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Nature of Human Development in SAARC Region: A Panel Data Analysis

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Abstract: The paper relates education expenditure, health expenditure and GDP per capita of SAARC bloc with its human development index during 1990-2016 in panel data analysis. The growth rates of human development indices and its structural breaks were analysed through semi-log linear model and Bai-Perron model. Pedroni, Kao and Johansen models of cointegration were applied for long run association. Long run causality was verified by cointegrating equations and short run causality was tested by the Wald test. The paper concludes that HDI of SAARC have been increasing with upward structural breaks. HDI is negatively related with education and health expenditures and positively related with GDP per capita during 1990-2016. They have at least one cointegrating equation and there were significant long run causalities from education expenditure, health expenditure and GDP per capita to the human development index of SAARC but they had no short run causalities. Rather, there was short causality from human development index to the health expenditure of the SAARC nations.

Key words: Human Development Index, education expenditure, health expenditure, random effect model, panel cointegration, panel vector error correction, short run causality, long run causality

JEL classification: C22,C23,E24,F15,H15,I10,I18,J24,J64,O15,O40

1. Introduction

Human capital is a multidimensional concept relating to health and educational characteristics which promote growth and technological progress including innovations. Better quality of education contributes significantly to the development of cognitive skills and plays an important role in increasing employment, productivity, and income growth. Continuous development of skills through pre-employment and on-the-job training is critical to sustaining growth in employment and labor productivity.

The main engine of growth is the accumulation of human capital and/or knowledge and the main source of difference in living standards among nations is a difference in human capital. The new growth theories tried to establish that economic growth and development cannot attain an optimum and self-sustenance path without the development of human resources

(Romer, 1990, 1993a; Lucas, 1993; Stiglitz, 1993; Barro, 2001). Education and training enhances the skills and capabilities of the people and brings them to the center stage of economic development of a country (Agarwal, 2006). Stiglitz (1997) stated that improvements in education or health are not just means to an end of increased output, but are an ends in themselves. Growth would suffer if government cuts investment in education through reducing deficit spending. Based on a cross-country analysis, Krueger (1968) showed that human capital differences had the most important role in explaining per-capita income differences between the US and developing countries. Marshall (1920) emphasized that the men's skills and knowledge have the capacity to produce increasing returns. The implementation of new technology from abroad is a direct function of its domestic human capital stock (Nelson and Phelps, 1966). Development is closely related with expanding human capabilities (which is primary end and the principal means of development) and enlarging human freedom which in turn, empower the people to make choices and lead the lives they have reason to value (Sen, 2000). The very quality and sustainability of growth, eventually, depends on the human development and vice-versa. Investment in education and health were the central conception of development (Myrdal, 1968).

The SAARC as a bloc has been lagging behind in terms of human development. HDI of SAARC in world ranking did not improve to high level during a period of 15 years rather narrowed down their gap with the high HDI countries. Despite the fact, SAARC has attained a remarkable improvement in certain indicators related to health and education. The education gaps by income and gender are also very glaring in SAARC countries. The low level of income, along with poor expenditure to education and health, turns the situation from bad to worse. Astonishingly, the expenditure on defense was higher than that on education and health, both as percentage of GDP and percentage of central government expenditure. In such a scenario, there are two-way outs, [i] redistribution of the benefits of growth with public policy intervention and [ii] making the very growth process more and more inclusive. The latter policy would require raising human capabilities and, hence, it is a medium and long-run process. The two-pronged policy recommendations would then be to strengthen the redistributive mechanism and empower the people with quality education and health.

Of late, the SAARC countries have formulated reformed policies on both health and education as their national goals but their expenditures on education and health are not quite fitted with the policy measures which were ultimately observed negative impact on human development index of SAARC during the survey period from 1990 to 2016.

In this context, the paper endeavors to explain the impact of health and education expenditure as well as impact of GDP per capita of SAARC on the human development index of SAARC during the period from 1990 to 2016. The paper attempts to fit econometric models of cointegration and vector error correction so that short term and long-term relationships are available. The random effect regression model of panel data can also verify their relationships in SAARC region.

2. Literature review

The relevant literatures have been discussed in brief. Ranis, Stewart and Ramirez (2000) provided an initial exploration of the two-way relationship between human development and economic growth. Boozer et al (2003) followed this model and asserted that education, health, and other aspects of human development involve fixed costs that can create non-convexities in the social returns to various levels of human development, and thus result in low and high levels equilibria. Shomeand Tondon (2010) analyzed GDP and HDI relation in ASEAN-5 during 2000-2009 with the help of Pearson Correlation coefficient and for individual economies. They found that there is a positive and significant correlation between HDI and GDP in ASEAN-5. Park (2012) estimated a panel of cross country data during 1970-2007 and found that investment in human capital and research and development have significant positive effects on total factor productivity growth i. e. a one year increase in average years of schooling led to an increase in total factor productivity growth by about 0. 3% per year. Razmi, Abbasian and Mohammadi (2012) tried to show the relationship between government health expenditure and human development index in Iran during 1990-2009 by OLS method and showed the positive and significant relation. Elmi and Sadeghi(2012),using panel data from 1990 to 2009 of the developing countries and applying cointegration, causality and vector error correction model,showed that there is short run causality running from GDP to health expenditure and bi-directional relationship in the long run. After analyzing the data, Poudel (2014) concluded that the difference between the SAARC countries' HDI is very low because of the much higher differences in the education index and adult literacy rate. However, HDI in SAARC countries is not as high as it could be although the region has been showing continuous progress in HDI. Shah (2016) studied relation among HDI and its determinants like GDP percapita, literacy rate, life expectancy, inflation rate, CO_2 emission, fertility rate, Gini index for 188 countries. Regression analysis showed that GDP, life expectancy, literacy rate, influenced positively and Gini, fertility rate, CO_2 emission and inflation rate influenced negatively on HDI significantly. Mirahsani (2016) examined the relationship between human development index and health expenditure as a ratio of GDP in 25 South West Asian countries during 2000-2009 through OLS method with F test and found the relationship was significant and positive.

Dwivedi (2017) studied that the gender inequality index (GII) in the South Asian countries is gradually decreasing in which there are three dimensions of disparities such as- reproductive health, empowerment, and labor market participation. The gender disparity in education is considered as the biggest hindrance in women empowerment. It has a direct impact on economic growth through lowering the average quality of human capital. Economic growth is indirectly affected through the impact of gender inequality on investment and population growth. Economically, South Asian women have limited access to resources and rely on male for any type of financial decision. Historically, South Asian women are deprived by land rights. Simply by increasing the literacy level among girls and women, promoting woman's labor participation and economic independency, and expanding the female reproductive health right can significantly reduce the long persist inequality in this region. Nevertheless, equal access to education, health and employment can assure the women empowerment and gender equality in the long run. Zaidi (2017) emphasized on policy prescriptions such that in South Asia equitable access can be accelerated by health ministers through action on financing, governance or human resources to direct health resources towards poor people or through action on social determinants of health such as health insurance scheme and contracting private sector services, improving risk pooling and reducing point of service payment. Lim(2018) explained the methods of the World Bank and tried to link between investing in people and economic growth to accelerate financing for human capital investments. It estimated educational attainment using 2522 censuses and household surveys taking lives of age 20 to 64 years and adjusted for educational attainment, learning or education quality, and functional health status using rates specific to each time period, age, and sex for 195 countries from 1990 to 2016 and estimated on 1894 tests among school-aged children using functional health status on the prevalence of seven health conditions, which were taken from the Global Burden of Diseases, Injuries, and Risk Factors Study 2016 (GBD, 2016). The study showed marked variation from less than 2 years of progress in 18 countries to more than 5 years of progress in 35 countries. Larger improvements in expected human capital appeared to be associated with faster economic growth. The top quartile of countries in terms of absolute change in human capital from 1990 to 2016 had a median annualised growth in gross domestic product of 2·60% (IQR 1·85–3·69) compared with 1·45% (0·18–2·19) for countries in the bottom quartile.

In 17 countries of SAARC-ASEAN region, Rahman et al(2018) estimated fixed effect and random effect regression models during 55 years of data from the World Development Indicators and found that the effects of health care expenditure on life expectancy and on death rate are positive, and the estimated results of health care expenditures on infant mortality rate is negative. The condition of public health expenditure (as a percentage of government expenditure) is very poor in South Asia. It is less than one third of that of the OECD countries, and around half of that of South East Asian countries. Bhowmik(2018) studied that HDI of India has been increasing with three upward structural breaks in 1996, 2004 and 2011 respectively. One per cent increase in HDI of India led to 1. 41% increase in GDP growth rate during 1990-2016. Moreover, one per cent rise in HDI per year led to 5. 86% rise in GDP at current prices, 4. 828% increase in GDP per capita and 0. 5028% decrease in unemployment rate per year respectively during 1990-2016 in India. Even, HDI has unidirectional causality with GDP at current prices and GDP per capita. There is positive association among GSDP and GSDP per capita with high and medium human development and low human development states of India for those years. In fixed effect model of panel data, the regression between all states' HDI and GSDP per capita is positive. The paper finds sigma convergence of HDI of all states. Only four states showed negative growth of HDI in spite of their rising trends of social sector expenditure. Bhowmik (2019) found that one percent increase in GDP at current prices, education expenditure, and unemployment rate per year led to 0. 105% increase, 0. 028% increase and 0. 027% decrease in HDI per year significantly and one percent increase in health expenditure led to 0. 0124% increase in HDI per year insignificantly in ASEAN (Association of Southeast Asian Nations) during 1990-2016. Panel cointegration suggested that there are three cointegrating equations in which two are moving towards equilibrium. There is significant long run association among health expenditure percentage of GDP and unemployment rate on the Human Development Index (HDI) of the ASEAN during 1990-2016.

Therefore, empirical studies in different countries and regions did not find positive relation between HDI and education and health expenditures in all times.

3. Methodology and the source of data

Secondary data of SAARC countries' human development indices,education expenditure per cent of GDP,health expenditure per cent of GDP and GDP per capita at current US dollar were taken from the World Bank. India's education expenditure from 1990-2000 were collected from CSO. Health expenditure of Pakistan was taken from *www.data.un.org/data.*

The paper endeavors to find out econometric relations where some of the basic models have been used. The cross section random effect model of panel regression among human development index,education and health expenditure (as per cent of GDP) and GDP per capita (at current prices in US Dollar) during 1990-2016 of SAARC have been applied. The Hausman test (1978) has been utilized for acceptance or rejection of random effect model. Growth rates of human development indices were calculated by semi-log linear regression model. Structural breaks were calculated by Bai-Perron model (2003). Kao and Chiang (1999), Pedroni (1999) and Fisher (1932)-Johansen (1988) models of cointegration tests had been applied to find the long run association among the said variables of SAARC region. Hansen and Doornik (1994) model verified the normality of residual test of VECM. Wald test (1943) was used to justify the short run causality between the variables and long run causality was verified through the cointegrating equation which was derived from the estimation of the system equations of the VECM.

The Johansen Cointegration approach basically takes its starting point in the vector auto-regression (VAR) of order p given by

$$\mathbf{y}_t = \boldsymbol{\mu} + \mathbf{A}_1\mathbf{y}_{t''1} + \ldots\ldots + \mathbf{A}_p\mathbf{y}_{t''p} + \boldsymbol{\varepsilon}_t$$

where $\mathbf{y}_t$ is a nx1 vector of variables that are integrated of order one – commonly denoted I (1) – and $\boldsymbol{\varepsilon}_t$ is a nx1 vector of innovations. This VAR can be re-written as

$$\Delta y_t = \mu + \Pi y_{t-1} + \Sigma_{i=1}^{p-1} \Gamma_i \Delta y_{t-1} + \varepsilon_t$$

where $\Pi = \Sigma_{i=1}^{p-1} A_i - 1$ and $\Gamma_i = -\Sigma_{j=i+1}^{p} A_j$

If the coefficient matrix Π has reduced rank $r < n$ then there exist nxr matrices α and β with rank r such that $\pi = \alpha\beta'$ and $\beta' y_t$ is stationary,r is the number of cointegrating relationship.

The trace test and maximum eigenvalue test, shown in equations as follows,

$$J_{trace} = -T\,\Sigma_{i=r+1}^{n} \ln(1-\lambda t)$$

$$J_{max} = -T\ln(1-\lambda_t)$$

Here T is the sample size and λ_i is the ith largest canonical correlation. The trace test tests the null hypothesis of r cointegrating vectors against the alternative hypothesis of n cointegrating vectors. The maximum eigenvalue test, on the other hand, tests the null hypothesis of r cointegrating vectors against the alternative hypothesis of r +1 cointegrating vectors.

4. Observations of models and discussions

Human development indices of SAARC countries have been catapulting during 1990-2016 significantly although unequal because fundamentals of macroeconomic indicators are unequal and the outcomes of determinants of HDI are different. The panel data on human development indices of all SAARC nations have been plotted in a simple diagram where it was found that the bar diagram of HDI were upward for all countries. It is seen in Figure 1.

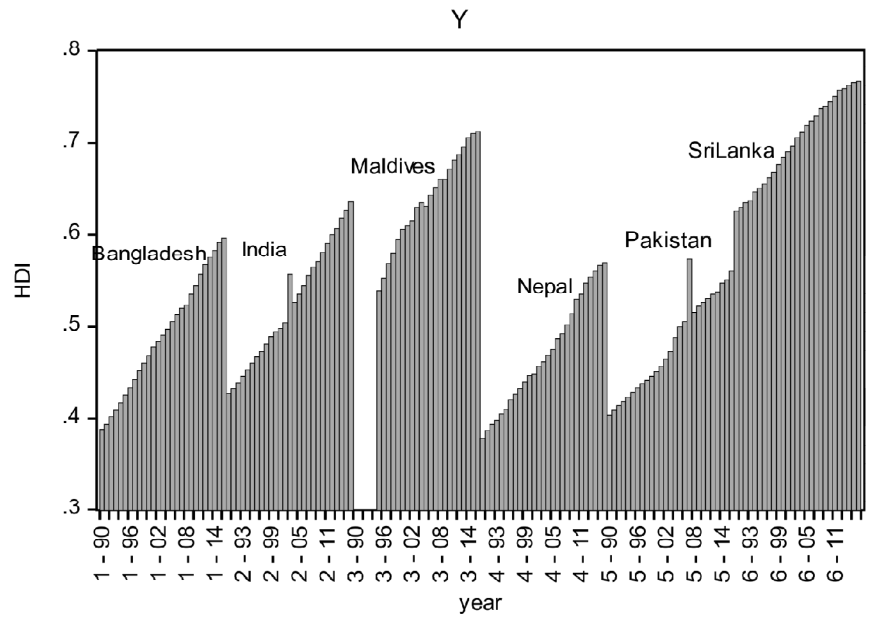

Figure 1: HDI of SAARC

Source: Plotted by author.

In Bangladesh,HDI had increased at the rate of 1.66% per year significantly in which there were four upward structural breaks in 1996, 2001, 2006 and 2011 respectively. In India, HDI had increased at the rate of 1. 56% per year significantly in which three upward structural breaks have been found in 1996, 2003 and 2010 respectively. Maldives had observed HDI growth rate of 1.23% per year during 1995-2016 where five significant upward structural breaks have been found in 1998, 2003, 2007, 2010 and 2013 respectively. HDI of Nepal grew at the rate of 1.60% per year significantly where three upward structural breaks were found during 1990-2013 in the years 1997, 2004 and 2010. HDI of Pakistan had increased at the rate of 1.34% per year during 1990-2016 in which two upward structural breaks were observed in 1997 and 2005 respectively. And in SriLanka,HDI had been rising at the rate of 0.85% per year during 1990-2016 in which there were four upward structural breaks in 1997, 2002, 2007 and 2012 respectively. All these findings have been arranged in Table 1 and Table 2.

Table 1 : Progress of HDI in SAARC

Countries	*Period*	*Growth rate of HDI per year*	*Results (*=significant at 5% level)*	*Sig/nonsig*
Bangladesh	1990-2016	1. 66%	$Log(y_1)$=-0. 954+0. 0166t (-321. 40)*(0. 10)* R^2=0. 99,y_1=HDI of Bangladesh,	Significant
India	1990-2016	1. 56%	$Log(y_2)$=-0. 870+0. 0156t (-152. 36)*(43. 74)* R^2=0. 98,y_2=HDI of India	Significant
Maldives	1995-2016	1. 23%	$Log(y_3)$=-0. 655+0. 0123t (-78. 74)*(26. 20)* R^2=0. 97,y_3=HDI of Maldives	Significant
Nepal	1990-2016	1. 60%	$Log(y_4)$= -0. 986+0. 0160t (-293. 42)*(76. 42)* R^2=. 99,y_4=HDI of Nepal	Significant
Pakistan	1990-2016	1. 34%	$Log(y_5)$=-0. 926+0. 0134t (-83. 17)*(19. 36)* R^2=0. 93,y_5=HDI of Pakistan	Significant
Sri Lanka	1990-2016	0. 85%	$Log(y_6)$=-0. 476+0. 0086t (168. 86)*(68. 68)* R^2=0. 98,y_6=HDI of Sri Lanka	Significant

Source: Calculated by author

Table 2 : Structural breaks of HDI

Countries	*Period*	*No. of breaks*	*Years of breaks*	*Sig. /non-sig*	*Upward/ downward*
Bangladesh	1990-2016	4	1996, 2001, 2006, 2011	Significant	Upward
India	1990-2016	3	1996, 2003, 2010	Significant	Upward
Maldives	1995-2016	5	1998, 2003, 2007, 2010, 2013	Significant	Upward
Nepal	1990-2016	3	1997, 2004, 2010	Significant	Upward
Pakistan	1990-2016	2	1997, 2005	Significant	Upward
Sri Lanka	1990-2016	4	1997, 2002, 2007, 2012	Significant	Upward

Source: Calculated by author

The structural breaks of HDI of six SAARC nations which were all significant upward during 1990-2016 were shown in a single framework of Figures below distinctly.

Using the Cochrane-Orcutt model (1949) the author calculated rho values in the trend equations and predicted values in 2030 which are shown in the table. All the rho values in the model are significant at 5% level. They are shown in the Table 3.

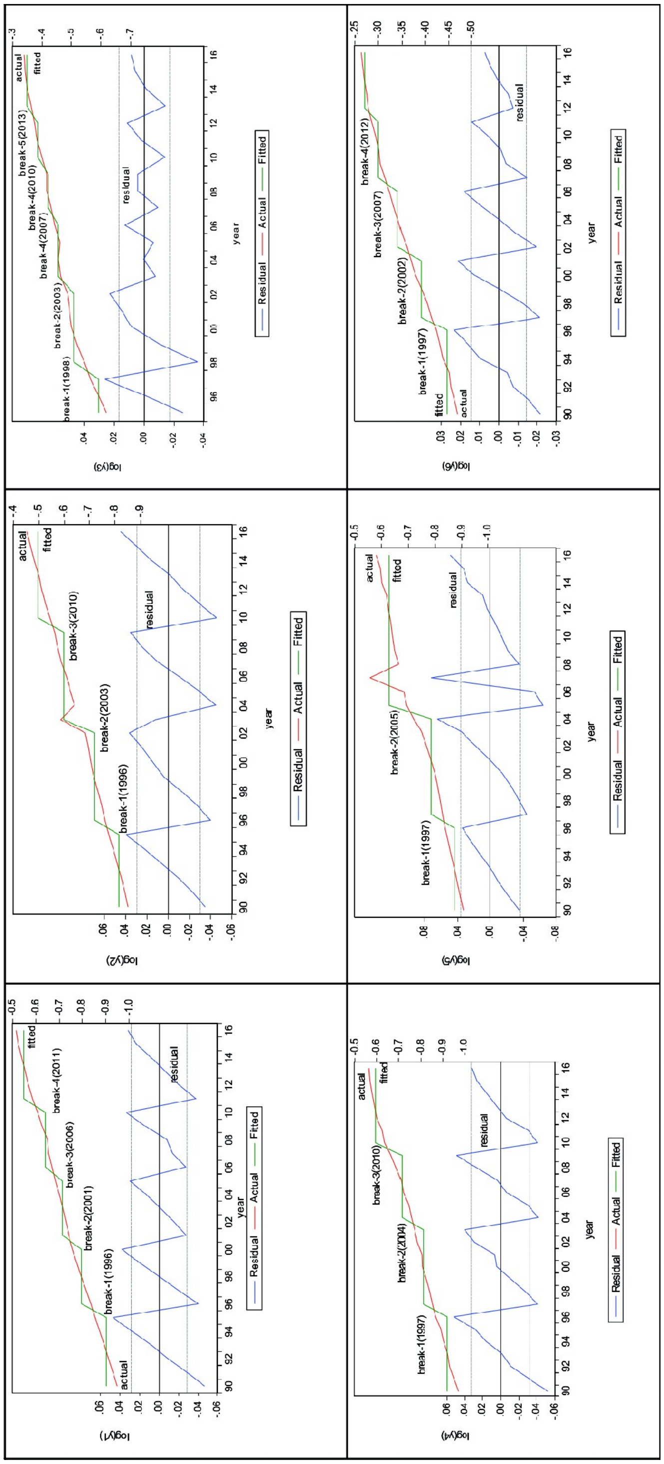

Figure 2: Nature of structural breaks of HDI

Source: Plotted by author

Table 3: Rho values in 2030

SAARC region	*Estimated Rho values*	*Rho values in 2030*
Bangladesh	-0. 00725	-0. 3498
India	-0. 204418	-0. 2654
Maldives	-0. 0258	-0. 2879
Nepal	0. 0267	-0. 3654
Pakistan	-0. 087019	-0. 4839
Sri Lanka	-0. 0577	-0. 19327

Source: Calculated by author

The predicted values of HDI in ARIMA(1,1,1) model for the SAARC countries have been plotted in Figure 3 in which the vertical lines on the predicted trendlines are shown at shown at 5% significant level i. e. upward movements are unaltered till 2030.

The GDP per capita in current prices in US$ of SAARC countries are unequal in nature and they are obviously not convergent but rising. The panel data of GDP per capita of all countries during 1990-2016 are shown in the Figure 4.

Even, the panel data of the education expenditure and health expenditure as per cent of GDP are showing cyclical,unequal and non-convergent which are shown in figure 5.

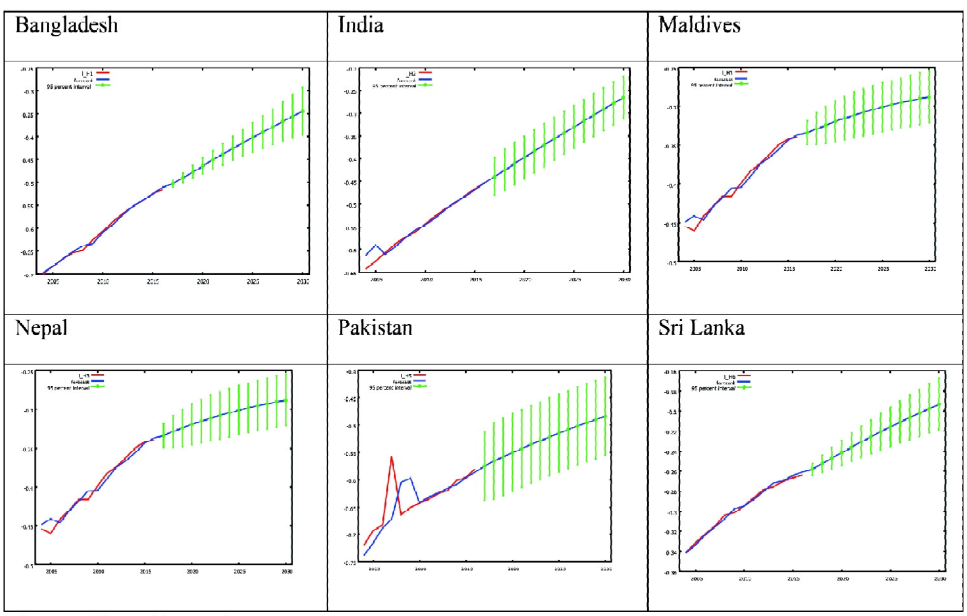

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Figure 3: Prediction of HDI in 2030

Source: Plotted by author

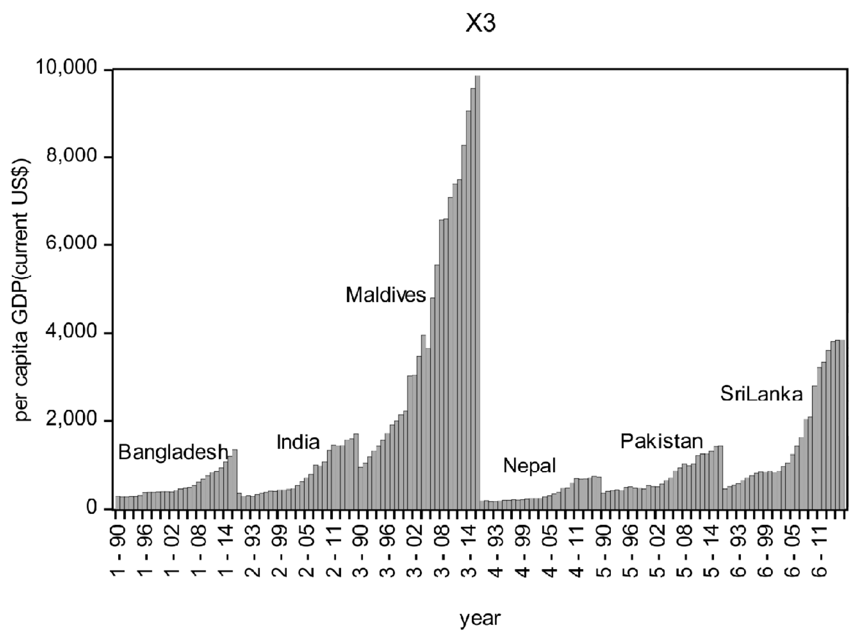

Figure 4: GDP per capita of SAARC

Source: Plotted by author

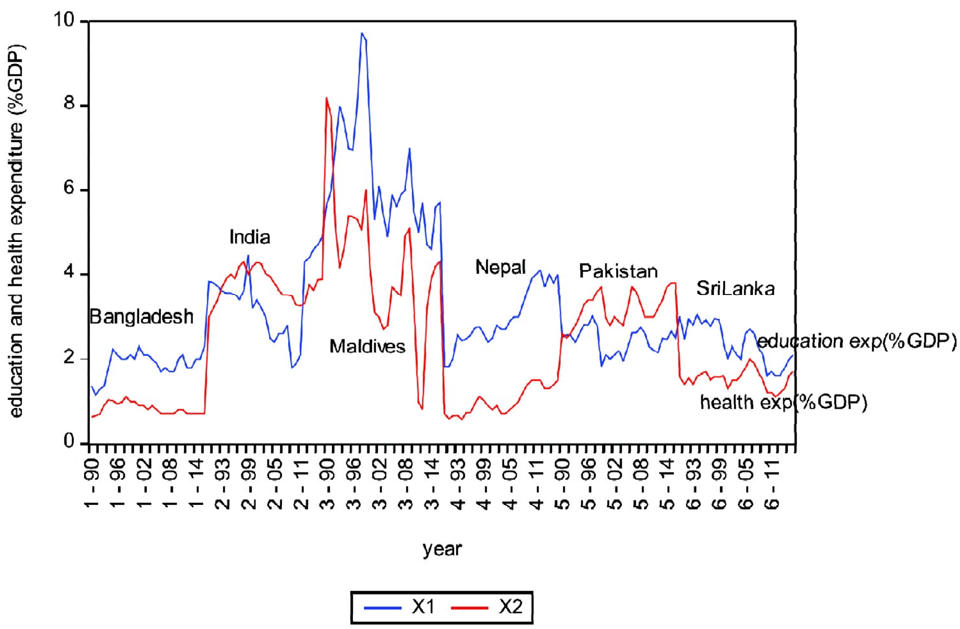

Figure 5: Education and health expenditures of SAARC

Source: Plotted by author

The Random effect panel regression model states that one percent increase in education and health expenditures as per cent of GDP led to 0. 0341 percent and 0. 03678 per cent decrease in human development indices of SAARC countries during 1990-2016 where former is insignificant and the latter is significant at 5% level. Again,one per cent increase in GDP per capita per year led to 0. 178 per cent rise in human development index of SAARC countries during 1990-2016 which is significant. It is a good fit since R^2 is very high and F is significant. Although very low DW signifies the problem of autocorrelation. Panel regression equation is given below. The random effect model is accepted by the Hausman test.

$$\underset{(-27.12)^*}{Log(y)=-1.75589}\ \underset{(-1.24)}{-0.03418\log(x_1)}\ \underset{(-2.244)^*}{-0.03678\log(x_2)}\ \underset{(16.97)^*}{+0.1782\log(x_3)}+u_i$$

R^2=0.704, F=121.77*,DW=0.0548 where y=human development index of SAARC bloc,x_1=education expenditure per cent of GDP of SAARC,x_2=health expenditure as per cent of GDP of SAARC,x_3= GDP per capita of SAARC in current US $ and u_i is the random error. Cross section=6,no of observations=157, period=27,*=significant at 5% level.

Hausman test (1978) of the value of Chi-square = $\chi^2(3)$=3.13 (probability= 0.37) is accepted. In the Figure 6,the fitted and the actual lines of the random effect regression model have been plotted clearly which are cyclical.

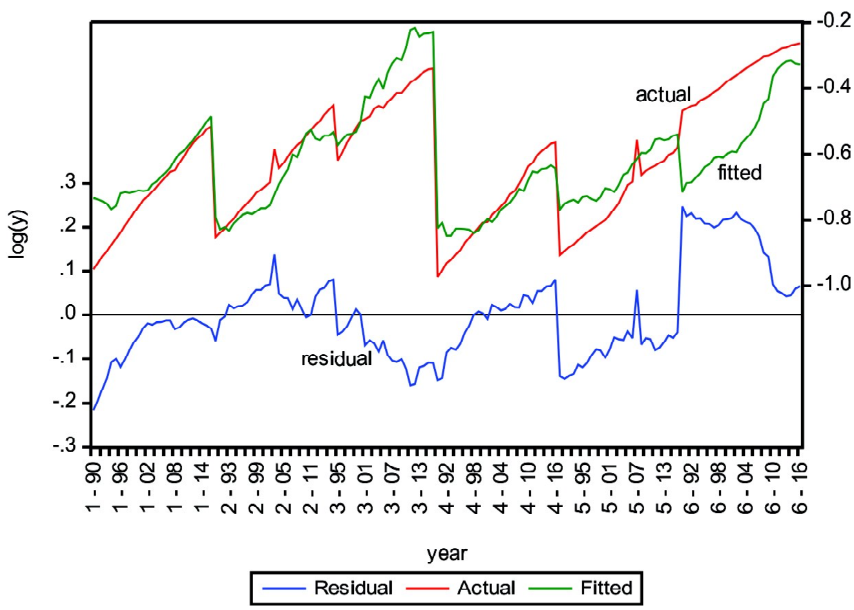

Figure 6: Actual and fitted curves of random effect regression

Source: Plotted by author

Residual cointegration test of Pedroni(1999) and Kao(1999) assumed no deterministic trend with automatic lag length selection based SIC with maximum lag of 1 and Newey-West automatic bandwidth selection and Bartlett Kenel showing H0=No cointegration during the sample period from 1990 to 2016 of 6 cross sections of 162 observations. In Table 4 the panel cointegration statistic have been arranged where majority of the statistic suggest that there is cointegration or long run association among the variables.

Table 4: Cointegration of Pedroni and Kao

	Alternative hypothesis: common AR coefficients. (within-dimension)			
	Statistic	*Prob*	*Weighted Statistic*	*Prob*
Panel v-Statistic	0. 561519	0. 2872	-0. 711885	0. 7617
Panel rho-Statistic	-0. 486477	0. 3133	-1. 558525	0. 0596
Panel PP-Statistic	-1. 642504	0. 0502	-3. 262599	0. 0006
Panel ADF-Statistic	-1. 626650	0. 0519	-3. 338150	0. 0004
	Alternative hypothesis: individual AR coefficients. (between-dimension)			
	Statistic	*Prob*		
Group rho-Statistic	-0. 097217	0. 4613		
Group PP-Statistic	-2. 301518	0. 0107		
Group ADF-Statistic	-2. 297833	0. 0108		
	Kao Residual Cointegration Test			
	t-Statistic	*prob*		
ADF	-3. 298935	0. 0005		
Residual variance	0. 223620			
HAC variance	0. 149920			

Source: Calculated by author

Johansen-Fisher Cointegration test among first difference series of log values of HDI,education expenditure,health expenditure and GDP per capita of SAARC during 1996-2016 confirmed that the trace statistic showed at least two cointegrating equations and max-eigen statistic showed at least one cointegrating equation which are significant at 5% level. The results are arranged in the Table 5.

Table 5: Panel Cointegration test

Hypothesized No. of CE(s)	*Fisher Stat. ** (from Trace Test)*	*Probability*	*Fisher Stat. ** (from Max-Eigen Test)*	*Probability*
None	45. 01	0. 0000	32. 82	0. 0010
At most 1	21. 16	0. 0480	12. 73	0. 3889
At most 2	16. 85	0. 1551	14. 65	0. 2610
At most 3	15. 70	0. 2052	15. 70	0. 2052

** Probabilities are computed using asymptotic Chi-square distribution,Source-Calculated by author

Thus, all the cointegration tests conclude that the long run association exist among HDI, education and health expenditures and GDP per capita in SAARC during 1990-2016 in India.

The estimated VEC model expressed that d(log(y)) is negatively related with d(log(y(-1)) and d(log(y(-2))) significantly and this is approaching towards equilibrium since t values of the negative co-efficient of $EC_1$is significant at 5% level. All the coefficients of the estimated equation of d(log(x_1)) are insignificant but d(log(x_2)) is positively related with d(log(x_1(-1)) and d(log(x_2(-1)) and negatively related with d(log(x_2(-2)) significantly. But d(log(x_3)) did not significantly affect any variables during 1990-2016 (Table 6).

Table 6: Estimated coefficients of VEC model

Error Correction:	*d(log(y))*	*d(log(x_1))*	*d(log(x_2))*	*d(log(x_3))*
CointEq1	-0. 036151	-0. 125118	-0. 096616	0. 092337
t values	[-3. 53181]*	[-1. 39547]	[-0. 81836]	[1. 96062]
d(log(y(-1)))	-0. 553571	0. 215290	0. 181152	0. 468238
t values	[-6. 56380]*	[0. 29142]	[0. 18623]	[1. 20666]
d(log(y(-2)))	-0. 201181	0. 177618	0. 124350	0. 189019
t values	[-2. 37466]*	[0. 23934]	[0. 12726]	[0. 48490]
d(log(x_1(-1)))	0. 015392	-0. 028893	0. 277456	-0. 043870
t values	[1. 51127]	[-0. 32387]	[2. 36190]*	[-0. 93617]
d(log(x_1(-2)))	0. 014552	-0. 066853	-0. 084009	0. 001076
t values	[1. 42247]	[-0. 74606]	[-0. 71199]	[0. 02286]
d(log(x_2(-1)))	0. 001509	0. 063867	0. 228067	0. 002939
t values	[0. 21114]	[1. 02027]	[2. 76692]	[0. 08939]
d(log(x_2(-2)))	0. 001121	0. 047681	-0. 358288	0. 016922
t values	[0. 15968]	[0. 77558]	[-4. 42597]*	[0. 52402]
d(log(x_3(-1)))	0. 037899	0. 234478	0. 189575	0. 016051
t values	[1. 98764]	[1. 40389]	[0. 86200]	[0. 18296]
d(log(x_3(-2)))	0. 002328	0. 160059	-0. 019345	0. 076756
t values	[0. 12632]	[0. 99156]	[-0. 09102]	[0. 90524]
C	0. 020844	-0. 026335	-0. 009139	0. 053423
t values	[7. 64089]*	[-1. 10209]	[-0. 29046]	[4. 25631]*
R-squared	0. 297670	0. 047978	0. 203904	0. 069410
F-statistic	6. 074917	0. 722337	3. 671200	1. 069087
Akaike AIC	-5. 416440	-1. 076161	-0. 525825	-2. 363832
Schwarz SC	-5. 205326	-0. 865048	-0. 314711	-2. 152719

Source: Calculated by Author,*=significant at 5% level.

In Figure 7, the estimated VECM-1 is approaching towards equilibrium which is shown below.

The roots of characteristic polynomial of the VECM have 3 unit roots,8 imaginary roots,two roots are positive and less than one and one root is less than zero (Table 7). So, all the roots lie inside or on the unit circle (Figure 8) which proved that the VECM is stable and non-stationary.

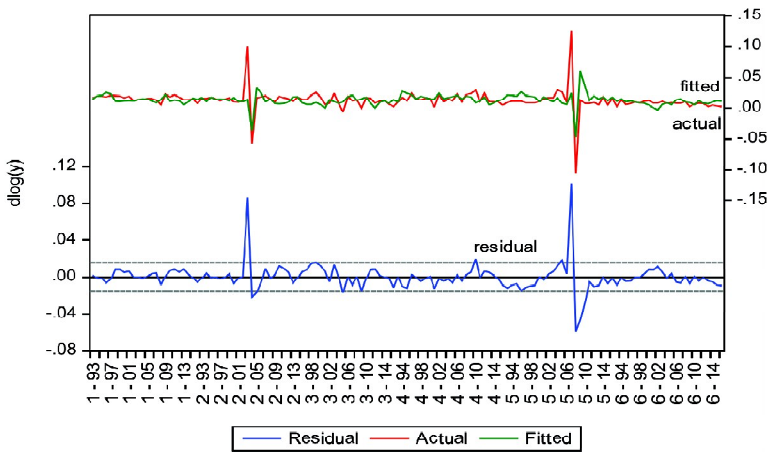

Figure 7: Equilibrium VECM-1

Source: Plotted by author

Table 7: Values of roots

Root	*Modulus*
1.000000	1.000000
1.000000 - 5.09e-16i	1.000000
1.000000 + 5.09e-16i	1.000000
0.974148	0.974148
0.104355 - 0.558957i	0.568614
0.104355 + 0.558957i	0.568614
-0.293712 - 0.340309i	0.449530
-0.293712 + 0.340309i	0.449530
0.310741	0.310741
-0.006606 - 0.300260i	0.300333
-0.006606 + 0.300260i	0.300333
-0.272786	0.272786

Source: Calculated by author

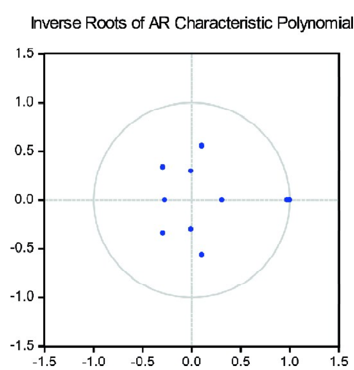

Figure 8: Unit circle

Source: Calculated by author

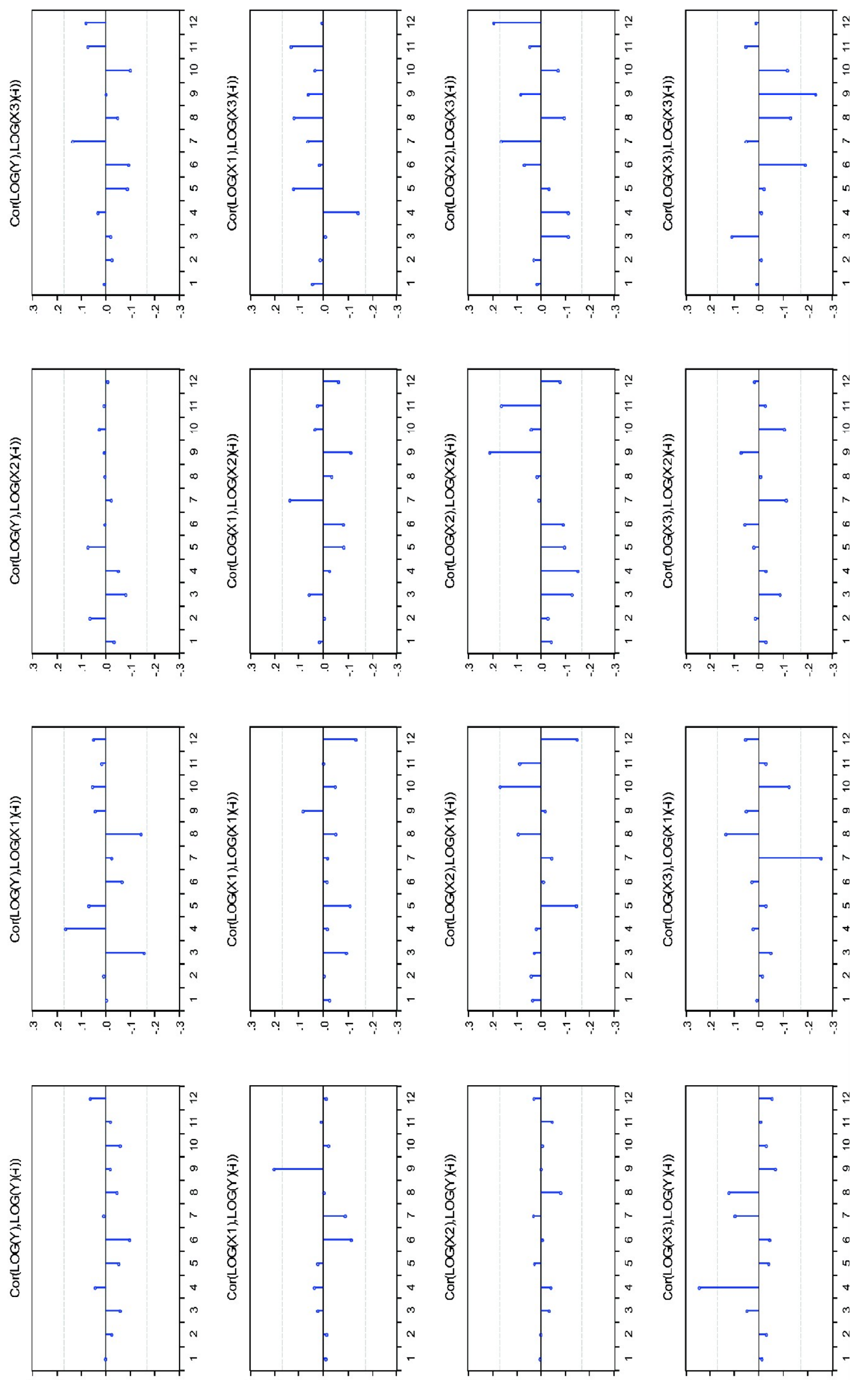

Figure 9: Autocorrelation

Source: Plotted by author

The residual test of VECM also showed that the model suffers from autocorrelation problem which is shown in the Figure 9 where vertical lines indicate non-symmetric.

Hansen-Doornik (1994) normality test assumed that the residuals are multivariate normal in null hypothesis in the component analysis of skewness, kurtosis and Jarque-Bera in terms of residual correlation. The Chi-square statistic of most of the components have been rejected the hypothesis which imply that the residuals are not normally distributed.

Table 8:Normality test

Component	*Skewness*	*Chi-square*	*Degree of freedom*	*Probability*
1	2. 936235	72. 77874	1	0. 0000
2	0. 533745	6. 505180	1	0. 0108
3	0. 130652	0. 431281	1	0. 5114
4	0. 693167	10. 30846	1	0. 0013
Joint		90. 02365	4	0. 0000
Component	*Kurtosis*	*Chi-square*	*Degree of freedom*	*Probability*
1	25. 96409	1. 812866	1	0. 1782
2	9. 375985	83. 65943	1	0. 0000
3	17. 66099	284. 8284	1	0. 0000
4	3. 464168	2. 251274	1	0. 1335
Joint		372. 5520	4	0. 0000
Component	*Jarque-Bera*	*Degree of freedom*	*Probability*	
1	74. 59160	2	0. 0000	
2	90. 16461	2	0. 0000	
3	285. 2597	2	0. 0000	
4	12. 55973	2	0. 0019	
Joint	462. 5756	8	0. 0000	

Source: Calculated by author

From the estimated system equation 1,it was found that the cointegrating equation has been converging towards equilibrium which ensures that there are long run causalities from education expenditure and health expenditures as per cent of GDP and GDP per capita of the SAARC region to the human development index of SAARC during 1990-2016 because t value of the coefficient of log(y(-1)) is significant at 5% level. The normalized cointegrating equation is given below. (*=significant at 5% level).

$$d(\log(y)) = -0.03615(\log(y(-1)) - 0.02639\log(x_1(-1)) + 0.0396\log(x_2(-1)) - 0.0519\log(x_3(-1)) + 0.9632$$
$$(-3.531805)^{*} \quad (-0.285) \quad (0.742) \quad (-1.354)$$

In the estimated system equation-1,the Wald test have been done for the coefficients from which it is concluded that there are no short run causalities from the education expenditure and health expenditure as per cent of GDP and from GDP per capita of SAARC region to the human development index of SAARC countries during the specified period. It is shown in tabular form.

Table 9: Short run causality

H0=No causality	*Chi-square(2)*	*Probability*	*Accepted/rejected*	*Causality-yes/no*
Causalities from d(log(y(-1)), d(log(y(-2)) to d(log(y))	43. 62	0. 00	Rejected	yes
Causalities from d(log(x_1(-1)), d(log(x_1(-2)) to d(log(y))	4. 012	0. 13	accepted	no
Causalities from d(log(x_2(-1)), d(log(x_2(-2)) to d(log(y))	0. 0812	0. 96	accepted	no
Causalities from d(log(x_3(-1)), d(log(x_3(-2)) to d(log(y))	3. 977	0. 13	accepted	No

Source: Calculated by author

The estimated system equation 2 explored that there are no short run causalities from human development index,health expenditure and GDP per capita of SAARC during 1990-2016 to the education expenditure of SAARC region which were obtained through the Wald test.

Table 10: Short run causality to education expenditure

H0=No causality	*Chi-square(2)*	*Probability*	*Accepted/rejected*	*Causality-yes/no*
Causalities from d(log(y(-1)), d(log(y(-2)) to d(log(x_1))	0. 0989	0. 95	accepted	no
Causalities from d(log(x_1(-1)), d(log(x_1(-2)) to d(log(x_1))	0. 629	0. 73	accepted	no
Causalities from d(log(x_2(-1)), d(log(x_2(-2)) to d(log(x_1))	1. 903	0. 38	accepted	no

In the estimated system equation 3,the Wald test showed that there is short run causality from education expenditure to the health expenditure of the SAARC region during the study period of 1990-2016 which are shown in the Table 11. The other causalities are also shown.

Table 11: Short run causality to the health expenditure

H0=No causality	*Chi-square(2)*	*Probability*	*Accepted/rejected*	*Causality-yes/no*
Causalities from d(log(y(-1)), d(log(y(-2)) to d(log(x_2))	0. 0368	0. 98	accepted	no
Causalities from d(log(x_1(-1)), d(log(x_1(-2)) to d(log(x_2))	6. 363	0. 04	rejected	yes
Causalities from d(log(x_2(-1)), d(log(x_2(-2)) to d(log(x_2))	24. 271	0. 0. 00	rejected	yes
Causalities from d(log(x_3(-1)), d(log(x_3(-2)) to d(log(x_2))	0. 7486	0. 68	accepted	No

Source: Calculated by author

Similarly, in the estimated system equation 4 states that there are no short run causalities to the GDP per capita from the HDI,education expenditure and health expenditure of the SAARC nations during 1990-2016 which were found from the Wald test and are arranged in the Table 12.

Table 12: Short run causality to GDP per capita

H0=No causality	*Chi-square(2)*	*Probability*	*Accepted/rejected*	*Causality-yes/no*
Causalities from d(log(y(-1)) , d(log(y(-2)) to d(log(x_3))	1. 462	0. 48	accepted	no
Causalities from d(log(x_1(-1), d(log(x_1(-2)) to d(log(x_3))	0. 884	0. 64	accepted	no
Causalities from d(log(x_2(-1)), d(log(x_2(-2)) to d(log(x_3))	0. 3018	0. 88	accepted	no
Causalities from d(log(x_3(-1)), d(log(x_3(-2)) to d(log(x_3))	0. 8593	0. 65	accepted	No

Source: Calculated by author

Thus, in brief, the paper explores that the human development index of SAARC has long run causalities from education expenditure, health expenditure and GDP per capita of SAARC during 1990-2016 but has no short causalities from them.

5. Discussions on policy frameworks of SAARC

The SAARC bloc has framed various policies on both education and health during successive summits since the inception.

In the second summit in 1986 at Bangalore, the main theme was education security, social and human development followed by re-educational facility in Kathmandu session in 1987. Again, in the next summit in 1988,to increase literacy rate was one of target in promoting welfare of SAARC people. In 1990 the improvement of quality of life was the target of the conference which was the moto of the human development. Again in 1996, literacy was the focal theme of SAARC summit. The region agreed to set up SAARC center for human resource development in 1998 at Islamabad. Again, in the summit of 2008 the attainment food security and the goal of quality of life were the focal goals of the conference. In the objectives of the SAARC region the Article 1 stated to promote the welfare of the South Asia and to improve their quality of life which ensures the betterment of human development in the bloc.

The SAARC Technical Committee in Health was set up in 1984 on child health care, primary health care, disabled and handicapped persons, control and combating major diseases such as malaria, leprosy, TB, Diarrhea,rabies and AIDS. Also, arrangements were made for training and research for combating major diseases. Even, the SAARC TB center was established in Kathmandu in 1982. The hike in investment in health and education was emphasized to pursue a rapid expansion in employment to raise capabilities of the poor where trading of medical equipments should be emphasized by SAFTA which was also encouraged to move teaching professionals in education under the article of SATIS and at last the South Asian University was set up in 2010 in New Delhi (RIS, 2015).

In the 12th SAARC summit at Islamabad in 2004, the sustainable development goals of SAARC were formulated in which health sustainable goals were in the number from 9 to 12 which were maternal health, child health care, affordable health care, improved hygiene and public health. On the other hand, the sustainable education goals were in the numbers from 13 to 16 which were access to primary /community schools for children, boys, girls, completion of primary education cycle, universal functional literacy, quality education at primary, secondary and vocational levels (CSO, 2013).

As such SAARC region postulated a list of targets to catapult human development index such as priority to social sector, disadvantaged regions and social groups,preparations of state and District HDI,strengthening statistical system, emphasis on SC, ST, minorities, disabled, improving gender budgeting, gender disaggregated data and so on to fulfill MDGs and SDGs (HDR of India, 2010).

The panel cointegration and vector error correction models of SAARC during 1990-2016 should undoubtedly prescribe to hike health expenditure and education expenditure as per cent of GDP upward continuously so that positive association with HDI must be achieved. Moreover, increase in social sector expenditure is also a pre-requisite policy to obtain positive relation among them in the SAARC region. More specifically,literacy race,gross enrollment ratio,and skill development of girls and boys should be increased. Public health services should be strengthened more to decline mortality rate and burden of diseases, to rise human efficiency, so that life expectancy and productivity must increase.

6. Conclusion and remarks

The paper concludes that education expenditure as per cent of GDP had insignificant negative impact on human development index of SAARC region, but health expenditure had significant negative effect on human development index and GDP per capita at current prices in US dollar had significant positive impact on human development index of SAARC region during 1990-2016 as have been found from the random effect regression model after verification of Hausman test. The cointegration tests suggested that the variables have at least one cointegrating equation. The vector error correction model became stable, non-stationary, non-normal and showing autocorrelation problems. There were significant long run causalities from education expenditure, health expenditure and GDP per capita to the human development index of SAARC during the survey period but they had no short run causalities. Rather,there was short causality from human development index to the health expenditure of the SAARC nations.

Besides, the paper suffers from shortcomings. To what extent health expenditure affects health index and how much education expenditure affects education index are to be explored so that they can relate positively with the human development index of SAARC during the survey period. Unfortunately, the paper had missed the exact links which need to find the determinants of education and health indices of India. Future research in this area might be given the fruitful answers.

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