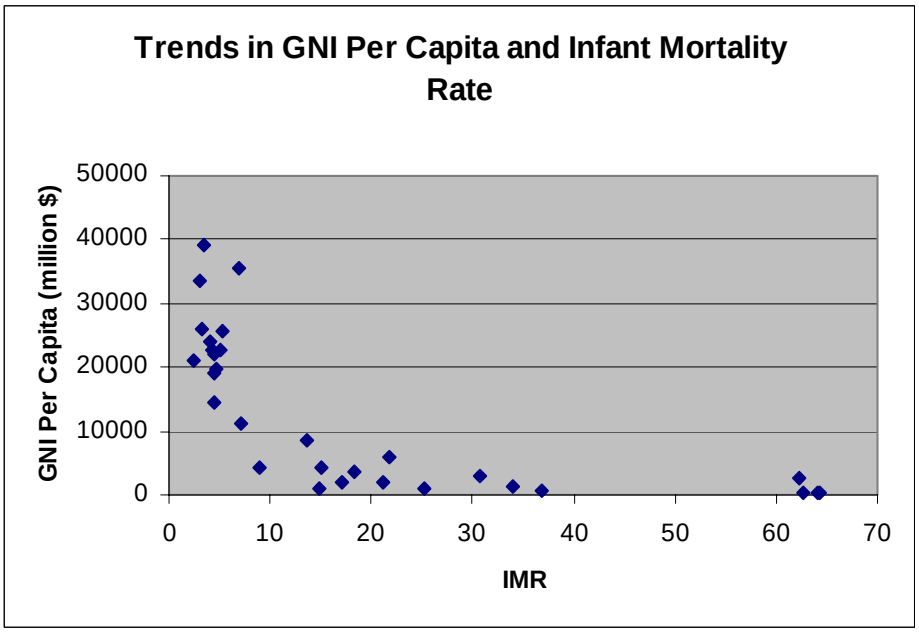
Source: WDI Indicators

Figure 9 : Gross National Income Per Capita Growth and Life Expectancy



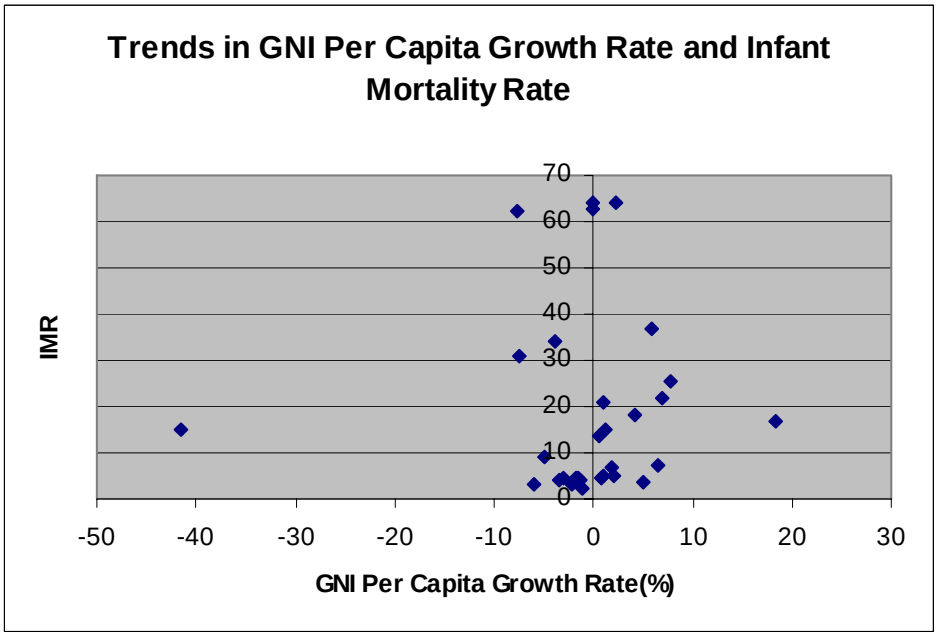
Source: WDI Indicators

Figure 10 : Gross National Income Per Capita and Life Expectancy



Source: WDI Indicators

Figure 11 : **Gross National Income Per Capita and Infant Mortality**



Source: WDI Indicators

Figure 12: **Gross National Income Per Capita Growth Rates and Infant Mortality**

Table 7 : OLS and 2SLS Model of GNI per capita (in 2002)

2SLS model for Gross National Income Per Capita		
Dependent variable: GNI per capita		
Variable	**OLS**	**2SLS**
Constant	-47545.63 (42972.25)	93389.86 (172850.9)
Life expectancy	751.7552 (500.2408)	-932.8229 (2083.256)
Annual growth rate of population	-520.651 (5566.987)	-
Infant mortality rate	-193.0355 (363.1426)	-793.6839 (689.4578)
Under-five mortality rate	212.7546 (249.6716)	90.25278 (393.1452)
Urban population	140.0731 (112.9407)	65.29554 (176.1271)
Total fertility rate	337.8001 (4858.439)	-2483.843 (3416.176)
Total population	-0.00000562 (0.00000739)	0.00000302 (0.000014)

Table 8 : OLS and Two-Stage Least Squares Model of GNI per capita growth rate (in 2002)

2SLS model of growth rate of Gross National Income per capita		
Dependent variable: GNI per capita growth rate		
Variable	**OLS**	**2SLS**
Constant	66.48211 (45.31538)	-14.62539 (159.0262)
Life expectancy	-0.6492342 (0.5275172)	0.3202301 (1.916636)
Annual growth rate of population	2.996395 (5.870535)	-
Infant mortality rate	-0.4503166 (0.3829435)	-0.1046471 (0.6343145)
Under-five mortality rate	0.0464733 (0.2632853)	0.1169723 (0.3617011)
Urban population	-0.1616095 (0.1190989)	-0.1185755 (0.1620403)
Total fertility rate	-2.82368 (5.123353)	-1.199842 (3.142947)
Total population	0.00000000772 (0.00000000779)	0.00000000274 (0.0000000129)

4.2 Results

The results show that the health indicators do not have a significant effect on gross national income. The correlation between the health indicators do not show high correlations between different indicators and gross national income in the sample year 2002. This is also corroborated by the regression results. Since health and income are interdependent conducting a linear regression would give inconsistent estimates as there is a problem of endogeneity. Therefore, to overcome this problem, we used a two-stage least squares method. This could finally be estimated in reduced form as given in Equation 2. Thus the results of this study are similar to other studies which have

investigated this relationship and tried to account for the two-way relationship between health and income.

To conclude, we have not found highly significant estimates for the effect of health indicators like life expectancy, infant mortality and total fertility rate. We also used other explanatory variables like the under-five mortality rate and the percentage of people living in urban areas. Thus we have shown that any policy initiatives should be aimed at improving health services. Some of these aspects of health which were not included due to missing observations are access to clean drinking water, public and private expenditure on health, immunizations and net primary school enrolment rate.

This study and its findings can provide more value added to current studies on health and growth for India. The inter-country comparisons also indicate that India will need to improve provision of health services as well as physical infrastructure in order to lift people out of poverty and provide them with better living standards. This is important since most of the literature on growth examines education instead of health as a key determinant of income. The literature on health is still growing and government expenditure on health needs to be at the same level as education.

5 INCIDENCE OF THE DISEASE

As on March 2000, 11, 251 cases of full-blown AIDS had been reported to the National AIDS Control Organisation of India (NACO). Of these 79 per cent were males and 21 per cent were females. This is only a fraction of AIDS morbidity in the country, reflecting both the stigma and the ignorance surrounding the infection. Widespread discrimination against HIV-infected people hinders their access to health care. The low-income levels of most of those infected preclude widespread use of the highly active anti-retroviral therapy. Consequently, morbidity and mortality of those infected continues to be high.

Andhra Pradesh, Maharashtra, Karnataka, Tamil Nadu, Manipur and Nagaland are currently classified as high-prevalence states where infection levels have crossed the 1 per cent mark among antenatal women—considered a proxy for the general population. Data for the year 2000 clearly show the great variation in the severity of the HIV epidemic among the states. Thus HIV infection trends are characterized by wide regional variations as well as by simultaneous epidemics due to differing transmission routes: heterosexual epidemics in Maharashtra and certain southern states, and an IDU epidemic in Manipur. Nearly two-thirds of the opportunistic infection among AIDS patients is TB, portending a dual epidemic in the future. Already there is evidence from Mumbai regarding the increasing role of TB as a cause of death among AIDS cases.

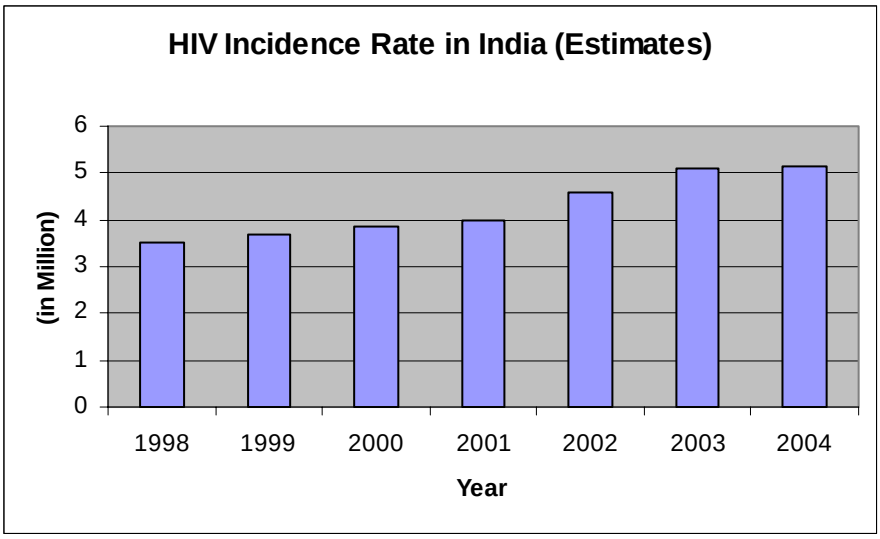
Several factors increase Indian vulnerability to a devastating AIDS epidemic: widespread poverty, illiteracy, poor nutritional and health status, social inequalities based on caste and gender, inadequate health infrastructure, taboos about the subject of sex, lack of political commitment, and a persistent denial of the AIDS epidemic in many states. Without the immediate and sustained implementation of preventive and control measures,

the adult HIV prevalence rate could be 5 per cent within the next five years—a total of nearly twenty-five million HIV infected people by the year 2006, roughly equal to the number of current infections in sub-Saharan Africa.

The HIV prevalence rate in the South Asian region is still low—from negligible in Bhutan and Maldives to about 0.9 per cent in India. This offers the region an opportunity to halt the spread of the epidemic. But like elsewhere, here too the stigma and the discrimination associated with AIDS are proving to be one of the biggest challenges in combating the epidemic. A significant reality of the South Asian region is the great degree of variability in the distribution of HIV infections. While there is no realistic assessment currently available for Afghanistan, the HIV prevalence rates for Bhutan, Bangladesh and Sri Lanka are below 0.1 per cent, for Maldives and Pakistan 0.1 per cent, for Nepal 0.5 per cent, and for India 0.9 per cent. HIV prevalence rate translates into a total of 5,100, 000 HIV infections in real terms. This alone accounts for more than 10 per cent of all people with HIV/AIDS in the world, placing India second only to South Africa. Epidemiological data show the epidemic in the region to be comparatively young and rapidly evolving—the number of people living with HIV/AIDS in the region has grown by 10 per cent since 2001. The most worrisome sign perhaps is the rapid spread of the epidemic into the general population. In India, HIV prevalence rates recorded by antenatal clinics attending to women in the three southern states are above 1 per cent, suggesting that the epidemic is no longer confined to pockets of high risk behaviour groups. Amongst the most crucial factors contributing to this rise are patriarchal norms and cultural taboos surrounding sex and sexuality, gender inequality and dual norms governing women's sexuality, unsafe sexual behaviour involving multiplicity of sexual partners and low condom use, injecting drug use behaviour in several pockets, the extent of sexual networking within the injecting drug use circuits, the sizes of the population at risk, high cross-border mobility and migration for social and economic reasons, general poverty and low literacy levels and weak public health infrastructure.

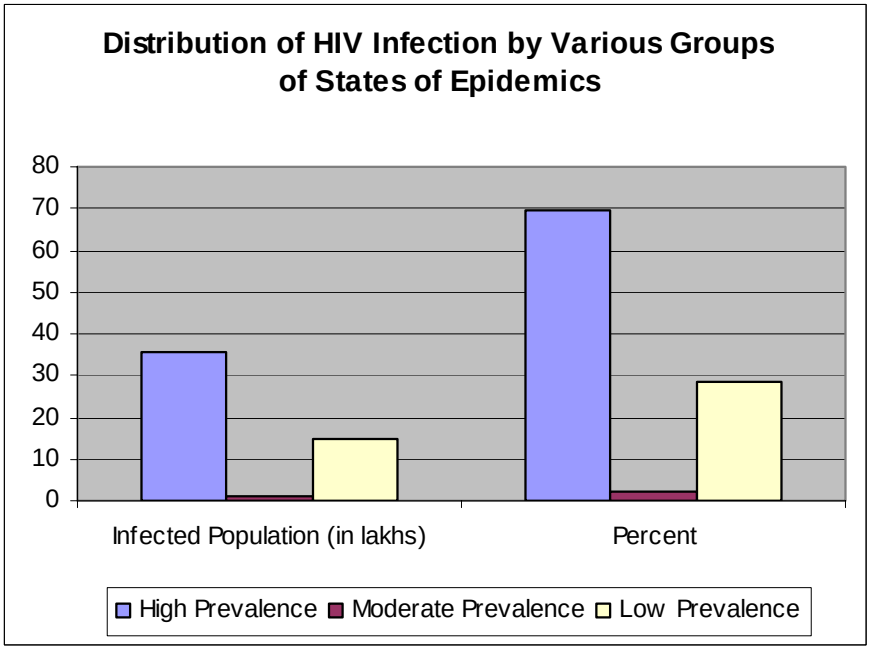
5.1 Data Trends and Evidence of HIV/AIDS Cases

By the end of 2004, there were nearly 400 lakh people living with HIV/AIDS worldwide, 22 lakh of them being children. More than 50 lakh deaths occurred due to HIV/AIDS in 2004. Each day nearly 14,000 new persons with HIV infections are added, with more than half of these occurring among young people under 25 years of age. India is on the verge of having the greatest increase in the estimated number of people living with HIV/AIDS in the world in the coming decades. With over 50 lakh people living with HIV/AIDS,(see Figures 14 and 15) India currently has the world's second largest number of cases. And with NACO projections of 90 lakh cases, India is set to overtake South Africa as the country with the largest number of AIDS cases. This will cause severe stress and have a catastrophic impact on families. One Indian study reports that families affected by HIV/AIDS spend, on an average, 49 per cent of household expenditure on treatment and this increases to 82 per cent among low-income families.



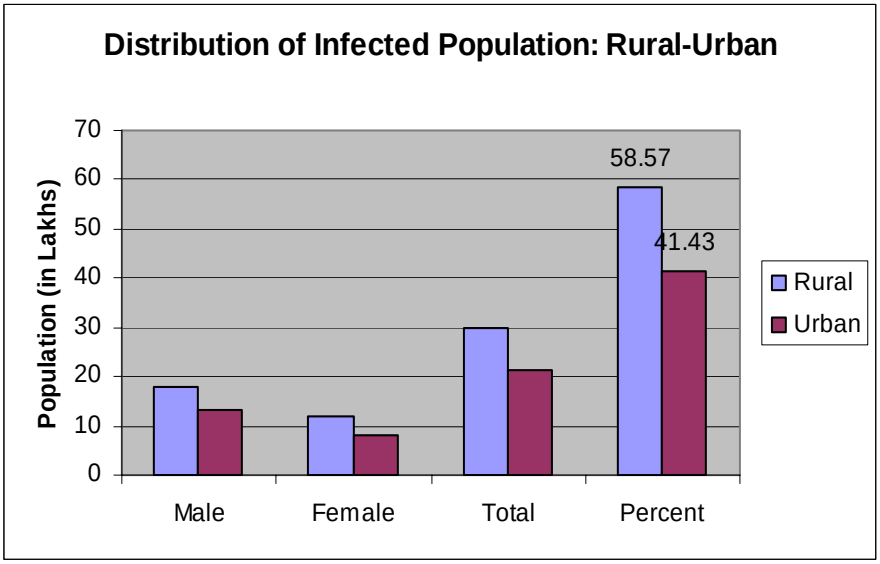
Source: WDI Indicators

Figure 13 : HIV/AIDS Trend for India (1998-2004)



Source: WDI Indicators

Figure 14 : **Distribution of HIV Infection by Various Groups of States of Epidemic**



Source: WDI Indicators

Figure 15 : **Distribution of Infected Population according to Rural/Urban**

There are also papers which substantiate that 'governance' is linked with the spread of the HIV/AIDS epidemic. The reasons for this claim are three-fold:

(i) development is inversely linked to HIV prevalence;

(ii) good governance systems are linked to stable HIV prevalence; and

(iii) countries with both development and good governance appear to have a winning combination and the epidemic has not taken off at a very fast rate in these countries.

The formula is 'development + good governance system = low and stable HIV prevalence'.

Highly developed countries have a relatively low and stable HIV prevalence. Although a few developing countries do have a low HIV prevalence, it is, generally, in developing countries, especially those in Africa, where one finds the highest levels of prevalence. Governments which are representatives of the people have a crucial role to play in arresting the epidemic. Data show that the higher the gross national product per capita, in US dollar terms, the lower the urban adult HIV prevalence.

A good governance system promotes equality in income distribution. Urban adult HIV prevalence is less where there is less inequality of income distribution. A good governance system consists of the full participation of the constituents. The rule of law, transparency, responsiveness, consensus orientation, equity, efficiency and equity, accountability and vision apply at all levels. By rule of law we are referring not only to the adoption of laws, bills and regulations but also to an environment that ensures that the constituents are fully aware of their rights and how they can improve their lives within the existing legal framework and policies. This refers not only to the reduction of all

forms of discrimination, particularly those relating to women or minority groups, but also to the encouragement of legal literacy. This form of empowerment of women contributes significantly to reducing abuse, trafficking and other forms of mistreatment which encourage the spread of HIV. Transparency requires the flow of information which should extend beyond the necessary health prevention measures for HIV. People should not only have the right to be informed of HIV/AIDS, its modes of transmission and the best ways to protect themselves, they should also be provided with information relating to job markets in order to improve chances of access to employment.

The trends across the country show that there is no galloping HIV epidemic in India as a whole, as no upsurge in HIV prevalence has been observed in the country. India remains a low prevalence country with an overall HIV prevalence of 0.91 per cent, that is, less than 1 per cent of the population. However, this masks the sub-epidemics in various foci in the country based on the evidence of high prevalence of HIV observed among both patients of STD and clinic attendees in mentioned sentinel sites. In absolute numbers, India, with 5.3 million HIV cases, continues to stand second to South Africa . However, in terms of prevalence percentage India has HIV prevalence of 0.91 per cent of the population as compared to 21.5 per cent in South Africa.

5.2 Major Issues Concerning HIV/AIDS in the Health Sector

The current low level of HIV prevalence in India has not yet led to any adverse macroeconomic impact. However, in select pockets where HIV prevalence is very high, there is evidence of adverse effects on families and communities. The HIV/AIDS epidemic, though spreading rapidly, is at an early stage in most parts of the country. So there is still scope for containing the epidemic within manageable levels.

The recent explosion of the AIDS epidemic is a critical global health problem with serious socio-economic consequences. A number of recent studies in India have documented the increasing pace of HIV infection and its impact on individuals, families and society as a whole. This complex epidemic has primarily emerged due to heterosexual transmission fuelled by the less studied patterns of bisexual or injecting drug behaviour. Data from sentinel surveillance system show a rapid evolution of the epidemic mainly in the southern and western parts of India. Andhra Pradesh and Karnataka have now overtaken Tamil Nadu to join Maharashtra as the states with the highest prevalence of HIV. The major northern states still report very low levels of HIV. Their vulnerability to the epidemic, however, in terms of male migration, adverse gender norms and weak infrastructure makes action in these states critical for the future path of the epidemic. Given the already large population base and the increasing population, India is expected to have the largest concentration of AIDS-affected individuals in the world if the current rate of transmission continues. In view of the above, it is highly desirable to have a comprehensive knowledge about the transmission patterns of the epidemic and its community-level impacts through morbidity and deaths. Recent evidence has clearly established that the HIV/AIDS epidemic in India has now moved into the general population. The last round of sentinel surveillance shows that in at least seven states, more than 1 per cent of pregnant women in urban areas are now infected. India’s rural

areas, home to 73 per cent of the country's one billion people, were believed to be relatively free of the epidemic. New studies show that at least in some areas, HIV has become common in villages. Yet another feature of the epidemic is that the young and productively active population characterizes it. Data show that 89 per cent of the reported cases are in the sexually active and economically productive age group of 18-40 years and over 50 per cent of all new infections takes place among young adults below 25 years.

The HIV/AIDS epidemic in South Asia presents both challenges and hope—challenges of dealing with great diversity in types of epidemic, and the hope of preventing it from escalating further given that many countries of the region are still in the early phase of the epidemic. However, stigmatization and discrimination of people living with HIV/AIDS and those associated with them, violations of their fundamental rights, fear and anxiety over sero-status disclosure, and lack of supportive legislature and mechanisms to implement AIDS and other protective policies, are proving to be major roadblocks in efforts to check the spread of the epidemic and in mitigating its impact on the affected population.

5.3 HIV/AIDS and Per Capita Income—Dual Economy Model

The paper by Haacker (2002a) uses a neoclassical growth model to examine the relationship between HIV/AIDS and economic growth. The main findings of the paper are that HIV/AIDS affects both the demand and the supply of labour in the formal sector. If there is a significant rise in the capital-labour ratio there will be an increase in formal sector employment.

In order to examine the estimates of the macroeconomic impact on economic growth or per capita income, we find that the negative impact of declines in productivity or the supply of human capital is offset by an increase in the (physical) capital-labour ratio. This model demonstrates how domestic investment rates respond to changes in the rate of return of capital. This section addresses how the impact of HIV/AIDS is demonstrated in a dual economy model.

$$Y=AK\alpha(ehphL)\beta(eUpUL)\gamma$$

where $\alpha+\beta+\gamma=1$; *(Equation 3)*
ph is the proportion of highly-skilled agents in the working population;
pu is the proportion of unskilled agents;
eh and eu are efficiency parameters for each group.

$$\dot{K} = sY - \delta K \qquad \textit{(Equation 4)}$$

$$w^*U,f= \lambda\, w^*U,i \qquad \textit{(Equation 5)}$$

Informal sector output takes the form:

$$Yi= AiKi\alpha(eULU,i)\gamma \qquad \textit{(Equation 6)}$$

with $\alpha i+ \gamma i= 1$.

The steady state output per capita and the (unskilled) equilibrium wage rate for the informal sector are given by:

$$yi^*=(Ai)(si/\delta+n)\alpha i/\gamma i\ eu \qquad \textit{(Equation 7)}$$

$$\text{and } w^*U,i=\gamma i(Ai)1/\gamma i(si/\delta+n)\alpha i/\gamma i\ eu \qquad \textit{(Equation 8)}$$

For the formal sector, aggregate output takes the form:

$$Yf=AfKf(eHLH)\beta f(eULU,f)\gamma i \qquad \textit{(Equation 9)}$$
with $\alpha i+\beta f+\gamma i= 1$.

The formal sector is assumed to be more capital intensive than the informal sector. Thus we get:

$$Yf= Af\ 1/\ (\alpha i+\beta)[\ \lambda i\gamma i(Ai)1/\gamma\ /\gamma f\ (si/\delta+n)\alpha i/\gamma i]\ -\gamma f/\ \alpha f-\ \beta f\ Kf\alpha/\alpha i+\beta(eHLH)\beta f\ /\ \alpha f+\beta f \qquad \textit{(Equation 10)}$$

In equilibrium the capita stock grows at the same rate as n, the labour growth rate.

$yf = Yf/(eHLH\ )$ and $k =Kf/(eHLH$ and $sfyf =(\delta+n)\ kf$

$$k=Af\ 1/\ \beta[\lambda i\gamma i(Ai)1/\gamma/\gamma f(si/\delta+n)\alpha i/\gamma i]-\gamma f/\beta f(sf/\delta+n)(\alpha i+\beta f)/\ \beta f \qquad \textit{(Equation 11)}$$

$$Yf =Af\ 1/\ (\alpha i+\beta)[\ \lambda i\gamma i(Ai)1/\gamma\ /\gamma f\ (si/\delta+n)\alpha i/\gamma i]\ -\gamma f/\beta f\ (sf/\delta+n)\ \alpha f/\beta f\ eHLH \qquad \textit{(Equation 12)}$$

$$eU\ LU\ \ = Af\ 1/\ \beta(si/\delta+n)\alpha i/\beta\ [\ \lambda i\gamma i(Ai)1/\gamma\ /\gamma f\ (si/\delta+n)\alpha i/\gamma i]-(\beta+\gamma f)/\gamma f\ eHLH \qquad \textit{(Equation 13)}$$

The changes in sector-specific variables like Af, Ai, sf and si do have the expected effect on the allocation of unskilled labour. A decline in Af or sf results in a reallocation of labour away from the formal sector and a decline in Ai or si results in a reallocation of labour towards the formal sector. The HIV/AIDS epidemic affects the two sectors simultaneously. Our analysis indicates that in the dual economy the formal sector is generally more responsive to common shocks. The hypothesis that HIV/AIDS will result in a decline in unemployment—as workers from the formal sector who die are replaced by unemployed workers or workers from the informal sector—is incomplete and misleading. HIV/AIDS affects both the supply of and the demand for labour. In the context of the present model, the share of the formal sector expands only if the capital-labour ratio in the formal sector expands sufficiently relative to the informal sector, and if the size of this effect is higher than the adverse effects of a decline in productivity, savings rates and the efficiency of skilled labour—all of which affect the formal sector more strongly than the informal sector.

$$dY/Y= \sigma-\rho/\beta(1-\rho)\ [dF/Af\ +\alpha f\ (dsf/sf)\ -\alpha fdn/(\delta+n)]+\ -\sigma\gamma f+(1-\sigma)\ [\beta f-\ \rho(\beta f\ +\gamma f)/(1-\ \rho]/\gamma f\ \beta f\ [dAi/Ai\ +\alpha idsi/si\ -\ \alpha dn/(\delta+n)]+\ \sigma-\rho/1-\rho[deh/eh\ +dLH/LH]\ +1-\sigma/1-\rho\ \ [deu/eu+dLu/Lu] \qquad \textit{(Equation 14)}$$

According to Bloom and Mahal (1995), 'There is more flash than substance to the claim that AIDS impedes national economic (income) growth' and 'AIDS prevalence rate increased more in those countries with characteristics that are associated with slower growth, and not, apparently, to AIDS itself having an independent negative influence on economic growth.' HIV/AIDS has an immediate effect on the health sector, increasing the demand for public and private services and taking its toll on health sector personnel. The share of hospital beds occupied by HIV/AIDS patients increases and HIV/AIDS affects government revenues primarily through its adverse impact on the tax base. As a result of the decline in the rate of population growth components of the tax base such as personal income, company profits, imports or consumption decline as well.

5.4 Empirical Specification and Results

The empirical model which is used to estimate the effect of the HIV/AIDS incidence on growth rates is a two-stage least squares model. The instrument used in this case is the public expenditure on health which is correlated with the number of AIDS cases in the country as well as the number of deaths due to HIV/AIDS but not with the gross domestic product growth rate and gross domestic product per capita.

GDP growth rateit= HIV/AIDSit+ Xit + uit

where Xit= other explanatory variables

The results do not show the AIDS incidence rate and number of HIV deaths to be highly significant even if we use two different measures. We tried using the number of HIV deaths as an explanatory variable in one set of regressions and the number of AIDS cases in a different set of regressions but this did not change the results drastically. We also used gross domestic product per capita and gross domestic product growth rate but there wasn't a very significant difference in these two models. In the model with gross domestic product per capita growth rate as the dependent variable the variable measuring the percentage employed in services comes out to be significant. The incidence of malaria comes out to be significant in the regressions with total factor productivity as the dependent variable.

These results could be interpreted as HIV/AIDS not being a factor influencing income but there could be other diseases which could provide better explanations. This could also be explained by the fact that HIV/AIDS may become the most severe in explaining growth in the next decade but at present it has not yet increased to catastrophic proportions. Also there could be other explanations as the sectors which are found to be highest in HIV/AIDS cases due to the nature of the occupation.

5.5 Future Growth of HIV-1 Infections and Potential Impact of Interventions

The future growth of HIV/AIDS is difficult to predict even though various projection models have been done. An extremely rapid growth does not seem to be occurring in India. A reasonable project model might involve the comparison of two scenarios. The worst case scenario produced by UNAIDS in 1999 suggested growth to about 4 per cent adult prevalence by 2010. More detailed work suggests that the rate of increase would continue to about a 5 per cent equilibrium prevalence by 2020. The updated modelling of

the Centre for Global Health Research Study uses the Nagelkerke scenarios and updates them using more up-to-date Indian data and a slightly different projection model. These are less optimistic than the UNAIDS best-case scenario of 1999, and suggest that a little below 3 per cent of the adult Indian population will be HIV positive by 2025. Even with the modest growth scenario of about 3 per cent equilibrium prevalence, about 500 lakh additional Indians will become HIV-1 infected over the next two decades.

Table 9 : Descriptive Statistics for 2003

Variable	**Means (Standard Deviations)**
Gross Domestic Product	174000000000 (292000000000)
Gross Domestic Product Per Capita	4142.414 (7344.466)
Gross Domestic Product per capita growth rate	3.37931 (4.345883)
Number of AIDS cases in total population	3.803448 (7.354905)
HIV deaths	45805.17 (83435.08)
Number of physicians	1 (1.114515)
Number of female-headed households	22.67619 (9.080689)
Number of tuberculosis cases in total population	213.5517 (186.4906)
Number of malaria cases in total population	1106603 (2622467)
Public health expenditure	2.962069 (1.7379)
Child immunization rate	77.27856 (20.06222)
Road traffic mortality	15.1037 (8.606504)
Number of children employed	15.48276 (13.66335)
Total population	95700000 (204000000)
Percentage of population employed in agriculture	44.148 (29.99904)
Percentage of population employed in industry	17.22727 (7.88091)
Percentage of population employed in services	42.60455 (22.95257)
Total factor productivity	7.280769 (26.38647)

Table 10 : 2SLS Model of the Effect of HIV on Gross Domestic Product Per Capita Growth Rate

2SLS model of the impact on GDP per capita growth rate		
Dependent variable: Gross domestic product per capita		
Variable	**Coefficient**	**SE-error**
Constant	-84.59468	47.15555
HIV deaths	0.0000248	0.0000739
Number of physicians	-3.532715	2.781915
Number of malaria cases	0.000000598	0.00000047
Number of tuberculosis cases	-0.0317053	0.0166642
Percentage of population employed in agriculture	0.9577221	0.4917351
Percentage of population employed in industry	0.8315641	0.4913751
Percentage of population employed in services	0.9803973*	0.4422148

* 5% significance level

Table 11 : 2SLS Model of the Effect of HIV on Gross Domestic Product Per Capita

2SLS model of the impact on GDP		
Dependent variable: Gross Domestic Product per capita		
Variable	**Coefficient**	**SE-error**
Constant	4971.414	35428.15
Number of HIV deaths in the population	-0.0258231	0.055048
Number of physicians	448.9265	2090.064
Number of malaria cases in total population	0.0001837	0.0555048
Number of tuberculosis cases in total population	-5.900072	12.5199
Percentage of population employed in agriculture	-5.354879	369.4424
Percentage of population employed in industry	87.59294	422.5737
Percentage of population employed in services	-63.19531	332.2377

Table 12 : 2SLS Model of the Effect of AIDS cases on Gross Domestic Product Per Capita Growth Rate

2SLS model of the impact on GDP per capita growth rate		
Dependent variable: Gross Domestic Product per capita		
Variable	**Coefficient**	**SE-error**
Constant	-87.27953	52.82491
Total AIDS cases in the population	-0.4853838	1.647928
Number of physicians	-3.197881	3.218181
Number of malaria cases	0.000000533	0.000000651
Number of tuberculosis cases	-0.0164711	0.0576091
Percentage of population employed in agriculture	0.9927496	0.5241038
Percentage of population employed in industry	0.9031472	0.5956126
Percentage of population employed in services	0.9757782	0.5048316

Table 13 : 2SLS Model of the Effect of AIDS cases on Gross Domestic Product Per Capita

2SLS model of the impact on GDP		
Dependent variable: Gross Domestic Product per capita		
Variable	**Coefficient**	**SE-error**
Constant	6313.285	21715.4
Total AIDS cases in the population	272.6502	442.9179
Number of physicians	696.485	1291.05
Number of malaria cases in total population	0.0000613	0.0001868
Number of tuberculosis cases in total population	-8.811053	11.29083
Percentage of population employed in agriculture	-51.04715	213.2739
Percentage of population employed in industry	19.8379	244.2297
Percentage of population employed in services	-60.05558	206.8939

Table 14 : 2 SLS Model of the Effect of HIV on Total Factor Productivity

2SLS model of the impact on total factor productivity		
Dependent variable: Total factor productivity		
Variable	**Coefficient**	**SE-error**
Constant	74.40437	82.84032
Number of HIV deaths in the total population	0.0000898	0.0003098
Number of physicians	-18.45569	-18.45569
Number of malaria cases in total population	0.00000537*	0.00000184
Number of tuberculosis cases in total population	-0.1036374	0.0796551
Percentage of population employed in agriculture	-0.6272021	1.076372
Percentage of population employed in industry	-0.8362362	1.913566

Table 15 : 2 SLS Model of the Effect of AIDS cases on Total Factor Productivity

2SLS model of the impact on total factor productivity		
Dependent variable: Total factor productivity		
Variable	**Coefficient**	**SE-error**
Constant	55.14781	46.14244
Number of AIDS cases	-1.520325	4.125785
Number of physicians	-15.30082	11.47279
Number of malaria cases in total population	0.0000051*	0.00000175
Number of tuberculosis cases in total population	-0.0488685	0.1482432
Percentage of population employed in agriculture	-0.4123862	0.4043826
Percentage of population employed in industry	-0.3997705	1.023902

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