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Improved Health Status and Economic Growth: Some Long-Run Co-integration Results from Developing Economies

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1. Introduction

Need for economic growth of a country is essential in sustaining the welfare of its people at large. Since public investment in the economic sector plays a critical role in enhancing economic growth. it should, therefore, hold a high priority for the government. In recent years, it has been argued that the expenditure on social services and human development is also equally (if not more) important and must not be treated as merely consumption outlays as investment in these areas has a high positive (both private, and social) return to the economy (e.g., Singer (19S3), Newman and Thomson (1989), Lau Jamieson and Louat (1990). Louis and Raut (1993), Anand and Ravallion (1993). Romer (19,86, 1994).

The impact of diverting resources towards basic infrastructure facilities may be felt more directly and rapidly,

HEALTH PROFILE OF SELECTED COUNTRIES

Country	Fertility rate		Life Expectancy at birth (yrs)		Infant mortality Rate (per 1000 births)		Crude Birth Rate (per 1000 population)		Crude Death Rate (per 1000 population)	
	1965	1990	1960	1990	1960	1991	1965	1990	1965	1990
South Asia										
Bangladesh	6.8	4.6	39.6	51.8	156	111	47	35	21	14
India	6.2	4	44	59.1	165	90	45	30	20	11
Pakistan	7	5.8	43.1	57.7	163	101	48	42	21	12
Sri Lanka	4.9	2.4	62	70.9	71	25	33	20	8	6
East Asia & Pacific										
China	6.4	2.5	47.1	70.1	150	29	38	22	10	7
Fiji	4.9	*3*	59	64.8	71	24	35.7	*27.3*	6	*4.1*
Hong Kong	4.5	1.5	66.2	77.3	44	6	27	13	6	6
Indonesia	5.5	3.1	41.2	61.5	139	68	43	26	20	9
Malaysia	6.3	3.8	53.9	70.1	73	15	40	30	12	5
Papua New Guinea	6.2	5.1	40.6	54.9	165	56	43	36	20	11
Philippines	6.8	3.7	52.8	64.2	80	42	42	29	12	7
Singapore	4.7	1.9	64.5	74	36	7	31	17	6	5
South Korea	4.9	1.8	53.9	70.1	85	22	35	16	11	6
Thailand	6.3	2.5	52.3	66.1	103	28	41	22	10	7
Africa										
Benin	6.8	6.3	35	47	185	88	49	46	24	15
Cameroon	5.2	5.8	39.2	53.7	163	66	40	41	20	12
Egypt	6.8	4	46.1	60.3	179	59	43	31	19	10
Ghana	6.8	6.2	45	55	132	84	47	44	18	13
Rwanda	7.5	8.3	42.3	49.5	150	112	52	54	17	18
Zimbabwe	8	4.9	45.3	59.6	110	61	55	37	17	8
Southern Europe										
Turkey	5.7	3.5	50.1	65.1	190	60	41	28	15	7
Latin America										
Argentina	3.1	2.8	64.9	71	60	30	23	20	9	9
Colombia	6.5	2.7	56.5	68.8	99	38	43	24	11	6
Developed Countries										
France	2.8	1.8	70.3	76.4	*22*	7	18	13	11	10
Japan	2	1.6	67.9	78.6	*13*	5	19	11	7	7
United States of America	2.9	1.9	69.9	75.9	*25*	9	19	17	9	9

SOURCES:
World Tables 1994; Human Development Report 1993; World Development Report 1992; World Tables 1987.

NOTE: Data in Italics refer to a year or period other than that specified in the column heading.

made to increase the life span of people. But since the social sector infrastructure is weak. it will be a long time before these nations reach a more acceptable status. Egypt has, however, made considerable improvements as its life expectancy of 46.1 in 1960, which was almost in the same range as other African countries, has since increased to 60.3 by 1990.

A similar situation can be observed when fertility and infant mortality rates arc examined in Table 1. Again, the low' income countries have shown high rates of infant mortality. Rwanda lops the list with an infant mortality rate of 112 per thousand in 1991 and the decline is much slower over the years (150 in 1990) as compared to other countries in the legion. In South Asia high rate of infant mortality prevails quite extensively across (lie region with Bangladesh, India and Pakistan still carrying an infant mortality rate of 90 or more per 1000 births. Sri Lanka has, however, continued to lower their infant mortality rate declining from 71 in 1960 to 25 in 1991.

In the case of crude birth rate, we again find (he highest rate emerging from the less developed countries with Rwanda topping the list with a crude birth rate of 54 per 1000 population in 1990. Similar trends can be observed for oilier less developed nations like Benin (46) and Ghana (44). The reasons for such high fertility rate may be due to less awareness among the masses and viewing more births per individual's household as economic investment. It is considered investment in the sense that these newborns, if they survived, would act as a social security for the previous generation when they retire. Developed countries lend to show low crude birth rate with Japan being the lowest across the countries considered. In the region wise comparison, among (lie South Asian countries. Pakistan shows (he highest crude birth rate. while in the fast Asian and Pacific region. Papua New Guinea shows the highest rate of 36 per 1000 population. In this legion, however, a positive change over the years is significantly visible, particularly in South Korea. In the African countries, the rate is quite high and does not show' visible improvements over a span of time (see Table 1). The developed countries realized from the beginning the nature of importance attached to these social variables. Although the crude birth rate was low even in the earlier periods, a declining trend in these countries still continues.

A similar trend is visible when crude death is examined in Table 1. The highest crude dealh rate is found in the less developed countries of Africa with Rwanda having a death rate of 18 per 1000 population. However, there seems to be some improvement in the crude death rate across the countries in South and East Asian regions.

The importance and priorities given by each country towards social development can be understood by comparing the share of social sector expenditures vis-à-vis other sectors. According to the World Development Report 1993, world spending on health was about $1.700 billion in 1990 almost 8 percent of the global income. The contribution of the government spending in this area is more than $1,000 billion which is about 60 percent. The developing countries of Africa, Asia and Latin America, spend only XI 70 billion on health, out of which the public sector contribution was half the amount. This amounts to about 2 percent of the GNP of these regions. On the other hand according to the report, in the well-established market economies, the governments spend $900 billion which amounts to more than 5 percent of GNf (total health spending for these economies was nearly $1,500 billion). The role of the government does not end here as, in an indirect way. it supports and strengthens the health status by making useful endeavours in the areas of' education, sanitation and other social measures.

The preference towards social sectors would certainly act as a catalyst in boosting the economic as well as social growth. 1 he highly developed countries are shown to carry a higher percentage of expenditures incurred in the areas of health and education. This holds true for cross country (as shown in Table 2) as well as regionwise comparison (as shown in Table 3). One very interesting point that emerges is the preference towards military expenditures by specific countries. Table 2 indicates dial the more a country is regarded as a developed nation, the less it lends to spend on military expenditures with the exception of few countries like Singapore. Figures reported in Table 2 for developed countries like France and USA show not only a decline in military expenditure but these countries have also directed their resources and spendings towards other socially and economically feasible domains. Singapore, being a small but well-developed country with highly developed defense, requires a relatively higher share of its GDP. On the other hand, the countries that can be considered as highly progressive like South Korea and Indonesia, have also registered a drop in military expenditure as a percentage of GDP as shown in Table 2. Furthermore, the public expenditures as a percentage of 'GNP in most of these countries shows an upward trend.

Table. 2

TRENDS OF EXPENDITURE OUTLAYS OF SELECTED COUNTRIES

Country	GNP per capita (US$) Millions		Military Expenditure (as % of GDP)		Public Expenditure on Health (as % of GNP)		Public Expenditure on Education (as % of GNP)	
	1966	1990	1960	1990	1960	1988-90	1960	1988-90
South Asia								
Bangladesh	70	210	-	1.6	-	0.9	0.6	2.2
India	90	360	1.9	3.3	0.5	3.2	2.3	3.2
Pakistan	120	400	5.5	6.6	0.3	4.5	1.1	3.1
Sri Lanka	170	470	1	4.8	2	2.3	3.8	2.7
East Asia & Pacific								
China	110	410	12	N.A	1.3	3.1	1.8	2.1
Fiji	310	1780	N.A	2.5	N.A	N.A	N.A	5
Hong Kong	680	11950	N.A	0.4	N.A	N.A	N.A	2.7
Indonesia	40	560	5.8	1.6	0.3	2.5	2.5	0.9
Malaysia	340	2360	1.9	3.6	1.1	1.6	2.9	5.5
Papua New Guinea	170	870	N.A	N.A	N.A	3.2	2.5	N.A
Philippines	200	730	1.2	1.8	0.1	5.3	2.3	3
Singapore	590	12400	0.4	5	1	2.9	2.8	3.4
South Korea	130	5450	6	4	0.2	0.4	2	3.7
Thailand	150	1470	2.6	3.2	0.4	5.6	2.3	3.8
Africa								
Benin	100	360	1.1	2	1.5	5.1	2.5	N.A
Cameroon	130	910	1.7	2.1	1	N.A	1.7	3.3
Egypt	180	610	5.5	4.6	0.6	5	4.1	6
Ghana	250	390	1.1	0.6	1.1	1.2	3.8	3.4
Rwanda	50	320	N.A	1.7	0.5	0.6	0.3	4.2
Zimbabwe	220	690	N.A	7.3	1.2	5.5	0.5	8.2
Southern Europe								
Turkey	310	1640	5.2	4.9	0.8	2.8	2.6	1.8
Latin America								
Argentina	1010	3270	2.1	3.3	1.3	N.A	2.1	1.5
Colombia	200	730	1.2	2.7	0.4	3	1.7	2.9
Developed Countries								
France	2210	19460	6.3	3.6	4.2	8.8	3.6	5.7
Japan	1010	25840	1	1	2.9	6.7	4.9	5
United States of America	3930	21970	8.8	5.6	5.2	12.2	5.3	5.7

SOURCES:

World Tables 1987 and 1994; Human Development Report 1993.

NOTE: For highly developed countries,total health expenditure and total education expenditure is given as a % of GDP.

Table 3

Country	GNP per capita* (US$) Millions		Military Expenditure** (as % of GDP)		Public Expenditure on Health** (as % of GNP)		Public Expenditure on Education** (as % of GNP)	
	1966	1990	1960	1990	1960	1988-90	1960	1988-90
South Asia								
Bangladesh	70	210	...	1.6	...	0.9	0.6	2.2
India	90	360	1.9	3.3	0.5	3.2	2.3	3.2
Pakistan	120	400	5.5	6.6	0.3	4.5	1.1	3.4
Sri Lanka	170	470	1	4.8	2	2.3	3.8	2.7
East Asia & Pacific								
China	110	410	12	N.a	1.3	3.1	1.8	2.4
Fiji	310	1780	N.a	2.5	N.a	N.a	N.a	5
Hong Kong	680	11950	N.a	0.4	N.a	N.a	N.a	2.7
Indonesia	40	560	5.8	1.6	0.3	2.5	2.5	0.9
Malaysia	340	2360	1.9	3.6	1.1	1.6	2.9	5.5
Papua New Guinea	170	870	N.a	N.a	N.a	3.2	2.5	N.a
Phillipines	200	730	1.2	1.8	0.4	5.3	2.3	3
Singapore	590	12400	0.4	5	1	2.9	2.8	3.4
South Korea	130	5450	6	4	0.2	6.4	2	3.7
Thailand	150	1470	2.6	3.2	0.4	5.6	2.3	3.8
Africa								
Benin	100	360	1.1	2	1.5	5.1	2.5	N.a
Cameeron	130	910	1.7	2.1	1	N.a	1.7	3.3
Egypt	180	610	5.5	4.6	0.6	5	4.1	6
Ghana	250	390	1.1	0.6	1.1	1.2	3.8	3.4
Kenya	120	360	0.5	2.4	1.5	2.1	4.6	6.4
Rawanda	50	320	N.a	1.7	0.5	0.6	0.3	4.2
Zimbabwe	220	690	N.a	7.3	1.2	5.5	0.5	8.2
Southern Europe								
Turkey	310	1640	5.2	4.9	0.8	2.8	2.6	1.8
Latin America								
Argentina	1010	3270	2.1	3.3	1.3	N.a	2.1	1.5
Colombia	200	730	1.2	2.7	0.4	3	1.7	2.9
Highly Developed Countries								
France	2210	19460	6.3	3.6	4.2	8.8	3.6	5.7
Japan	1040	25840**	1	1	2.9	6.7	4.9	5
United States of America	3930	21970	8.8	5.6	5.2	12.2	5.3	5.7

* World Tables 1987/1994 for 1966 and respectively
■ Total health expenditure as a % of GDP for 1960 and 1990
** Human Development Report 1993
Total education expenditure as a % of GDP for 1960 and 1988

II is interesting to note that less developed countries such as Zimbabwe show .1 comparative increase in the military spending (7.3 % of the GDP in 1990) and not substantial increments in UK Social sectors particularly in health and education over the years. There are of course, many demographic and political rationales behind high military expenditures and these cannot bi. overlooked.

3. Literature Review of Health Related Empirical Studies

In recent years, a number of analytical studies have been undertaken to test the importance of health status in economic growth. These studies involve diverse perspectives and have drawn results exploring different methodologies and incorporating various determinants of health. For instance, Siddiqui and Mahmood (1994), in cross-country analysis applying Generalized least Square (GLS) technique, suggested that literacy rate has a profound effect on improving the health status. Elevated literacy level tends to improve life expectancy and bring a decline in the infant mortality rate. GDP has also been seen as laying a meaningful role in influencing the health status. Increase in income creates more room for spending money on improving health. The analysis shows a difference in response of the low and high-income countries. The low-income countries are more predisposed to the increase in GDP as compared to high-income countries. S9imilarly, the repercussions of literacy on the infant mortality rate in the low-income countries are lower in comparison to high-income countries.

Since the Siddiqui and Mahmood (1994) study is based on a cross-country pooled time series data, the estimates attained are sensitive to the time period considered. The positive effects of increase in GDP over life expectancy are significant for 1990 but not for 1960 and 1970. Similarly, the coefficients of infant mortality are significant for 1990 only. Their study, however, does not consider the issue of simultaneity between econo9mic growth and health status. Moreover, the estimation was marred by the problem of multicollinearity. Similar inferences were made by Preston (1983) and Grosse and Perry (1983) for 1940 & 1970 and 1960s & 1970s, respectively, however, they differed in terms of significance of the parameters.

Knowler's (1995) study in this conical, however, suggested a stronger and more robust relationship between income per capita and educational human capital. He used a Two Stage Least Square (2SLS) method to estimate Ins results. Analyses done in these studies are based on cross country pooled time series data hence the estimates obtained may be sensitive to the time period considered. Wheeler (19MO) also suggested that human resource development promotes high labour productivity. It lessens the fertility rate and increments per capita income.

Anand and Ravallion (IW3) in a cross country analysis, suggested (hat there exists a relationship between average income and basic health indicators. The average affluence according to them has an effect on basic, health. This influence is visible in two ways one is that the prosperity may contribute in reducing the income and poverty levels and the oilier is in the enhancement in the public services. They further argued that the positive correlation across countries between life expectancy and affluence fades away once these two are regulated. It is seen that public spending on health has a more profound influence. They also found that two-thirds of the elasticity of life expectancy with respect to average income is associated with the positive effect of income on public health services while only one-third can be attributed to (he decline in the income and poverty levels. However, they point out that the relative importance of these two may differ among countries.

Most of the empirical studies so far analyse the relationship between health sector variables and economic grow. th (on a cross country basis), however, one ol the important aspects missing in these studies has been the establishment of a long-run stable relationship between these variables. This is important particularly in terms of formula! ing long-run economic and health policies. In order to test such a long-run relationship we have used the recently proposed estimation techniques and statistical tests know as "co-integration and error correction".

The next section is a discussion on (he model and the estimation techniques used in the study.

4. Model and Econometric Methodology

In order to test the role of health sector in economic development of a society we have adopted an approach which is more exploratory in character. While the traditional neoclassical production model postulates that it is the physical inputs such as private capital, labour, land and technology which are the key determinants of output and economic development, in recent years however, the social sector variables are also considered to be critical particularly for the long-run sustainable growth of the economy. In fact, what has been argued which is now in the form of "new growth theories" (due to Romer (1986, 95); Lucas (1988)| is that social variables (e.g.. education, health, knowledge, etc.) generate "positive externalities" and thus may facilitate and foster the process of economic growth and development.

Recently, the World Bank. based on a broad cross country study found some very interesting results in the above context. According to the *World Development Report* (1991) about fifty percent of the factor productivity contribution to output growth comes not from traditional physical inputs (capital, labour and land) but is a residual factor. This *unexplained* factor, in the past has been labelled (or as the *Report* called it “baptized”) as "technological change", however, the *World Development Report* (1991. p.42) claims that:

Technological innovations have no doubt generated some improvement in total factor productivity'. But the main additional element of *quality of labou*r (i.e. health status) on the total productivity of output.

Of course, the quality of labour will come about due to education, skills and the status of health that the society provides for the work force. In this study, we have, therefore tested the impact of one of the key elements of *quality of labour* (i.e., health status) on the total productivity of output.

4.1 ***Model*** We postulate the following exploratory specification for the output per capita as a function of health related variable:

GNPPC =f(FERT, LIFE ,EXP. IMP. CBR. CDR. POPBED. POPPHY. PPBED).

where the variables in the above equation are de-fined as:

GNPPC	GNP Per Capita
PERT	Fertility Rate
LIFE_EXP	Life Expectancy
IMR	Infant Mortality Rate
CBR	Crude Birth Rate
CDR	Crude Death Rate

POPBED	Population Per Bed
POPPHY	Population Per Physician
PPBED	Bed Per Physician

With the exception of life expectancy all other variables in general should have a negative relationship with GNP per capita income. This is based on the premise that negative attributes of health status such as high rates of birth, mortality, death, more population per bed, physician etc. arc expected to impart a negative impact on economic growth. On the other hand, a positive quality of health such as elevated life expectancy is expected to have a favourable influence on GNP. There may, of course be some country specific variations and multicollinearity problems in estimation which may lend to unexpected signs in some of the health related variables considered.

4.2 ***Econometric Methodology***

Inspite of some of the technical and cross country specific anomalies, the crucial and main focus of this study is to examine whether there exists a long run stable relationship between economic development (GNPPC) and health related social variables. Rather than using the traditional simple correlation or classical regression analysis, we have used the recent econometric techniques proposed for testing long-run relationship between health variables and economic development. It has been argued [Engle and Granger (1987)]' that traditional econometric properties of test-statistics (e.g., t-test and F-test) are predicated on the assumption that the time series generating such statistics are *stationary* or else the standard interpretation of these measures (mean and variance) will break down. Intuitively stationary is simply the proclivity of a variable moving towards its long-run trend value alter encountering a shock. In the absence of stationary, the direct functional relationship between two or more non-stationary time series could be due to spurious correlation.

Our methodology of empirically testing the long-run equilibrium relationship between economic development and health thus entails the following steps:

a) First, we test the stationary of each time series variable in levels based on the commonly used

1 A plethora of literature is now available on this topic and readers may refer to the orginal ar4ticles by Engle and Granger (1987). An excellent intuitive exposition on stationary and co-integration is also available in Mossa (1992)

Augmented Dicky Fuller (ADF) statistics with appropriate lags.2

b) II the time series variables are *found* to be stationary, we then directly apply the standard regression technique to examine the long-run importance of the causal (with lags) variable on the dependent variable alter taking into account the lag effects of the latter variable.

c) In case of non-stationary series., we test for the existence of co-integration. If the series are co-integrated, then a OLS regression is applied on the co-integrated variables within the framework of an "Error-Correction" model.

d) As for non-co integrated and non-stationary series in levels, we simply integrate (or difference to higher order) the variable to make it stationary before applying the standard 01.S technique.

5. Data and Results

5.1 Data

For estimation purposes a concerted effort has been made to acquire the most reliable, standardized and long lime series data on a cross-country basis. Our data set spans over thirty years ranging from 1960 to 1990. Keeping in view the aim of broad cross-country analysis, twenty-six countries from South Asia, East Asia and Pacific, Africa. Latin America, and Developed Economics of the world have been included in the study. Mainly, the economic variable employed is the per capita gross national product given in US dollars while (he health variables used incorporate life expectancy, fertility rate. infant mortality rate. population per physician, population per bed. crude birth rate and crude death rate.

2. For a technical details on stationarity test, reader may refer to Dickey and Fuller (1979, 1981).

3. Intuitively, the concept of co integration is straightforward. What it implies is that even if two or more series may be individually non-stationary, it is possible that a linear combination of these series may have a long-run relationship. Thus. the stochastic error-terms of this co integrating equation should be stationary. A simple ADF test can then be applied on this error-term to test for the existence of co integration. For technical details, reader may refer to Johansen (1988, 1991, 1992)

4. In the case of non-stationary co integrating variables, the Granger-causality test also includes an appropriate Error-correction (EC) term generated from the long-run relationship. The advantage of incorporating such an EC term in the causal equation is that it controls for "disequilibrium en-or (i-e., the gap between actual behavior and the long-run relationship given by the co-integrating variables" of the series. [See for details Engle and Granger 1987].

The major source of data for the analyses is derived from the World Tables of 1987 and 1994 published by the World Bank and (he Statistical Year Book for Asia and Pacific of 1987 and 1994 published by United Nations. During the course of compilation of data, at some instances, we felt the constraint of missing data. Missing data gaps have been filled by using the standard growth rates and regression forecasting techniques. Data on per capita gross national product was readily available except for the period of 1960 to 1965. whereas, data on health variables posed certain availability obstacles. Very few gaps were present in the data on life expectancy and fertility rates and were. therefore, lilted by using simple growth rate. Data on population per physician and population per bed was extensively missing and. therefore, has been generated using regression analysis and. in some cases, growth rate.

It is important to note that the data on several variables in the developing countries may neither be fully available nor completely reliable. Therefore, when interpreting the variables, these limitations should be kept in mind.

5.2 ***Results*** We postulate a simple model assuming that the per capita gross national product is affected in the long run by various health variables. '1 he results are discussed in the following paragraphs.

5.2.1 Stationarity

Following the standard practice in the literature, we have applied *Angfnentei.1 Dickey-Fuller* (ADF) technique to lest for the stationanty of each lime series variable in the study. The basic null hypothesis tested is the presence of non-stationarity (or unit root) in the series. A large negative ADF value will establish the stationarity of the Series. Estimated ADF test statistic and its critical values are reported in Table 4. Based on (lie *ADF* test statistic values, we found, as expected, almost all the time series variables to be non-stationary (201 out of 234) at the 5 percent level of significance. Given the non-stationarity behaviour of these variables, a simple con-elation

Table. 4
Unit Root Stationarity Test:
Estimated Augmented Dicky Fuller (ADF) Statistics

Country	GNPPC	FERT	Life_Exp	IMR	CBR	CDR	POPBED	POPPHY	PPBED
South Asia									
Bangladesh	-3.137	-0.451	1.271	-4.143*	-2.212	-3.712*	-0.123	-1.758	-1.154
India	-1.729	-2.388	-1.152	-1.474	-2.040	-2.497	-2.185	-2.432	-2.314
Pakistan	-2.048	-0.326	0.312	-2.982	-1.815	-2.747	-1.485	-0.899	-2.100
Sri Lanka	-1.535	-1.091	-1.847	-2.101	-1.675	-2.335	-3.163	-1.868	-0.908
East Asia & Pacific									
China	-1.760	-2.237	-1.488	-2.156	-1.299	-3.249	-0.448	-2.736	-2.159
Fiji	-1.960	-1.392	-2.042	-3.618*	-2.143	-7.813*	-1.882	-2.228	-1.524
Hong Kong	0.055	-0.842	-2.439	-1.263	-2.625	0.068	-3.291	-2.030	-2.370
Indonesia	-2.073	-1.528	-1.390	-2.373	-1.757	-2.669	-1.949	-1.715	-0.570
Malaysia	-1.957	0.187	-1.685	-1.921	-1.290	-0.363	1.019	-1.735	-1.699
Papua New Guinea	-2.270	-1.652	-2.206	-1.870	-2.414	-1.908	-1.567	-0.942	-0.151
Phillipines	-2.184	-2.224	-1.769	-1.941	-1.864	-1.561	-1.179	-2.792	-2.601
Singapore	0.341	1.428	1.505	-0.727	-1.241	-3.472	-2.399	-2.934	-5.089*
South Korea	2.066	-1.083	-1.059	-4.958*	-1.969	-1.024	-2.791	-3.711*	-2.255
Thailand	-0.212	-2.936	-1.753	-0.806	-2.464	-3.177	0.221	-0.883	0.300
Africa									
Benin	-2.038	-2.022	-2.020	1.029	-2.473	-1.402	-1.993	-2.756	-2.621
Cameroon	-1.940	-1.310	-1.130	-8.218*	-4.461*	-2.337	-2.218	-2.543	-6.206*
Egypt	-1.912	-2.227	-1.380	-4.246*	-2.116	-1.079	-2.134	-0.494	-0.624
Ghana	-1.948	-1.881	-2.556	-1.802	-1.748	-2.423	-9.127*	-3.836*	-1.722
Rwanda	-3.991*	0.058	-2.072	-1.286	-3.034	-2.309	-2.354	-10.009*	-6.736*
Zimbabwe	-1.813	-1.470	-0.634	-1.235	-2.860	-2.712	-1.827	-2.619	-3.369
Southern Europe									
Turkey	-2.29	-1.11	-1.78	-3.544	-1.48	-0.89	-1.59	-2.09	-3.217
Latin America									
Argentina	-2.360	-2.065	-2.023	-2.197	-2.153	-2.256	-3.728*	-2.028	-1.093
Colombia	-2.184	-2.224	-1.769	-1.941	-1.864	-1.561	-2.889	-3.455	-2.554
Developed Countries									
France	-1.546	-1.839	-1.364	0.051	-2.097	-3.458	-1.980	-1.761	-0.903
Japan	-0.112	-3.072	-1.697	-3.858*	-2.831	1.512	-2.470	-2.204	-3.809*
United States of America	-0.898	-0.155	-2.160	-1.582	-2.317	-2.342	-4.661*	-2.136	0.057

Note:

1. Critical value for ADF Statistics at 5% level of significance is -3.57
2. Variable marked with astrick are stationary at least at 5% level of significance

or regression on them, in this context, may produce results which could be termed as spurious in character unless a co-integration relationship exists between (lie variables.

5.2.2 Co-integration

Two or more non -stationary time series variables are considered to be co-integrated if the error term produced by a linear combination of these variables does not have stochastic trend and is stationary. Parameters estimated by a *Co-integrating equation* can be interpreted as having a long-run relationship which is not spurious. The co-integration test between two or more non-stationary time series was performed using Tohansen (1991) procedure which simply computes the likelihood ratio values for a null hypothesis of no co-integration. If the estimated likelihood ratio statistic exceeds the critical value at a stated level of significance, then the null hypothesis of no co-integration is rejected in favour of the existence of co-integration, 'fable 5 reports the results for both estimated likelihood ratio test and eigen values performed on a co-integration equation consisting of GNPPC and given health related variables defined earlier. For instance, in Table 5 figures such as 2^1.29 and 0.98 in parenthesis, respectively, represent estimated likelihood ratio and eigen value for a co-integrating equation between GNPP<.' and all other health related variables for Pakistan. One asterisk on the likelihood ratio value, in this context, implies the rejection of no co-integration null hypothesis at the 1 percent level of significance.

Based on the statistical significance of estimated likelihood ratios, figures in Table 5 clearly indicate that the hypothesis of no co-integration between GNPPC and overwhelming majority of the education variables are rejected for all the countries considered in the paper. 1 his implies that there exists a long-run relationship between economic development and health indicators across all (lie countries considered in the study.

5.2.3 ***Estimated Repress urn Results*** Given the existence of long-run co-integrating relationship between economic development and

health variables, we can now legitimately apply a simple ordinary least squares (OLS) technique to estimate the postulated model proposed earlier. Based on high R2 (explanatory power) values

Table. 5
Long Run Cointegration Test: Estimated Likelihood and Eigen Values

Country	GNPPC	FERT	Life_Exp	IMR	CBR	CDR	POPBED	POPPHY	PPBED
South Asia									
Bangladesh	190.53** (0.94)	121.94** (0.84)	42.16 (0.62)	0.89 (0.03)	4.24 (0.13)	18.66 (0.45)			76.53** (0.76)
India	105.75** (0.81)	7.98 (0.27)	64.86 (0.65)	0.01 (0.00)	38.42 (0.49)	21.58 (0.41)			
Pakistan	281.29** (0.98)	181.83** (0.95)	63.82** (0.65)		5.18 (0.18)	19.07* (0.42)	105.69** (0.81)	37.45** (0.52)	
Sri Lanka	262.20** (0.96)	177.97** (0.91)	114.35** (0.77)	5.87* (0.20)	21.18* (0.44)	75.65** (0.73)			40.81** (0.52)
East Asia & Pacific									
China	82.91** (0.71)	52.25* (0.59)	11.15 (0.26)		3.32 (0.12)				29.57 (0.52)
Fiji	254.91** (0.95)	176.92** (0.91)	116.15** (0.77)		79.09** (0.76)	43.17** (0.62)	0.20 (0.01)	18.67* (0.52)	
Hong Kong	322.66** (0.98)	206.06** (0.92)	138.87** (0.79)	36.19** (0.51)	97.18** (0.68)	65.60** (0.66)	2.27 (0.08)	14.69 (0.36)	
Indonesia	170.89** (0.86)	119.06** (0.79)	77.26** (0.70)	0.97 (0.03)	26.27 (0.41)	12.198 (0.35)		15.10 (0.52)	
Malaysia	215.47** (0.95)	138.707** (0.88)	17.25* (0.49)			0.38 (0.01)	37.81** (0.56)	84.33** (0.84)	
Papua New	307.55** (0.97)	210.96** (0.95)	135.85** (0.89)		38.73** (0.62)	3.71 (0.13)	14.33 (0.34)	80.40** (0.81)	
Philippines	287.29** (0.96)	204.13** (0.94)	132.08** (0.87)	27.20** (0.51)		47.46** (0.55)	9.23** (0.30)	79.74** (0.72)	
Singapore	292.43** (0.94)	215.02** (0.94)	139.12** (0.90)	38.13** (0.65)	3.44 (0.12)	79.05** (0.79)		10.33 (0.23)	
South Kore	168.80** (0.93)	102.28** (0.77)	34.53* (0.55)		4.48* (0.17)	14.85 (0.35)			66.34** (0.73)
Thailand	169.16** (0.89)	70.28** (0.68)	111.36** (0.79)	7.18** (0.24)	39.92** (0.51)				20.85** (0.41)
Africa									
Benin	162.68** (0.88)	107.53** (0.82)	62.69** (0.67)		15.15 (0.29)	6.01* (0.21)			33.46* (0.51)
Cameroon	306.51** (0.98)	44.87** (0.57)	129.47** (0.85)	8.57** (0.29)	81.56** (0.76)	204.19** (0.94)			23.13** (0.44)
Egypt	290.69** (0.98)	177.56** (0.95)	99.17** (0.76)		13.81 (0.39)	0.76 (0.02)	33.17* (0.52)	61.88** (0.66)	
Ghana	147.39** (0.91)	86.84** (0.79)	45.37 (0.58)		9.32 (0.30)	0.01 (0.00)			22.79 (0.40)
Rwanda	187.76** (0.94)	114.43** (0.84)	66.71** (0.71)	11.25 (0.35)		34.13* (0.58)			0.01 (0.00)
Zimbabwe	271.16** (0.96)	38.87** (0.53)	185.96** (0.93)	19.69* (0.44)	76.73** (0.77)	117.55** (0.81)		1.93* (0.17)	
Southern Europe									
Turkey	148.69** (0.82)	105.34** (0.81)	64.65** (0.77)		0.67 (0.02)	27.15 (0.51)			9.28 (0.29)
Latin America									
Argentina	260.71** (0.98)	46.01 (0.62)	160.87** (0.95)		85.86** (0.79)	1.26 (0.04)	21.45 (0.42)	7.68 (0.22)	
Colombia	169.31** (0.94)	97.49** (0.76)	62.41** (0.68)		34.75* (0.64)	0.11 (0.01)			(10.21) (0.34)
Developed Countries									
France	166.81** (0.91)	105.91** (0.77)	67.20** (0.73)	3.81* (0.13)		14.18 (0.32)		33.04* (0.51)	
Japan	124.09** (0.86)	76.77** (0.79)	16.54 (0.31)		0.44 (0.01)	7.42 (0.25)			39.12 (0.61)
United Stat of America	225.12** (0.89)	165.36** (0.87)	21.57** (0.41)		41.69** (0.53)	8.03** (0.26)	112.16** (0.78)	71.78** (0.68)	

*(**) Indicate the rejection of null hypothesis that there exist no cointegration between GNPPC and the tested variable at 5% (1%) level of significance

Values in parenthesis are Eigen values

and other statistical tests (e.g., LM, ARCH, WHNCT and DW tests)5 as reported in Table 6, one can safely argue that the proposed estimated model has fitted and explained the data quite well across the countries. In the following we therefore, present a brief discussion on the important findings and economic interpretation of the estimated OLS results for each health variable on a broad cross country basis.

Life Expectancy. In our analysis, we find that life expectancy is the most important indicator of health representing a positive relationship with GNP per capita across all countries. We also find that the coefficients are highly statistically significant. The results become more positively significant as we approach the more developed nations and high income countries. In the developed countries elasticity of life expectancy is much higher with Japan at 25.68. France at 53.4 and USA at 4.64. respectively. As discussed in the previous sections, these countries had set their priority towards health improvement.

Fertility Rate:

Another statistically significant health variable is the fertility rate. Fertility rate has a negative influence on GNP per capita in almost all the countries considered with the exception of Rwanda which is showing a positive but insignificant effect. '1 he highest coefficient was found in the less developed countries (Benin showed the value to be 22.03) the coefficient is relatively higher in the developing countries as compared to the developed nations. Our results support the merits of low fertility rates. Across the sample of twenty-six countries, it has been found to be a consistent inference that population control measures would improve the per capita income and would assist in raising the level of economic growth. The magnitude of impact of low fertility trend, however, differs depending on the per capita income of the concerned country. In poor countries the impact is more apparent and elastic.

Infant Mortality Rate::

Infant mortality in most of the countries appeared to be negatively related to GNP per capita. In developed countries like France and Hong Kong. there is a positive

5. LM statistics 111 tins context simple lest for the presence of serial correlation in the time series regression. This is particularly useful when lagged dependent variables fire present in the regression Autoregressive conditional heteroscadasticity (ARCH(), on the other hand, detects the presence of heteroscadasticity residuals. White's hetereoscedasticity statistics (WHNCT) is used to test misspecification of the stipulated model. For detailed discussions on the tese various tests, readers may refer to Johnston (1984), R. Engle (19??) and White, H (1980).

Table 6
Estimated Results

Country			GNPPC	FERT	Life_Exp	IMR	CBR	CDR	POPBED	POPPHY	PPBFD	R^2	LM Test (Probabilty)	Arch Test (Probabilty)	WHNCT (Probabilty)	D.W
South Asia																
Bangladesh	Variable	C		lag (-1)	lag (-2)	lag (-1)	lag (-5)	lag (-1)			lag (-2)	0.92	0.18	0.30	0.07	2.02
	Co-efficient	-5.85		-1.45	1.33	0.80	1.40	-0.47			0.43					
	t-Statistics	-1.14		-3.03	1.92	2.54	1.88	-3.07			3.78					
India	Variable	C		lag (-3)	lag (-4)	lag (0)	lag (-3)	lag (-1)				0.98	0.34	0.13	0.14	1.42
	Co-efficient	5.82		-1.37	1.77	1.24	-2.37	-1.00								
	t-Statistics	0.81		-2.44	1.35	2.89	-5.35	-2.19								
Pakistan	Variable	C	lag (-1)	lag (-4)	lag (-3)		lag (0)	lag (-1)	lag (-2)	lag (-1)		0.99	0.59	0.53	0.93	1.85
	Co-efficient	14.66	0.76	-1.87	0.16		-2.21	0.14	-0.96	0.58						
	t-Statistics	1.79	7.91	-1.70	0.14		-3.38	1.52	-3.85	1.47						
Sri Lanka	Variable	C		lag (-3)	lag (0)	lag (-2)	lag (0)	lag (0)			lag (0)	0.99	0.10	0.62	0.88	1.22
	Co-efficient	-35.86		-0.84	9.64	0.69	-1.38	1.22			0.59					
	t-Statistics	-7.68		-3.27	8.91	4.09	-5.19	5.82			4.09					
East Asia & Pacific																
China	Variable	C		lag (-1)	lag (-1)		lag (-4)				lag (-2)	0.98	0.10	0.98	0.86	1.36
	Co-efficient	6.33		-0.36	0.50		-0.69				-0.23					
	t-Statistics	5.29		-2.51	1.83		-4.73				-5.50					
Fiji	Variable	C		lag (-2)	lag (-4)		lag (0)	lag (-3)	lag (-3)	lag (0)		0.98	0.31	0.69	0.18	1.30
	Co-efficient	-30.10		-5.80	0.28		7.87	-3.72	-3.30	5.50						
	t-Statistics	-1.55		-4.46	0.26		4.23	-3.53	-2.22	2.49						
Hong Kong	Variable	C		lag (-2)	lag (0)	lag (-2)	lag (0)	lag (-1)	lag (-1)	lag (0)		0.99	0.27	0.77	0.56	1.62
	Co-efficient	3.49		-2.05	0.64	-0.65	0.72	-2.07	0.28	0.74						
	t-Statistics	0.21		-7.87	0.16	-1.69	1.34	-3.28	0.37	2.21						
Indonesia	Variable	C		lag (-3)	lag (-2)	lag (-1)	lag (-2)	lag (-2)		lag (0)		0.99	0.26	0.88	0.59	1.39
	Co-efficient	-32.81		-3.78	6.23	-1.66	13.83	-3.74		-1.28						
	t-Statistics	-2.82		-2.92	3.10	-1.27	5.10	-2.64		-3.08						
Malaysia	Variable	C		lag (-4)	lag (0)			lag (-3)	lag (0)	lag (-3)		0.99	0.29	0.68	0.33	1.41
	Co-efficient	-6.60		-3.93	0.45			0.74	1.73	0.71						
	t-Statistics	-1.00		-8.37	0.45			1.89	4.53	3.15						
Papua New Guinea	Variable	C		lag (-2)	lag (-2)		lag (0)	lag (-2)	lag (-4)	lag (0)		0.99	0.10	0.34	0.18	2.15
	Co-efficient	-31.53		-1.30	8.07		0.60	-0.47	-0.47	1.07						
	t-Statistics	-9.00		-1.88	10.22		2.79	-1.21	-1.94	6.09						
Philippines	Variable	C		lag (-4)	lag (0)	lag (-2)		lag (-3)	lag (0)	lag (0)		0.97	0.57	0.96	0.40	1.57
	Co-efficient	-23.53		-3.45	7.42	-3.09		3.43	-1.90	2.58						
	t-Statistics	-1.57		-6.87	3.01	-3.16		3.83	-5.75	4.62						
Singapore	Variable	C		lag (0)	lag (-2)	lag (0)	lag (0)	lag (-3)	lag (0)	lag (0)		0.99	0.44	0.22	0.22	1.47
	Co-efficient	-31.27		-0.60	8.82	-0.75	0.40	-0.19	1.62	-0.79						
	t-Statistics	-2.67		-1.85	3.99	-2.49	1.09	-0.44	2.31	-2.40						
South Korea	Variable	C		lag (-2)	lag (-2)		lag (-5)	lag (-1)			lag (-5)	0.99	0.14	0.53	0.78	1.83
	Co-efficient	-6.01		-0.49	5.13		-2.31	-0.16			-0.20					
	t-Statistics	-0.88		-3.65	3.60		-7.44	-0.56			-1.85					
Thailand	Variable	C	lag (-1)	lag (-3)	lag (-3)	lag (0)	lag (-1)				lag (-1)	0.99	0.99	0.56	0.05	1.99
	Co-efficient	-40.05	0.68	-0.25	8.84	3.10	-1.96				0.19					
	t-Statistics	-2.86	7.17	0.33	3.23	3.23	-3.05				2.24					

Table 6
Estimated Results

Country			GNPPC	FERT	Life_Exp	IMR	CBR	CDR	POPBED	POPPHY	PPBED	R^2	LM Test (Probabilty)	Arch Test (Probabilty)	WHNCT (Probabilty)
Africa															
Benin	Variable	C		lag (-2)	lag (-2)		lag (-1)	lag (-2)			lag (-3)	0.94	0.26	0.78	0.24
	Co-efficient	162.28		-22.04	10.03		-40.94	5.41			-2.80				
	t-Statistics	3.07		-7.11	3.61		-3.47	4.26			-3.80				
Cameroon	Variable	C		lag (0)	lag (-3)	lag (-4)	lag (-1)	lag (-4)			lag (-4)	0.98	0.26	0.64	0.02
	Co-efficient	-171.50		-0.34	1.35	-10.76	53.53	9.48			-1.14				
	t-Statistics	-2.69		-0.51	1.43	-3.83	3.63	5.20			-2.15				
Egypt	Variable	C		lag (0)	lag (-1)		lag (-2)	lag (-3)	lag (-3)	lag (-2)		0.99	0.02	0.25	0.52
	Co-efficient	-28.05		-0.63	2.51		1.71	-2.96	-3.86	0.49					
	t-Statistics	-2.22		-2.91	2.12		2.95	-13.91	-2.43	1.76					
Ghana	Variable	C		lag (-3)	lag (-2)		lag (-3)	lag (0)			lag (-1)	0.91	0.42	0.83	0.57
	Co-efficient	47.99		-0.01	0.73		-12.41	2.44			-1.39				
	t-Statistics	3.32		-0.01	0.26		-4.30	1.81			-3.62				
Rwanda	Variable	C		lag (-3)	lag (0)	lag (-1)		lag (-2)			lag (0)	0.95	0.73	0.49	0.00
	Co-efficient	-1.24		0.68	-1.98	3.49		4.10			-4.26				
	t-Statistics	-0.14		0.40	-3.50	2.09		2.02			-4.80				
Zimbabwe	Variable	C		lag (0)	lag (-4)	lag (0)	lag (0)	lag (-2)		lag (0)		0.96	0.56	0.44	0.32
	Co-efficient	-227.82		-7.74	1.34	3.41	14.49	8.46		17.04					
	t-Statistics	-6.73		-4.14	1.47	6.12	4.00	6.13		8.08					
Southern Europe															
Turkey	Variable	C		lag (-3)	lag (-1)		lag (-1)	lag (-2)			lag (-4)	0.98	0.60	0.80	0.60
	Co-efficient	-28.23		-3.56	10.59		-5.31	7.35			-1.04				
	t-Statistics	-1.33		-3.77	2.76		-3.39	7.52			-2.64				
Latin America															
Argentina	Variable	C		lag (0)	lag (-3)		lag (-2)	lag (-4)	lag (-1)	lag (-1)		0.96	0.13	0.82	0.34
	Co-efficient	-90.67		-2.03	9.33		3.91	0.44	6.55	2.21					
	t-Statistics	-4.87		-1.83	2.68		3.54	0.08	6.23	3.51					
Colombia	Variable	C		lag (-2)	lag (-4)		lag (-1)	lag (-5)			lag (0)	0.98	0.19	0.71	0.82
	Co-efficient	-35.45		-6.00	6.99		5.08	0.82			1.14				
	t-Statistics	-3.14		-3.76	3.13		2.47	2.02			4.74				
Developed Countries															
France	Variable	C		lag (-1)	lag (-2)	lag (-2)		lag (-2)		lag (-3)		0.99	0.19	0.66	0.34
	Co-efficient	-236.23		-0.72	53.45	-0.56		-5.85		4.84					
	t-Statistics	-3.22		-1.86	3.55	-0.91		-2.80		3.39					
Japan	Variable	C		lag (-1)	lag (-3)		lag (-2)	lag (-5)			lag (-1)	0.99	0.38	0.62	0.23
	Co-efficient	-102.65		-1.31	25.68		0.69	1.30			-1.25				
	t-Statistics	-8.12		-2.99	10.57		4.57	1.50			-1.82				
United States of America	Variable	C		lag (-3)	lag (-2)		lag (-1)	lag (-3)	lag (-1)	lag (-1)		0.99	0.60	0.59	0.01
	Co-efficient	-7.70		-0.23	4.65		-0.31	0.92	0.97	-1.42					
	t-Statistics	-1.22		-4.02	3.63		-2.21	1.33	5.66	-8.96					

and thus result in higher output and per capita. Because of this roundabout and indirect iniluenee these variables may turn out to be insignificant.

6. Concluding Remarks

Significance of improved health status on economic growth and prosperity of a nation was recognized even in the early stages of the development of economic theory. In fact, as early as 1890, Alfred Marshall in his famous book entitled " The Principles of Economics" noted that "health and strength, physical, mental and moral are the basis of industrial wealth". Given that physical, mental and moral health of the labour force are key factors in raising their productivity and that impact of these factors on the economic development is a long term sissue, in this paper we have therefore, empirically tested this proposition within the framework of the recently proposed "co-integration" technique exclusively designed for testing long-run relationship.

In general our empirical results based on 26 developing and developed countries indicate that there exists a strong stable long run relationship between health status and per capita gross national product. Our long-run results are consistent with the other empirical studies in this context. It is important to note that of the eight explanatory health related variables considered in this study, two of them, namely, life expectancy and fertility rates stand out clearly in influencing the GNP per capita For all the 26 countries. This finding has important implications in the future policy making of the country particularly the third world nations. Our results support the premise that. in order to enhance the economic growth of a nation, the policy makers should give priority towards controlling the population growth (fertility) and provide better health services so as to improve the the expectancy of the people. Investing society's scarce resources in these health related factors may have a long lasting impact on the country's economic prosperity.

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