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The Determinants of Health Status: A Cross-Country Analysis*

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INTRODUCTION

An analysis of health status is an important aspect of human resource development. Improvements in health do not only improve the productivity of the labour force, but they also help to improve the impact of other forms of human capital formation, e.g. education. In most developing countries health status is difficult to determine as the question arises as to what measures should be used as indicators of health status. At a general level most of the demand or production function considerations are obtained by aggregating over the micro factors.[1] However, in the case of health status micro and macro measures may not be perfectly correlated. In most cross-country studies life expectancy at birth or the infant mortality rate are taken as indicators of health status. Other measures which can be used to indicate such improvements in health status are age and disease-specific mortality or morbidity and life expectancy. However, the improvement in health status can be observed most obviously from increases in life expectancy which is a better measure for cross country comparison than age and disease-specific mortality or morbidity, which are more difficult to compare at the international level.

The comparison of health indicators such as life expectancy and the infant mortality rate between developing and developed countries shows that the former is much lower and the latter much higher in developing countries as compared to

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[1]In micro studies the following health measures are used: (1) clinical measures of bodily attributes; (2) measures of height and weight, etc.; (3) respondent-reported disease symptoms and/or (4) incapacity for undertaking normal respondent activities.

These micro measures have problems also. According to Behrman and Deolalikar (1988) these micro measures are expected to be highly colinear with macro measures, but it is not expected to be perfect.

developed countries. However, the last fifty years have seen substantial improvements in the health status of people living in the developed and developing countries. A manifestation of this improvement in health status is the rise in the levels of life expectancy at birth and declines in infant mortality (see Appendix Table 1).

The question then arises as to what has determined this improvement in the level of health status. Have economic or social factors contributed to this improvement? In most empirical studies, for example, Correa (1992), Folop and Rinke (1983); Gerdtham and Jonsson (1992); Grosse and Perry (1983); Hitiris and Posnett (1992); Preston (1983) and Wheeler (1980), per capita income, adult literacy, nutritional status and the availability of health services are included as important determinants of health status.[2] Preston finds that, in 1940 and 1970, per capita income and adult literacy are significant determinants of life expectancy in less developed countries but nutritional status is not statistically significant. Similarly, Wheeler's simultaneous equation model study shows that GDP per capita is statistically significant. The study by Grosse and Perry (1983) tries to find the correlates of life expectancy during the 1950s and the 1970s. Their results also show that per capita income and literacy rates are the major determinants of health status. However, this study draws some important conclusions regarding the significance of general social indicators like sanitation, transport and communications. The results show that sanitation, health expenditure and population per physician are not statistically significant determinants for 1960, but these variables become significant for the later period, i.e., 1970. All these studies show that both economic and social factors play an important role in determining the health status in developed and developing countries. However at the initial stages of development the impact of these variables is much stronger.

In this study our objective is to explore the determinants of health status, in the developed and developing countries, during 1960, 1970 and 1990. This will help us to determine the impact and importance of economic and social variables on health status over time. We include gross domestic product per capita, literacy rate, per capita expenditure on health, urbanisation, female literacy, population per physician, population per nurse, and calorie-intake per day explicitly in our analysis. Therefore, we can say this study updates and extends the earlier studies. The order of the study is as follows:

Section I examines the existing levels and trends in life expectancy at birth,

[2]In cross-section studies prices are not included. However, availability of health care services is interpreted, in most studies, as price indicators.

infant mortality rates and other socio-economic variables. Section II dilates on the model and the methodology. This section also discusses the data used in the study. Section III presents the results of our exercise and Section IV presents the conclusions that emerge from our study.

I. TRENDS IN HEALTH STATUS AND SOCIO-ECONOMIC VARIABLES

Table 1 presents the gains in life expectancy and improvements in infant mortality rates for the period 1960–90. For low income countries (LICs) life expectancy increased from about 40 years in 1960 to 60 years in 1990. For high income countries (HICs), the increase was from 59 years in 1960 to about 75 years in 1990. The total gain in life expectancy over these three decades for the low income countries was 20.46 years and for the high income countries almost 16 years. However, the gain was greater for both low and high income countries for the decade 1960–70 than for the period 1970–90. Similarly improvements have been registered with respect to infant mortality rates. For low income countries these have declined from 168.96 in 1960 to 73.93 in 1990 and for high income countries from 93.37 in 1960 to 15.74 in 1990. Again, the period that saw the greatest gain in the decline of infant mortality rates was the decade 1960–70.

Table 1

Gains in Life Expectancy and Infant Mortality during 1960–90

	Mean			Gain		
	1990	1970	1960	1960–90	1970–90	1960–70
Life Expectancy at Birth						
LIC	60.06	52.82	39.60	20.46	7.24	13.22
HIC	74.696	69.70	58.846	15.85	4.996	10.854
Infant Mortality						
LIC	73.93	113.61	168.96	–95.03	–39.68	–55.35
HIC	15.74	28.13	93.37	–77.63	–12.38	–65.24

Source: *World Bank Development Report* (Various Issues).

Notes: LIC = Low Income Countries, i.e., countries with GDP per capita less than $1000 in 1970.
HIC = High Income Countries, i.e., countries with GDP per capita more than $1000 in 1970.

Table 2 presents summary statistics on life expectancy and on health expenditure for different regions of the world. Life expectancy is highest for the countries classified as market economies, followed by former Socialist Europe and then by Latin America. Similarly these three regions have the highest per capita health expenditure (for 1990) $ 1860 for market economies, $142 for former Socialist Europe and $ 105 for Latin America. With regard to the percentage of health expenditure to GDP, the market economies and India spend 9.2 percent and 6 percent respectively on health.

Table 2

Life Expectancy and Health Expenditure

	Life Expectancy		In $ in 1990 Health Exp. per Capita	Health Exp. /GDP	Health Aid
	1960	1990			
Sub-Saharan Africa	43	52	24	4.5	2.5
India	47	58	21	6.0	0.3
China	43	69	11	3.5	0.1
Other Asia	50	62	61	4.5	0.9
Latin America	54	70	105	4.0	1.3
Former Socialist Europe	66	72	142	3.6	–
Market Economics	70	76	1860	9.2	–
Middle East	44	61	77	4.1	0.9
World	53	65	323	8.0	–

Source: World Development Report 1993.

II. MODEL, METHODOLOGY AND DATA

The following general form of the health status equation is estimated in this study:[3]

$$HS = f(GDP, HE\text{-}PC, Urb., Lit., Flit., Phy., n., Cal.) \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

[3]In most macro studies, micro relationships are aggregated, and average data are used for estimation. However, these averages may be misleading if the distribution of variables, like GDP, is important or the variables which are exogenous at the micro level become endogenous at the macro level.

HS is the health status indicator. For the purpose of this study life expectancy at birth and the infant mortality rate are used as health status indicators. GDP is per capita gross domestic product. *HE-PC* is health expenditure per capita. *Urb.* is the percentage of population living in the urban areas. *Lit.* is defined as the literacy rate in a country. *Flit.* is the female literacy rate. *Phy* is population per physician. *n* is population per nursing staff. *Cal.* is average calorie-intake per day.

The growth of GDP is expected to improve health status in a country. As incomes grow households can spend more money on looking after their health. However, this variable may be highly colinear with a number of other variables, like urbanisation, literacy, and health expenditure. In that case looking only at GDP may not tell us much about its own impact on health status. In order to avoid the problem of biased estimates, we are including variables such as urbanisation, literacy and others, explicitly, in our analysis.

HE-PC is health expenditure per capita. It is expected to have a positive influence on health status. This variable has important implications for policy purposes as well. However, health expenditures may not be representing the same preventive or curative expenses in developing and developed countries. Therefore, the impact may be different.

Urb. is the percentage of population living in urban areas. This variable may have a positive or negative effect. If an increase in urbanisation means quick access to better health services the effect is expected to be positive. However, if it results in inefficient health services or if it creates environmental problems it can lead to adverse effects on health.

Lit. (literacy) is expected to have a positive effect on health. However, it is difficult to say that its coefficient will reveal the net effect of changes in human capital as it may be correlated with the distribution of wealth. In the absence of any empirical evidence it is difficult to assess the direction of bias.

Similarly female literacy (*Flit*) is expected to be positively related to health improvements as better educated mothers are expected to be better informed about the availability of health services and are able to adopt preventive and curative measures more effectively.

The availability of physicians and nursing staff indicate the availability of health services. In this study, population per physician (*Phy.*) and population per nursing staff (*n*) are included. These variables are also taken as the indicator of price of health services. If '*Phy.*' or '*n*' increases it implies that the price of health services is rising and the health status will deteriorate and vice versa.

Improvements in calorie intake per day (*Cal.*) are expected to improve the

nutritional status of a nation, and consequently the health status. However, the effect may be very strong at the initial changes in caloric intake and then may be slower after a certain level of nutrition has been achieved.

In order to estimate (1), we may face econometric problems like:

1. The explanatory variables may be correlated. We test for multicollinearity and in case the coefficients are adversely affected we adjust for multicollinearity.
2. The measurement errors may be significant, however, with no alternative data source available we assume that these errors cancel out, on average.
3. Health status, nutrition and economic indicators may be determined simultaneously. We are planning to examine this issue at a later stage.

In this study, we have applied the generalised least squares (GLS) method of estimation.

Data

Data are taken from various World Bank Reports, Summers and Heston (1988), and UN population reports. For details of data see the technical notes in the World Development Report 1993 which is devoted to analyse health-related issues. The data are divided between low income countries (LICs) and high income countries (HICs) based on GDP per capita in 1970. The dividing level is $ 1000.

III. RESULTS

The results are reported in Appendix Table 2. Alternative specifications are estimated and reported equations are selected on the basis of minimum RMSE and on the basis of statistical significance of the coefficients. The results show that the low income and high income countries respond differently to changes in socio-economic conditions. Furthermore, the results show significant variation in coefficients over time. This indicates that country-specific effects between low and high income countries are present and aggregation over low and high income countries may lead to misleading conclusions.

The following conclusions emerge from Appendix Table 2. Increase in GDP per capita affects life expectancy at birth positively. The coefficient is not statistically significant for 1960 and 1970 except for 1990. Similarly for infant mortality the sign of the coefficients is negative and statistically significant for 1990 only. This

shows that during recent years GDP per capita has become an important factor in improving health status in low income and high income countries. The effect of health expenditure is negligible and it has not changed over time.

Urbanisation affects life expectancy positively in the earlier years but the effect is not statistically significant in the later years. The reason could be that over-crowded cities and other problems related to urbanisation have negated the earlier positive impact on life expectancy. However, infant mortality rate is not affected by urbanisation, except in the 1960s in high income countries. These results also show that the effect of urbanisation on the IMR is mixed. For example, in low income countries the effect on the IMR is positive for 1990 and 1960, but for high income countries the effect is negative except in 1990. On the basis of these results we can say that although urbanisation led to an improvement in health status, its effect is reversed with the passage of time, and the reason may be the problems associated with rapid urbanisation, particularly in low income countries.

Literacy is the most important and statistically significant variable. This variable improves life expectancy and has a significantly negative effect on the infant mortality rate. The effect of female literacy shows mixed results. Its effect on life expectancy is not significant and it varies over time although the effect on the IMR is consistently negative. However, the insignificant coefficients may be a result of strong multicollinearty between *'Lit'* and *'Flit'*. therefore, we can say that human capital formation as a result of the rise in literacy in a country is important for improving the health status of a country. This supports the results of Grosse and Perry (1983) and Hitiris and Posnett (1992) that human capital formation plays an important role in improving health status.

The price variables, i.e., population per physician and population per nurse are not statistically significant. Similarly nutrition is also found to be statistically insignificant.

On the basis of these results we can say that literacy is the most important variable affecting health status in low and high income countries during 1960 and 1990. GDP per capita and urbanisation are also important variables but the effect of these variables has changed over time.

These results do not contradict the earlier results reported by Grosse and Perry (1983) and others. However, the results for 1960 and 1970 are quite different in terms of significance of the parameters.

The comparison of elasticity estimates, reported in Table 3 shows that in general the elasticity estimates with respect to GDP have increased over time. The results also show that the effect of changes in GDP is higher in low income

countries, implying a more stronger impact of changes in GDP in the LICs as compared to the HICs.

Table 3

Elasticity Estimates – Multiple Regression Results

	1990		1970		1960[a]	
	LIC	HIC	LIC	HIC	LIC	HIC
A. Life-expectancy at Birth						
GDP – P.C.	0.09	0.019	0.032**	0.017**	0.052**	0.006**
H.E. – P.C.	–	0.004**	0.016	–0.008**	–	–
Urb	–0.026	0.016	0.066	0.221	0.040	0.050
Literary	0.108	0.206	0.286	0.190	0.089	0.261
Flit	0.047**	–	0.134	0.038	0.039**	0.028**
Phy	–0.072	–	–	–	0.017**	–0.061**
n	–0.02**	–	–	–	0.042**	0.012**
Cal	–	–	0.267	0.027**	–	–
	1990		1970		1960	
	LIC	HIC	LIC	HIC	LIC	HIC
B. Infant Mortality Rate						
GDP – P.C	–0.237	–0.526	–0.129	–0.410**	–0.045**	–0.011**
H.E. – P.C	–0.045**	–0.020**	–0.044**[a]	–0.003**	–	–
Urb	0.342*	0.221**	–0.018	0.385*	0.039**	–0.246
Lit.	–0.363	–2.001	–0.683	1.116**	–0.149	–1.068
Flit	–0.1.99**	–	–0.382	1.607	–0.028**	–0.051**
Phy	–	–	–	–	–0.010**	–0.077**
n	–	–	–	–	–0.015**	0.025**
Cal	0.177**	–	–0.662**	–0.631	–	–

* Statistically Significant at 5 percent.

** Statistically insignificant.

[a] Linear functional form was selected for 1960.

The effect of health expenditure is insignificant but in absolute terms the effect of changes in HE-PC is higher in the LICs and the coefficient has not changed much during 1970 and 1990, whereas it has increased over time for the HICs.

The elasticity estimates for 'urb.' vary significantly over time and across countries. Literacy affects IMR more than proportionally, i.e., a one percent increase in literacy brings more than one percent decline in the IMR in HICs. But in LICs the effect is less than proportionate. Similarly, the remaining elasticity estimates show, a less than proportionate effect on life expectancy and on the IMR.

If we predict life expectancy at birth and the infant mortality rate for 1990 using 1960 coefficients and the mean values of the explanatory variables for 1990 we see that life expectancy is underestimated and the infant mortality rate is overestimated. The predicted values of life expectancy are 52.43 years and 64.37 years for LICs and HICs, respectively. Similarly predicted values of the infant mortality rate are 129.60 and 38.34 in LICs and HICs, respectively.[4] This discrepancy is higher for the infant mortality rates (IMR) showing that the predictive power of IMR–equations is much lower and the results should be interpreted with caution.

IV. CONCLUSIONS

The main conclusion of this study, like earlier empirical studies, is that literacy is the most significant variable affecting health status. This variable has remained important for the last 30 years and it is important for all countries irrespective of their developmental stage. Urbanisation can be used as an important variable to improve health status but its effectiveness may be limited. Similarly GDP is also an important variable which affects health status and its role is becoming important over time. Thus the results of this study confirm the conclusions drawn in the earlier studies. However, these results should be interpreted with care as the aggregation may have concealed important policy information. Therefore, it may be important to do the same analysis for individual countries. At present, the data constraints do not allow such an analysis to be undertaken.

Another important issue could be the simultaneity bias. This issue may be important as the health status may affect economic growth also. The study by Wheeler (1980) estimates a simultaneous equation model but the results are not very precise. Therefore the existing empirical studies do not confirm or reject the presence of simultaneity bias. At present, time and data nonavailability are the major constraints. However, we intend to explore this issue in a study later.

[4] Actual life expectancy in 1990 was 60.06 and 73.93 years in LICs and HICs, respectively. Actual infant mortality rate was 74.696 and 15.74 in LICs and HICs.

Appendix Table 1

Summary Statistics–Mean, Standard Deviation and Coefficient of Variation

	1990		1970		1960	
	LIC	HIC	LIC	HIC	LIC	HIC
Life Expectancy	60.06	74.696	52.82	69.70	39.60	58.846
	(10.58)	(5.973)	(10.455)	(6.977)	(5.73)	(10.55)
	[0.176]	[0.080]	[0.198]	[0.100]	[0.145]	[0.179]
IMR	73.93	15.74	113.61	28.13	168.96	93.37
	(40.89)	(25.74)	(45.12)	(33.79)	(35.166)	(58.67)
	[0.553]	[1.635]	[0.397]	[1.201]	[0.208]	[0.628]
GDP–per Capita	1372	17805	309.97	2476	510.31	3370
	(2147)	(8430)	(253.92)	(1142)	(198.48)	(5888)
	[1.565]	[0.473]	[1.221]	[0.461]	[0.388]	[0.572]
HE–per Capita	7.882	555.78	2.76	49.69	–	–
	(18.903)	(473.97)	(5.951)	(44.95)	–	–
	[2.398]	[0.853]	[2.156]	[0.905]	–	–
URB	44.278	75.04	32.167	69.17	13.948	49.49
	(22.583)	(15.349)	(21.594)	(17.96)	(9.701)	(22.04)
	[0.510]	[0.205)	[0.671)	[0.260)	[0.696)	[0.445)
Literacy	58.264	94.87	64.56	99.00	32.98	87.86
	(29.73)	(13.19)	(33.717)	(23.31)	(29.19)	(30.09)
	[0.510)	[0.139)	[0.522)	[0.236)	[0.885)	[0.343)

Continued–

Appendix Table 1 – (*Continued*)

Female Literacy	58.694	93.91	42.125	90.15	20.176	68.14
	(31.694)	(16.08)	(26.57)	(21.484)	(19.45)	(28.79)
	[0.625]	[0.171]	[0.631]	[0.238]	[0.964]	[0.423]
Nutrition	2493	3303	2262	3128	–	–
	(474.38)	(319.71)	(331.95)	(414.85)	–	–
	[0.190]	[0.097]	[0.147]	[0.133]	–	–
Pop–per Physician	7282	324.78	15928	2300	34561	3617
	(13988)	(239.75)	(21962)	(7093)	(33151)	(6528)
	[1.921]	[0.738]	[1.379]	[3.084]	[0.959]	[1.805]
Pop–per Nurse	465.634	39.13	2908	163.91	8315	2322
	(1073)	(122.21)	(7819)	(201.65)	(12145)	(3091)
	[2.304]	[3.123]	[2.689]	[1.230]	[1.461]	[1.331]
N	66	23	66	23	51	58

Notes: LIC = low income countries, i.e., countries with GDP–per capita less than $ 1000 in 1970.
HIC = high income countries, i.e., countries with GDP–per capita greater than $ 1000 in 1970.
* Numbers in parentheses are standard deviation.
** Coefficient of Variation is reported in brackets.
N = number of observations.

Appendix Table 2

Multiple Regression Results of Selected Equations

	1990				1970				1960	
	LIC		HIC		LIC		HIC		LIC	HIC
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
A. Life Expectancy at Birth										
C	3.845	1.07	3.102	3.36	3.848	1.341	2.733	3.285	30.28	32.22
	(5.93)	(1.00)	(17.38)	(38.68)	(9.15)	(1.74)	(5.70)	(5.09)	(13.85)	(8.29)
GDP–PC	0.091	0.057	0.019	0.024	0.03	0.032	0.005	0.017	0.004	0.0001
	(2.24)	(1.19)	(2.11)	(5.21)	(1.24)	(0.55)	(0.40)	(0.39)	(1.26)	(1.46)
HE–PC	–	–0.011	0.004	–	–	0.016	–	–0.008	–	–
	–	(0.44)	(0.69)	–	–	(0.91)	–	(1.14)	–	–
Urb.	–0.026	–0.08	0.016	0.011	–0.003	0.066	0.085	0.221	0.114	0.059
	(0.48)	(1.08)	(0.87)	(0.61)	(0.09)	(1.93)	(3.63)	(2.52)	(1.82)	(1.76)
Lit.	0.108	0.516	0.206	–	0.085	0.286	0.256	0.190	0.174	0.31
	(2.30)	(1.18)	(4.76)	–	(2.30)	(6.56)	(4.64)	(2.92)	(3.87)	(6.94)
Flit.	–0.047	–0.20	–	0.151	0.037	0.134	–0.023	–0.038	0.047	0.019
	(0.68)	(0.65)	–	(7.20)	(0.86)	(3.17)	(0.43)	(0.45)	(1.57)	(0.46)
Phy.	–0.072	–	–	–	–0.054	–	0.007	–	0.00002	–0.0001
	(2.73)	–	–	–	(2.57)	–	(0.28)	–	(1.16)	(0.59)
n.	–0.020	–	–	–	–0.007	–	0.006	–	0.00002	–0.0003
	(0.58)	–	–	–	(0.44)	–	(0.44)	–	(0.45)	(1.37)
Cal.	–	0.198	–	–	–	0.267	–	0.027		
	–	(1.37)	–	–	–	(2.34)	–	(0.17)		
R^2	0.873	0.705	0.858	0.85	0.836	0.878	0.975	0.988	0.71	0.873
F	14.90	10.35	42.14	76.33	36.60	42.98	45.59	42.75	16.16	56.06
N	32	32	32	32	49	42	22	22	46	55

Continued—

Appendix Table 2 – (*Continued*)

B. Infant Mortality Rate

C	3.902	11.803	15.575	15.575	7.256	11.466	20.88	6.546	197.38	216.37
	(1.14)	(2.40)	(7.72)	(7.72)	(3.86)	(3.17)	(2.25)	(5.19)	(12.91)	(9.63)
GDP–PC	–0.164	–0.237	–0.526	–0.547	–0.308	–0.129	–0.469	–0.41	–0.015	–0.0003
	(0.86)	(1.99)	(5.08)	(9.90)	(2.56)	(0.48)	(2.09)	(0.37)	(0.76)	(0.58)
HE–PC	–	–0.045	–0.020	–	–	–0.044	–	–0.031	–	–
	–	(0.41)	(0.34)	–	–	(0.52)	–	(0.09)	–	–
Urb.	0.391	0.342	0.221	0.281	0.026	–0.018	0.481	–0.385	0.466	–0.465
	(1.40)	(1.47)	(1.06)	(1.30)	(0.20)	(0.11)	(1.06)	(1.65)	(1.04)	(2.42)
Lit.	–0.229	–0.363	–2.001	–	–0.285	–0.683	3.96	–1.116	–1.25	–1.463
	(0.40)	(1.84)	(4.08)	–	(1.75)	(3.33)	(3.72)	(6.98)	(3.96)	(5.67)
Flit	–0.466	1.99	–	–1.273	–0.071	–0.382	1.684	1.607	–0.144	–0.054
	(1.27)	(1.44)	–	(4.98)	(0.36)	(1.92)	(1.64)	(3.50)	(0.68)	(0.22)
Phy.	0.115	–	–	–	–0.001	–	–0.624	–	0.00005	–0.0002
	(0.85)	–	–	–	–(0.01)	–	(1.37)	–	(0.33)	(0.26)
N.	0.241	–	–	–	0.03	–	–0.374	–	0.0003	0.001
	(1.26)	–	–	–	(0.42)	–	(1.40)	–	(0.95)	(0.61)
Cal.	–	0.177	–	–	–	–0.662	–	–0.631	–	–
	–	(0.27)	–	–	–	(1.23)	–	(3.47)	–	–
R^2	0.71	0.705	0.917	0.88	0.636	0.673	0.863	0.92	0.62	0.849
F	5.36	10.35	77.78	100.21	12.50	12.33	7.34	19.18	10.60	45.83
N	32	32	32	32	49	42	22	22	45	55

*For details, see notes in Appendix Table 1.
[a]Linear functional form was selected for 1960.

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