Short run and long run dynamics of impact of health status on economic growth Evidence from Pakistan

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Short run and long run dynamics of impact of health status on economic growth: Evidence from Pakistan

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Abstract

The paper investigates the impacts of different health indicators on Economic growth in Pakistan. The Cointegration and Error Correction techniques were applied on the time series data of Pakistan for the period of 1972-2006. We find that Per capita GDP is positively influenced by health indicators in the long run and health indicators are having significant impact on per capita GDP. However, in the short run the health indicators fails to put significant impact on per capita GDP. It reveals that health indicators have a long run impact on economic growth. . It suggests that impact of health is only a long run phenomenon and in the short run there is no significant relationship exists between health variables and economic growth. The major policy implication of the study is that if we desire a high levels of per capita income, we can achieve it by increasing and improving the stock of health human capital, especially if current stocks are at lower end. Moreover, study also points out a rather diminutive role of public health expenditure in determining the per capita GDP.

Keywords: Health human capital; Economic growth; Per capita GDP; Cointegration; Error Correction

JEL classification: O4, O5, O1, I1

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Human capital plays pivotal role for sustainable economic Growth. As different growth, theories suggest the role of human capital as a significant for growth process. The concept of human capital in economic literature defined broadly by including education, health, training, migration, and other investments that enhance an individual's productivity. However, the growth economists have paid greater attention on analysing the impact of education on economic growth, while ignoring the role of health human capital. It is only in very recent times that studies have started looking at health and tried to estimate the relationship between health status and economic growth.

There exists a two-way relationship between improved health and economic growth. Health and other forms of human and physical capital increases per capita GDP by increasing productivity of existing resources. Furthermore, some part of this increased income is spent on investment in human capital, which results in further per capita growth. According to Fogel (1994), approximately one third of GDP of Britain between 1790 and 1980 is the outcome of improvements in health especially improvement in nutrition, public health, and medical care facilities and these improved health facilities should be considered as labour enhancing technical change.

On the other hand, Economic development results in improved nutrition, better sanitation, innovations in medical technologies; all this increases the life expectancy, reduces the infant mortality rate. World Development report 2007 depicts the situation by concluding that average life expectancy at birth worldwide rose from 51 years to 65 in less than 40 years. Similarly average life expectancy in developing countries was only 40 years in 1950 and is increased to 63 years by 1990 (World Bank 1993). Preston (1976) has analysed various determinants of life expectancy and emphasized that economic development is the most important factor.

Purpose of this paper is to analyse the short run and long run relationships between health and per capita GDP, by using Cointegration and Error Correction. Long run analysis of health and economic growth would be very helpful in determining the possible magnitudes of fully accumulated effects of health on economic growth. Two main hypotheses would be tested; firstly, hypothesis that 'health affects economic growth' is a long run phenomenon would be tested. Secondly, what is the role of health input and health output variables in per capita GDP growth

The organization of the paper is as follows: Section 2 reviews some of the previous studies conducted on the subject of the relationship between economic growth and health status. Section 3 describes the status of human capital situation in Pakistan. In Section 4 Econometric Model and data used in the study was discussed which make the Analytical Framework of the paper. Section 5 discuses the results and main findings of the analysis and in section 6 the conclusion emerges from the study are highlighted.

2. Literature Review:

As mentioned in introduction that numerous studies were conducted on the relationship between human capital development and economic growth. The main conclusion of these studies is that there exists a positive relationship between human capital and economic growth.[1] It is only last decade that there is a flurry of studies exploring the relationship between health and economic growth.

By using the adult survival rate as an indicator of health status, Bhargava et al (2001) finds positive relationship between adult survival rate and economic growth. Results remains similar when adult survival rate is replaced by life expectancy. However, fertility rate have a

[1] For more details see Barro, 1991, Mankiw et al., 1992; Sachs &Warner, 1997 etc.

negative relationship with economic growth as life expectancy is extremely influenced by the child mortality.

Mayer (2001) also uses the probability of adult survival by gender and age group as a measure of health status. By using Granger-type, causality test, study concludes that health status causes economic growth in Latin America generally, and specifically in Brazil and Mexico. Improvements in adult health are associated with 0.8–1.5% increase in annual income. Moreover, the growth impact is higher for improvements in health of female compared with health of male.

Bloom et al (2004) by using 2SLS technique finds that life expectancy and schooling have a positive and significant effect on GDP. Improvements in health increase the output not only through labour productivity, but also through the Capital accumulation. Study also finds that improvement of one year in a population's life expectancy resulted into an increase of 4% in output.

By using the average height adult survival rate and life expectancy as an indicator of health status Weil (2001) finds that health is an important determinant of income variations in different countries. Approximately 17-20 % of the cross-country variation in income can be explained by cross-country differences in status of health.

Arora(2001) uses the life expectancy at birth, at ages five, ten, fifteen, or twenty, and structure of adulthood as health indicators for 10 industrial countries. Study concludes that improvement in health status has increased the pace of long-term economic growth by 30-40 %. It also concludes that high rate of disease prevalence and deaths are among the main reasons for poor long-term growth in developing countries.

Lorentzen et al (2005) analysed the impacts of adult mortality rate on economic growth. Study finds that high mortality rate reduce the economic growth by curtailing the time horizon. Resultantly people take actions that yield short-term benefits at the long-term cost. Study also concludes that fertility, investment in physical and human Capital, are the channels b adult mortality rate affects economic growth.

Measuring health status by health status by infant mortality rate, life expectancy rate and crude health rate and per capita GNI as indicator of economic growth; Malik (2006) finds that if OLS is used then there is no significant relationship between health status and economic growth. However, when 2SLS is used then study finds highly significant effect of health indicators on economic growth.

Scheffler (2004) argues that health may not be treated as output (life expectancy, adult survival rate etc.) but it needs to be treated as input (health expenditure). Study finds that elasticity of health care spending with respect to GDP is greater than one. This means that if GDP increases by 10 percent then healthcare spending goes up by more than 10 percent. Consequently, developed countries spend more on health as compared to developing countries.

Tallinn (2006) uses adult mortality rate, fertility rate and life expectancy to analyse the economic costs of ill health along with economic benefits from improving it for Estonia. Study finds that fertility rate and adult mortality rate have a significant and negative impact in both OLS and Fixed effect model specification. Moreover By using survey data Study also concludes that ill health has a statistically robust and negative impact on labour supply and productivity at the individual level.

Zon (2001) concludes that good health is a necessary condition for people to be able to provide labour services. Study finds that an increase in the demand for health services caused by an ageing population will negatively affect the economic growth.

Gyimah-Brempong (2004) finds that investment (health expenditure) and stock (child mortality rate) of health human capital have a positive and significant relationship with growth of per capita income. However, the relationship is quadratic. Study concludes that investment in health in LDCs will boost the economic growth in the short run and increases the level of income in the long run because investment in health become a part of Stock of human capital.

While analysing the contribution of health by measuring it by the survival rate of males between age 15 and age 60 in economic growth, Jamison (2003) finds that better health accounted for about 11% of growth. Study concludes that investment in physical capital, education and health plays critical role in boosting the economic growth.

By using different household survey indicators of adult nutrition and health, Schultz (2005) examines the impact of health on total factor productivity. Study finds that better health human capital have a significant and positive impact on wages and workers productivity. Study finds the developing countries often lack the resources for investment in health; on the other hand poor health status slows down the economic growth. Developing countries seems to be in a vicious cycle resulting in persistent underdevelopment.

By using data of mortality rate Fogel (1994) concludes that approximately one third of income growth in Britain during 1790-1980 may credited to improvements in health facilities and better nutrition. Study also concludes that public health and medical care must be recognised as labour-enhancing technological change.

While taking into account initial poverty, economic policy, tropical location, and life expectancy Gallup and Sachs (2000) find that per capita GDP of the countries having intensive prevalence of malaria grew 1.3% less compared with other countries. Study also concludes that a 10% reduction in malaria incidence would result in 0.3 percentage increase in the growth rate of per capita GDP.

Sachs and Warner (1997)by using life expectancy as indicator of health s finds a quadratic relationship between health human capital and the rate of economic growth. Study concludes that health human capital increases economic growth at a decreasing rate.

3. Scenario of Human Capital in Pakistan:

Pakistan have been facing financial crunch since its emergence. This scarcity of resources has bound Pakistan to spend limited resources on Development. Low Revenues coupled with rising defence and debt servicing expenditure government mostly have very little cushion available to spend on development especially on human capital. Development expenditure was on average 7.4% of GDP during 1973-77. It squeezed to 2.3 % of GDP in the FY 2000-01, however thereafter situation improves and in FY 2006-07 these become 4.5% of GDP. Resultantly, Human Capital shows a dismal picture. . On the human poverty index, Pakistan ranked 77th among 108 countries and 136th among 177 countries on the human development index.[2]

The healthcare facilities in Pakistan present a very disappointing scenario. It is the outcome of extremely low expenditure on health over the last 60 years. Health expenditure in Pakistan remains at low band of 0.5-0.8 % of GNP during 1970-2007. In FY 2006-07health expenditure was only 0.6% of GNP, which was very low comparing with other developing countries. Not only the health expenditures are low but also delivery of available healthcare facilities is also inefficient. Moreover, primary healthcare and rural health services were ignored and the priority was given to hospitals, medical colleges and curative services in the urban areas. In Pakistan, infant mortality rate was high at 77 per thousand live births; life expectancy was low at 65 years in 2006. Comparing the indicators in 2000, 85 per thousand

[2] Human development report 2007-08

live births and life expectancy of 62 years, there is improvement in health indicators but pace is rather slow. Trend in the health indicators over the years, summarized in table below:

Table 1 Health Indicators

Years	Life expectancy at birth, total (years)	Infant Mortality rate (per 1,000 live births)
1960	44	139
1970	49	120
1980	55	110
1985	57	105
1990	59	100
1995	61	93
2000	63	85
2005	65	79
2006	65	78

Source: World Development Indicator

Education sector also shows the same situation. Public expenditure on education was on average 0.8% of GNP in 1980s, 2.3 % of GNP in 1990's, lowest in FY 2004-05 of only 1% of GNP and 2.4 % in FY 2006-07, that is much lower than other low income countries of the region. Moreover as in the case of health expenditure, most of spending on education goes largely to the recurring expenditure. Historically, priority was given to the higher education, whereas primary education was ignored. As a result, literacy rate was just 55 percent and gross primary enrolment rate was 87 percent in 2006. Pakistan's health and education indicators represent a depressing picture when it is compared with the countries with same level of development such as India, Bangladesh, China and Sri Lanka. There is a dire need to increase the expenditure on health and education.

4. Data and Methodology:

In order to determine relationship between health and economic growth different health variables can be used. There are two categories of health indicators, health input indicators and health output indicators. Health input indicators comprises of expenditure on health services, availability and quality of health facilities etc. While health output indicators includes life expectancy, Infant mortality rate and Adult survival rate, fertility rate etc.

Table 2 Description of variables

Sr. No.	Variables	Data Source
1	Per Capita GDP (proxy for economic growth	WDI 2008
2	Age Dependency	WDI 2008
3	Openness (Trade % of GDP)	WDI 2008
4	Life expectancy	WDI 2008
5	Infant Mortality Rate	WDI 2008
6	Investment % of GDP	WDI 2008
7	Secondary Enrolment	SBP Annual Reports
8	Health Expenditure % of GDP	SBP Annual Reports
9.	Population per bed	SBP Annual Reports

Depending upon availability of time series data; life expectancy and Infant mortality are used as health indicators. As data for these variables are not available in a consistent time series, so data was interpolated by using DigDB 7.1.3.3 an excel Add inn. The major output variable used is health expenditure as percentage of GDP. The independent variable of the model is Per capita GDP and is used as a proxy for economic growth. There are certain other explanatory variable. A Brief description of all the variables used in the study is presented in table 2. The data of all the variables is used ranging from 1972 to 2006.

4.1 Theoretical Model:

Numerous models were developed to incorporate impact of human capital in economic growth. Romer (1990), Barro (1991) have emphasized that human capital is the most important factor in determining the economic growth.

As the focus of study is to analyse the effects of health human capital on economic growth so the human capital is separated into two parts health human capital (H) and other forms of human capital i.e. education human capital (E). Per capita income

(Y) is assumed as a function of the stocks of physical capital (K), health human capital (H), education human capital (E) and a vector of other variables (Z) that include technology and other environmental variables.

$Y = f(K, H, E, Z)$

Y is per capita GDP, H is health human capital, E is Education human capital and Z is all other explanatory variables. H in time t is the sum of the stock of health human capital in the previous period and accumulation to the stock in the current period. It is assumed that accumulation in the health human capital stock (ΔH) depends on the amount of resources devoted to health care and the efficiency by which this expenditure is converted into health stock. It was further assumed that quantity of resources devoted to health investment is a product of the proportion of income devoted to health care (Y_h) and the level of income. The stock of health human capital evolves in the following way

$H_t = H_{t-1} + \Delta H_t$, and $\Delta H = \lambda Y_h Y$,

where λ is the productivity parameter of health expenditure and all other variables . The ability to transform health expenditure into health stock is assumed to be dependent on the stock of health human capital. The health technology equation can be written as : $\lambda = \lambda(H)$. Substituting λ into the ΔH equation and that in turn into the production function, the income growth equation become.

$$\dot{Y} = \dot{Y}(\Delta H + \Delta K + \Delta E + H_{t-1} + Z)$$

The per capita output equation that is estimated and the empirical model developed can be written in the following form.

$$\text{Per capita GDP}_t = \alpha + \beta \text{ Age Dependency} + \gamma \text{ Health Expenditure} + \delta \text{ Openness} + \vartheta \text{ Population per bed} + \lambda \text{ Life expectancy} + \Gamma \text{ Investment} + \rho \text{ Mortality rate} + \Omega \text{ Secondary Enrolment} + \xi_t$$

5 Empirical findings

In order to find out Short run and long run relationship between variables Cointegration technique coupled with Error Correction model is used, however before examining the long-term relationship between the variables, first Step is to determine their weather time series is univariate or not.

5.1 Unit Root Test:

Unit root test is used to check weather data is stationary or not. A process is said to be stationary if its probability distribution remains unchanged as time proceeds and we can say that data generation process does not changed. To test the unit root most widely used test is Augmented Dickey Fuller (ADF) test. The general form of ADF test can be written at level and first difference form as follows.

$$\Delta x_t = \alpha x_{t-1} + \sum_{i=1}^{k} \beta_i \Delta x_{t-1} + \vartheta + \gamma_t + \varepsilon_t$$

$$\Delta\Delta x_t = \alpha \Delta x_{t-1} + \sum_{i=1}^{k} \beta_i \Delta\Delta x_{t-1} + \vartheta + \gamma_t + \varepsilon_t$$

Table 3 Results of ADF Test

Name of Variable	Level			1st Difference		
	Intercept	Trend	None	Intercept	Trend	None
Per Capita GDP	-1.55 (-2.97)	-0.16 (-3.56)	-1.05 (-1.95)	-5.66(-2.95)	-5.59 (-3.56)	-2.8 (-1.95)
Age Dependency	-1.55 (-2.97)	-0.16 (-3.57)	-1.59 (-1.95)	-5.66 (-2.95)	-5.59 (-3.57)	-5.62 (-1.95)
Health Expenditure	-2.34 (-2.95)	-2.34 (-3.55)	-0.41 (-1.95)	-4.18 (-2.95)	-4.57 (-3.57)	-4.28 (-1.95)
Investment	-1.98 (-2.95)	-2.03 (-3.55)	0.88 (-1.95)	-4.85 (-2.95)	-4.78 (-3.55)	-4.69 (-1.95)
Life Expectancy	-2.02 (-2.95)	-2.33 (-3.55)	3.83 (-1.95)	-3.73 (-2.95)	-4.27 (-3.56)	-1.34 (-1.95)
Mortality Rate	1.21 (-2.95)	-2.32 (-3.55)	-1.79 (-1.95)	-3.1 (-2.95)	-3.71 (-3.56)	-1.27 (-1.95)
Openness	-2.68 (-2.95)	-2.71 (-3.55)	0.40 (-1.95)	-5.70 (-2.95)	-5.59 (-3.55)	-5.73 (-1.95)
Population per bed	-1.01 (-2.95)	-0.79 (-3.55)	-1.38 (-1.95)	-5.48 (-2.95)	-5.65 (-3.55)	-5.19 (-1.95)
Primary Enrolment	2.46 (-2.95)	-0.36 (-3.55)	4.90 (-1.95)	-2.96 (-2.95)	-3.70 (-3.55)	-1.89 (-1.95)
Secondary Enrolment	1.28 (-2.95)	-1.53 (-3.55)	4.28 (-1.95)	-4.34 (-2.95)	-4.68 (-3.55)	-3.08 (-1.95)

Values in parenthesis are MacKinnon critical values for rejection of hypothesis of a unit root.

In the Table 3 Null Hypothesis of unit root against alternative of stationarity is tested. Results reveals that all the variables are non-stationary at level so the null hypothesis of unit root at level cannot be rejected. However, at first difference null hypothesis of unit root is rejected for all the variables and all the variables are I (1).

5.2 Cointegration:

With the aim of determining long run, relationship between variables cointegration technique is used. To test cointegration among the variables, there exist two main techniques; Engle and Granger (1987) approach and Johansen (1988) approach. In order to test cointegration among procedure developed by Johansen (1988) is used. This technique depends on direct investigation of cointegration in the vector autoregressive (VAR) representation. It yields maximum likelihood estimators of the unconstrained cointegration vectors and it allows one to explicitly test for number of cointegration vectors so that the weaknesses of Engle- Granger (1987) two-step procedure are overcome. Engle and Granger (1987) technique is a two-step methodology and stability deviations from the relationship is examined by using the coefficients estimated after fitting static regression. However, the test suffers from a number of shortcomings. The basic assumption of the technique is that the cointegrating vector is unique, bounding to a model that is a linear combination of independent cointegrating vectors. However, if cointegrating vector is not unique it fails to address the situation. Moreover, it examines only the dominant cointegrating vector between series.

If there is a VAR of order p

$$yt = \alpha_1 y_{t-1} + \alpha_2 y_{t-2} \dots\dots\dots\dots\dots \alpha_p y_{t-p} + \beta x_t + \epsilon_t$$

Where y_t is a k-vector of non-stationary I(1) variables, is a x_t is a d-vector of deterministic variables, and ϵ_t is a vector of innovations. We may rewrite this VAR as,

$$\Delta yt = \bigcup y_{t-1} + \sum_{i=1}^{p-1} \bigvee_i \Delta y_{t-i} \quad + \beta x_t + \epsilon_t$$

Where

$$U = \sum_{i=1}^{p} A_i - I$$

$$V_i = - \sum_{j=i+1}^{p} A_j$$

Granger's representation theorem asserts that if the coefficient matrix U has reduced rank r,k then there exists k×r matrices α and β each with rank r such that U= αβ' and $\beta' y_t$ is I(0). r is the number of cointegrating relations (the cointegrating rank) and each column of β is the cointegrating vector. The elements of are α known as the adjustment parameters.

Johansen's method is to estimate the matrix from an unrestricted VAR and to test whether we can reject the restrictions implied by the reduced rank of U.

There are four different steps involved while testing cointegration, in the first step order of stationarity is determined and variable must be stationary at same level. We have already found that variables are stationary at first difference i.e. series of the model are I (1). Therefore, the cointegration can be determined between the variables. Second step involves choosing the optimal lag length. To determine the lag length VAR model is used. According to AIC criteria, we determine the lag length of one for the model. Next step deals with determining the number of cointegrating vectors. In the study, both trace statistic and eigenvalue statistic are used. The results of both of the statistics are summarised in table 4 and table 5.

Table 4 Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.961769	407.4585	197.3709	0.0000
At most 1 *	0.884889	299.7428	159.5297	0.0000
At most 2 *	0.861482	228.4013	125.6154	0.0000
At most 3 *	0.815939	163.1684	95.75366	0.0000
At most 4 *	0.737361	107.3164	69.81889	0.0000
At most 5 *	0.580019	63.19614	47.85613	0.0010
At most 6 *	0.450058	34.56712	29.79707	0.0131
At most 7	0.334958	14.83502	15.49471	0.0627
At most 8	0.040786	1.374157	3.841466	0.2411

Trace test indicates 7 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 5 Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.961769	107.7157	58.43354	0.0000
At most 1 *	0.884889	71.34145	52.36261	0.0002
At most 2 *	0.861482	65.23291	46.23142	0.0002
At most 3 *	0.815939	55.85203	40.07757	0.0004
At most 4 *	0.737361	44.12022	33.87687	0.0022
At most 5 *	0.580019	28.62902	27.58434	0.0366
At most 6	0.450058	19.73211	21.13162	0.0775
At most 7	0.334958	13.46086	14.26460	0.0667
At most 8	0.040786	1.374157	3.841466	0.2411

Max-eigenvalue test indicates 6 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Results of trace static suggest that there exist seven cointegrating vectors while the results of maximum Eigenvalue value suggest the six cointegrating vectors.

Table 6 Normalized Cointegrating Coefficients

Variable	Coefficient	Std. Error	t-Statistic
AGE_DEPENDENCY	-18494.47	5501.205	-3.361895*
HELATH_EXPENDITURE	3309.714	1724.952	1.902094
OPENESS	118.7778	46.34173	2.563086*
POPULATION_PER_BED	-12.98682	2.976037	-4.363799*
SECONDARY_ ENROLMENT	0.004666	0.001038	4.493965*
INVESTMENT	81.81509	77.32077	1.058126
LIFE_EXPECTANCY	526.8660	68.63043	7.676856*
MORTALITY_RATE	153.2179	74.95079	2.044246**
R-squared	0.989909		
Adjusted R-squared	0.987292		
S.E. of regression	623.8845		
Sum squared resid	10509261		
Log likelihood	-270.3802		

* & ** Indicate significance at the 5 percent level and at 1 percent level respectively.

Empirical evidence presented in table 6 reveals that in the long run age dependency is negatively and significantly affects per capita GDP, as more people become idle due to age or other factors then these people would definitely have negative impacts on economic growth. The public health expenditure is also having positive but insignificant impact on per capita

GDP. These results show that as public health expenditures are very little so it fails to put a significant impact on economic Growth. It also confirms the poor allocation and utilization of public health expenditure. Nevertheless, other health status indicators like life expectancy, mortality rate and population per bed all are having significant impacts on economic growth.

It means that improvement in health status is a result of private sector and public health expenditure are so mere and are utilized in such a way that they fails to have a significant impact on economic growth. These results confirm the vital and significant contribution of private sector in improving the health conditions. As the public sector fails to contribute in provision of health facilities then it is the private sector, which came forward and contributed in this regard, and improved the health standards. Openness to trade is having positive and significant impact on economic growth. The population per bed is negatively affecting the economic growth. When population per bed increases, it means that less health facilities are available to the people, so this situation will definitely affects economic growth in the long run. Secondary education remains highly significant implying that more educated nation's workers, greater their potential to catch up with prevailing technologies and to achieve the economic growth. Contradicting with theory gross capital formation has failed to have a significant impact on economic growth in the long run, however relationship is positive.

Results reveals that in the long run indicators of human capital i.e. health and education both are having significant impact on economic growth. Therefore, we can say that for sustainable economic growth policies should be aimed for improving the standards of health and education. As the public health expenditure does not have significant impact on economic growth so health policy may be directed in such a way that it will give more incentives to private sector for investing in health facilities.

5.3 Error Correction Model:

If there a long run relationship between different variables exists then an error correction process is also taking place. Error correction model indicates the speed of adjustment towards the long run equilibrium after a short run shock. In order to check error correction following equation is estimated.

$$\Delta \text{Per capita GDP}_t = \alpha + \sum_{i=1}^{m} \Psi_i \Delta \text{Per capita GDP}_{t-i} + \sum_{i=1}^{m} \beta_i \Delta \text{Age Dependency}_{t-i} + \sum_{i=1}^{m} \gamma_i \Delta \text{Health Expenditure}_{t-i}$$
$$+ \sum_{i=1}^{m} \delta_i \Delta \text{Openness}_{t-i} + \sum_{i=1}^{m} \eta_i \Delta \text{Population per bed}_{t-i} + \sum_{i=1}^{m} \psi_i \Delta \text{Life expectancy}_{t-i} + \sum_{i=1}^{m} \theta_i \Delta \text{Investment}_{t-i}$$
$$+ \sum_{i=1}^{m} \varsigma_i \Delta \text{Mortality rate}_{t-i} + \omega EC_{t-1} + \xi_t$$

Table 7 Error Correction model estimation

Variable	Coefficient	Std. Error	t-Statistic	Probability
D(AGE_DEPENDENCY)	112965.4	43997.96	2.567515	0.0214
D(HELATH_EXPENDITURE)	960.1742	990.0141	0.969859	0.3475
D(OPENESS)	49.40765	31.80442	1.553484	0.1411
D(POPULATION_PER_BED)	-4.265212	2.434431	-1.752036	0.1002
D(SECONDARY_ ENROLMENT)	0.002938	0.001161	2.530879	0.0231
D(INVESTMENT)	-24.64672	73.67595	-0.334529	0.7426
D(LIFE_EXPECTANCY)	-41.1806	344.7947	-0.119435	0.9065
D(MORTALITY_RATE)	-389.4584	445.1464	-0.8749	0.3954
D(GDP_PER_CAPITA(-1))	0.277605	0.212884	1.304016	0.2119
D(AGE_DEPENDENCY(-1))	-115873.5	42775.77	-2.708858	0.0162
D(HELATH_EXPENDITURE(-1))	-387.314	1069.411	-0.362175	0.7223
D(OPENESS(-1))	-34.21279	36.27845	-0.943061	0.3606
D(POPULATION_PER_BED(-1))	1.093438	2.658591	0.411285	0.6867
D(SECONDARY_ ENROLMENT (-1))	0.000625	0.001467	0.426117	0.6761
D(INVESTMENT(-1))	-19.73265	77.5046	-0.2546	0.8025
D(LIFE_EXPECTANCY(-1))	-182.8239	455.2101	-0.401625	0.6936
D(MORTALITY_RATE(-1))	115.7301	435.1011	0.265984	0.7939
ECT(-1)	-0.684606	0.238475	-2.87077	0.0117
R-squared	0.736754	Mean dependent var		553.7899
Adjusted R-squared	0.438409	S.D. dependent var		475.5985

S.E. of regression	356.4104	Durbin-Watson stat	2.352009
Sum squared resid	1905426	Log likelihood	-227.7262

The estimated results show that estimated lagged error correction term is negative and significant suggesting that error correction is happening in the model. The coefficient of feedback coefficient (Error Correction term) is -0.68, indicating that approximately 0.68 % of disequilibrium in previous year is corrected in the current year. Other estimated coefficients shows that in the short run only age dependency and secondary education have significant impact on per capita GDP. No health indicators have the significant impact on economic growth. It shows that impact of health is only a long run phenomenon and in the short run there is no significant relationship exists between health variables and economic growth.

6. Conclusions and Policy implications:

The main objective of this paper is to analyse the short run and long run dynamic of health human capital on economic growth. To attain that objective Cointegration coupled with Error Correction technique are used.

The Cointegration result confirms that health variable plays a very significant role in determining the long run economic growth. As all the health indicators; life expectancy, Population per bed and mortality rate have a significant impact on the long run economic growth. However, health expenditure have insignificant impact on per capita GDP. Similarly, results obtained from Error Correction model reveal that health indicator does not have the significant impact on economic growth in the short run. It suggests that impact of health is only a long run phenomenon and in the short run there is no significant relationship exists between health variables and economic growth.

The policy implications of the study is that countries that desire a high levels of per capita income, they can achieve it by increasing and improving the stock of health human capital, especially if current stocks are at lower end. Moreover, study also points out a rather diminutive role of public health expenditure in determining the per capita GDP.

From a research perspective, results implies that health human capital must be included in the growth equations as it is also a very important part of human capital. Moreover there is dire need of study, which analyse the dynamics of health demand in Pakistan, as such study is lacking for many years.

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