FACTORS OF HUMAN DEVELOPMENT INDEX IN ASEAN: PANEL COINTEGRATION ANALYSIS

Debesh Bhowmik

Indian Economic Association (IEA) & The Indian Econometric Society (TIES), India

Corresponding Author's Email: debeshbhowmik269@gmail.com

ABSTRACT

In this paper, the author tried to relate HDI (Human Development Index) with GDP (Gross Domestic Product), education expenditure, health expenditure and unemployment rate in ASEAN-9 during 1990-2016 with fixed effect panel regression model, Fisher-Johansen cointegration and panel VECM (Vector Error Correction Model) respectively. The author found that one percent increase in GDP, 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 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. In panel VECM, it was found that-

i. There is significant long run causality from health expenditure percentage of GDP and unemployment rate to the Human Development Index (HDI) of the ASEAN during 1990-2016.

ii. There is significant long run causality from health expenditure percentage of GDP and unemployment rate to the educational expenditure % of GDP of the ASEAN during 1990-2016.

iii. There is also a significant short run causality from education expenditure to GDP, from HDI to education expenditure and from GDP to unemployment rate of ASEAN during 1990-2016.

Keywords: Human Development Index, Gross Domestic Product, Fixed Effect Regression, Panel Cointegration, Panel Vector Error Correction

INTRODUCTION

ASEAN is one of the leading regional trading blocs in Asia as well as in the world, but majority of its members are facing low GDP per capita and HDI value. Poverty and unemployment problems of ASEAN are randomly hampering the development process where both physical and human capital is suffering. Human capital as a function of growth through improvement in education and skill development and with high productivity should be a great concern in the ASEAN region. Human competitiveness index of ASEAN region is not satisfactory in the world economy. Even in the era of globalization and liberalization the human development factor is not given prior importance. The indicators of human development were not properly nourished. Therefore, the transformation of the economy through human development was underutilized. ASEAN as a single market for the goods, services, investment, skilled labor, free capital flows in accelerating economic integration process, intra and inter-competitiveness of human skill and productivity through human development. It is necessary because Lucas (1988) in his endogenous growth theory emphasized investment in human capital more directly and linked it to long term rates of economic growth. Sen (1999) argued that standard of living of a society should be judged not by the average level of income but by people's capabilities to lead the life they value. On the one hand, economic growth provides the resources to permit sustained improvement in human development. On the other hand, sustained improvement in the quality of human capital is an important contribution to economic growth.

LITERATURE REVIEW

Binder & Georgiadis, (2010) applied a novel dynamic panel data model with state dependent coefficients to study the effects of a set of macro policy–investment in physical capital, government consumption and trade openness on development of HDI and GDP per capita. They took 84 countries during 1970-2005 for HDI and GDP per capita. They found that HDI development in various counts differs notably from that of GDP. Both GDP and HDI exhibit conditional cross-country convergence properties, the HDI adjustment process is slower than that for GDP. Realizing gain in HDI development requires more potential than in case for GDP development policies. Macro-economic policies such as international trade integration, stimulation of investment in physical capital and government consumption stimuli that may spur GDP development relatively notably will have less pronounced effects of macro-economic policies across countries. It allows high degree of cross-country heterogeneity in the development process and can assess the characteristics such as institutional quality, gender inequality, and religious environment. Shome & 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. They also found for individual economies where there is a significantly negative and low coefficient like in Philippines and Singapore. Even, there is significantly low and positive correlation for Malaysia and Thailand, but in Indonesia this correlation is positive and significantly high. Sarkar, Sadeka & Sikdar (2012) explained in their paper that there is an imbalance among ASEAN regarding HDI, but Malaysian indicator is quite high in terms of environmental performance index, renewable energy, fossil fuel etc. but far behind from regarding GNI (Gross National Income) per capita, life expectancy and so on. Malaysia produced highest CO_2 emission and GHG (Greenhouse Gas) in ASEAN. But it has strong growth and low poverty and failed to achieve the best in ASEAN region. The country needs to gear up indicators of HDI and conduct better research in this area. Bangun (2014) analyzed between HDI and competitiveness score in ASEAN-10 during 2000-2012. He found that Indonesia is the lowest in ASEAN-6 where 33.1% was classified as educated skilled labor and its HDI is increasing very slowly. Correlation coefficient between HDI and competitiveness score was found as 86.30% in ASEAN-10 which is significant. Indonesia needs to improve its human and physical capital and needs education and training for improving competitiveness. Roshaniza & Selvaratnam (2015) used OLS (Ordinary Least Squares), and Johansen cointegration test in Malaysia during 1990-2012 among HDI, poverty and GDP. They found there is a long run association between HDI and poverty with GDP where HDI and poverty is positive with GDP and HDI and GDP is negative. In the short run, HDI and GDP have no relationship. Poverty and GDP has negative relation with GDP. Shah (2016) studied relation among HDI and its determinants like GDP per capita, 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. Kumar (2017) studied panel cointegration between HDI and trade per capita in ASEAN-7 during 1995-2005 and found that there is long run association between HDI and trade per capita. The more a country increases trading intensity the greater is the increase in its income level, the greater is the influx of innovative technology, transfer of superior human skill, its productive efficiency, the more availability of new goods. Thus, ASEAN cannot ignore the implications its free trade regime although it needs more investment on education and training of human capital as the economy opened. Arisman (2018) used panel data fixed effect model during 2000-2015 in ASEAN-10 taking HDI and its influencing factors population, per capita income growth rate, inflation and unemployment rate. Author showed that population and per capita income growth rate affects HDI in ASEAN while inflation and unemployment rate does not have an impact on HDI.

Objective of the paper

In this paper, author attempted to examine panel data analysis during 1990-2016 for ASEAN-9 to relate HDI and GDP at current prices, education expenditure percentage of GDP, health expenditure percentage of GDP and unemployment rate through fixed effect regression method, Fisher-Johansen panel cointegration test and estimates of VECM where short run and long run causalities among those variables were examined through system equations and with the help of Wald test.

RESEARCH METHODOLOGY

Assume for all countries in ASEAN, Y= HDI, x= GDP at current prices, x_1= education expenditure percentage of GDP, x_2= health expenditure percentage of GDP, x_3= unemployment rate percentage of total labor force. Data for aforesaid variables have been collected from World Bank. Laos has deleted due to lack of data.

To find the relationship among the human development index, GDP, education expenditure, health expenditure and unemployment rate in ASEAN-9 during 1990-2016, the author used fixed effect panel regression model after verifying the Hausman Test (1978). Residual cross section dependence test of Breusch & Pagan's LM (Lagrange Multiplier Test) (1979), Pesaran, (2004) scaled LM, A Bias –corrected scaled LM test of Pesaran, Ullah & Yamagata (2008) and Pesaran's (2004) cross-sectional dependence (CD) test have been applied. Fisher (1932), Johansen (1991) cointegration test was used to show cointegration. Johansen (1991) Panel VECM was also used to show long and short run association where Wald (1943) test was verified in the system equations.

Some Observations from econometric model

Panel Random effect regression estimate is found as:

$$\text{Log}(y)=-0.85609+0.104794\log(x)+0.029573\log(x_1)+0.013255\log(x_2)-0.027732\log(x_3)$$
(-17.29) * (23.53) * (2.629)* (1.66) (-4.88)

$R^2= 0.828$ F=269.58 DW=0.217

Where Y= HDI, x= GDP at current prices, x_1= education expenditure percentage of GDP, x_2= health expenditure percentage of GDP, x_3= unemployment rate percentage of total labor force, no. of cross section= 9, no. of observations= 228, period= 27, *= significant at 5% level.

Hausman test showed that Chi-Square statistic equals 14.329 with 4 degree of freedom whose probability is 0.0063 which means random effect model is rejected. Therefore, the regression of fixed effect model becomes as follows:

$$\text{Log}(y)=-0.859008+0.10593\log(x)+0.0283\log(x_1)+0.01247\log(x_2)-0.02788\log(x_3)$$
(-41.16)* (23.42) * (2.51)* (1.55) (-4.87)

$R^2= 0.97$ F= 664.73*, DW= 0.235, *= significant at 5% level.

The estimated regression equation states that one percent increase in GDP, 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 insignificantly in ASEAN during 1990-2016. It is a good fit except DW which produced autocorrelation.

The residual cross section dependence test of null hypothesis of no cross-section dependence is rejected for the statistic of Breusch & Pagan (1979) scaled LM, Bias–corrected scaled LM and Pesaran CD whose values of probabilities are less than 5%.

Table 1: Residual cross section dependence test

Test	Statistic	df	Probability
Breusch-Pagan LM	284.7553	36	0.0000
Pesaran scaled LM	28.25543		0.0000
Bias-corrected scaled LM	28.08236		0.0000
Pesaran CD	12.49425		0.0000

Source-Calculated by Author

Applying lag1 and assuming constant and trend for 270 observations with 10 cross sections during 1990-2016 in ASEAN, Johansen Fisher Panel cointegration test suggests that Trace statistic and Max Eigen statistic contains at most 3 cointegrating equations whose probabilities are greater than 5%.

Table 2: Cointegration test

Hypothesized No. of CE(s)	Fisher Stat.* (from Trace test)	Prob.	Fisher Stat.* (from Max-eigen test)	Prob.
None	135.3	0.0000	96.77	0.0000
At most 1	56.37	0.0000	37.33	0.0007
At most 2	27.61	0.0160	16.56	0.2803
At most 3	18.35	0.1914	13.56	0.4833
At most 4	13.99	0.4506	13.99	0.4506
Hypothesis of at most 3 cointegration relationship	Individual cross section result			
1	13.0070	0.7377**	10.0522	0.6133**
2	23.2914	0.1013**	13.2734	0.3064**
3	15.7871	0.5097**	11.6925	0.4443**

** Probabilities are computed using asymptotic Chi-square distribution. **MacKinnon-Haug-Michelis (1999) p-values.*

Since they are cointegrated, then VECM estimates showed three cointegrating equations which are stated below,

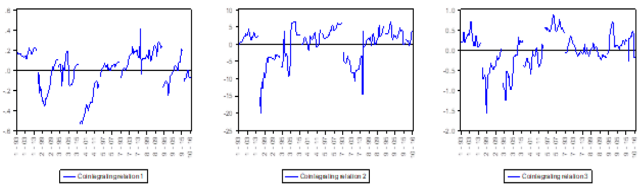
[1] $ECT_{1t-1}= \log y_{t-1}-0.17225\log x_{2t-1}-0.82779\log x_{3t-1}-0.000551t+0.6040$
(-3.307)* (-1.83) (-1.31)

[2] $ECT_{2t-1}= \log x_{t-1}+6.878\log x_{2t-1}+1.2068\log x_{3t-1}+0.000197t-5.8908$
(3.71)* 0.75) (0.013)

[3] $ECT_{3t-1}= \log x_{1t-1}-0.1612\log x_{2t-1}-0.1156\log x_{3t-1}-0.001779t-0.698$
(-1.26) (-1.042) (-1.72)

Three cointegrating equations are plotted in Figure 1.

Figure 1: Cointegrating Equations



Source- Plotted by Author

The estimated equations of VECM are given below:

[1] $\Delta\log y_t=-0.0137EC_1-0.000165EC_2-0.002673EC_3+0.19408\Delta\log y_{t-1}+0.09086\Delta\log y_{t-2}$
(-4.35)* (-1.15) (-1.57) (2.58)* (1.22)
$+0.002032\Delta\log x_{t-1}-0.004874\Delta\log x_{t-2}+0.005419\Delta\log x_{1t-1}+0.002193\Delta\log x_{1t-2}$
(0.51) (-1.29) (1.81) (0.75)
$+0.000209\Delta\log x_{2t-1}-0.002873\Delta\log x_{2t-2}-0.00228\Delta\log x_{3t-1}-0.00162\Delta\log x_{3t-2}+0.00724$
(0.123) (-1.45) (-1.02) (-0.725) (6.65)*
$R^2=0.367$, F=8.34, AIC=-7.12, SC=-6.89

[2] $\Delta\log x_t=-0.100082EC_1-0.000138EC_2-0.01129EC_3-0.3359\Delta\log y_{t-1}-1.189\Delta\log y_{t-2}$
(-1.65) (-0.05) (-0.34) (-0.23) (-0.83)
$+0.1419\Delta\log x_{t-1}-0.0578\Delta\log x_{t-2}+0.0378\Delta\log x_{1t-1}-0.146\Delta\log x_{1t-2}$
(1.87) (-0.802) (0.65) (-2.62)*
$+0.0192\Delta\log x_{2t-1}-0.0417\Delta\log x_{2t-2}-0.00344\Delta\log x_{3t-1}-0.00711\Delta\log x_{3t-2}+0.0855$
(0.59) (-1.09) (-0.8) (-0.16) (4.09)*
$R^2= 0.11$, F=1.84, AIC=-1.21, SC=-0.98

[3] $\Delta logx_{1t}=0.0908EC_1+0.00357EC_2-0.156EC_3-5.049\Delta logy_{t-1}+3.566\Delta logy_{t-2}$
(1.06) (0.92) (-3.40)* (-2.49)* (1.78)
$+0.0402\Delta logx_{t-1}+0.0896\Delta logx_{t-2}-0.0308\Delta logx_{1t-1}-0.0222\Delta logx_{1t-2}$
(0.37) (0.88) (-0.8) (-0.28)
$+0.0604\Delta logx_{2t-1}-0.0047\Delta logx_{2t-2}+0.0573\Delta logx_{3t-1}-0.0165\Delta logx_{3t-2}+0.0188$
(1.32) (-0.089) (0.85) (-0.27) (0.64)
$R^2= 0.149$, F=2.52, AIC=-0.53, SC=-0.302

[4] $\Delta logx_{2t}=0.3048EC_1-0.0103EC_2-0.093EC_3-2.562\Delta logy_{t-1}+3.593\Delta logy_{t-2}$
(1.97) (-1.48) (-1.12) (-0.69) (0.99)
$+0.0251\Delta logx_{t-1}-0.00366\Delta logx_{t-2}+0.1739\Delta logx_{1t-1}+0.214\Delta logx_{1t-2}$
(0.129) (-0.019) (1.18) (1.49)
$-0.219\Delta logx_{2t-1}-0.1601\Delta logx_{2t-2}-0.049\Delta logx_{3t-1}-0.047\Delta logx_{3t-2}+0.00778$
(-2.63)* (-1.64) (-0.45) (-0.42) (0.145)
$R^2=0.15$, F=2.54, AIC=0.66, SC=0.89

[5] $\Delta logx_{3t}=0.0466EC_1-0.0075EC_2+0.0357EC_3-1.0288\Delta logy_{t-1}-0.8228\Delta logy_{t-2}$
(0.41) (-1.56) (0.61) (-0.40) (-0.32)
$-0.3374\Delta logx_{t-1}+0.1358\Delta logx_{t-2}-0.1214\Delta logx_{1t-1}+0.0078\Delta logx_{1t-2}$
(-2.51)* (1.06) (-1.19) (0.078)
$+0.0911\Delta logx_{2t-1}+0.09215\Delta logx_{2t-2}-0.00402\Delta logx_{3t-1}-0.02112\Delta logx_{3t-2}+0.0145$
(1.58) (1.35) (-0.05) (-0.27) (0.39]
$R^2=0.066$, F=1.02, AIC=-0.07, SC=-0.018

All the estimated equations are poor fit having insignificant R^2, SC and AIC, yet the vector error correction in equation 1 (EC1) and in equation 3 (EC3) are significant whose speed of adjustment is 1.32% per year and 15.6% per year respectively. Both the error correction equations tend to equilibrium significantly.

VECM is stable but nonstationary because it has two-unit roots and all the roots lie inside the unit circle.

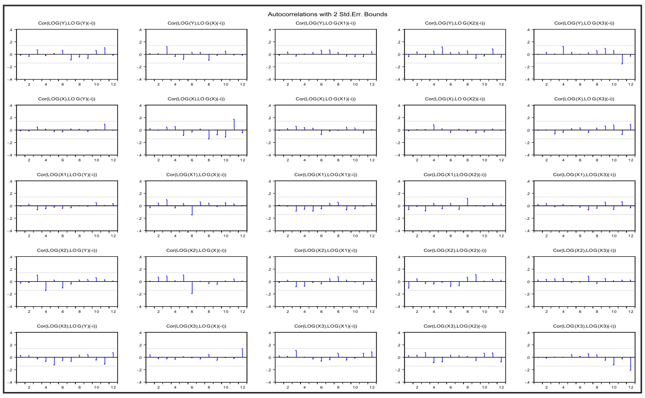
Table 3: Values of roots

Roots	Modulus
1.000000	1.000000
1.000000	1.000000
0.977878	0.977878
0.889123 - 0.035366i	0.889826
0.889123 + 0.035366i	0.889826
0.458380	0.458380
-0.223833 - 0.374251i	0.436079
-0.223833 + 0.374251i	0.436079
0.293287 - 0.304618i	0.422859
0.293287 + 0.304618i	0.422859
-0.087994 - 0.412136i	0.421425
-0.087994 + 0.412136i	0.421425
-0.324211	0.324211
-0.033291 - 0.231524i	0.233905
-0.033291 + 0.231524i	0.233905

Source- Calculated by Author

Residual test showed that it suffers from autocorrelation problem which is shown by the figure of correlogram.

Figure 2: Auto-correlation



Source-Plotted by Author

VEC residual normality test is rejected and the residuals are not normally distributed which was observed by Doornik-Hansen test.

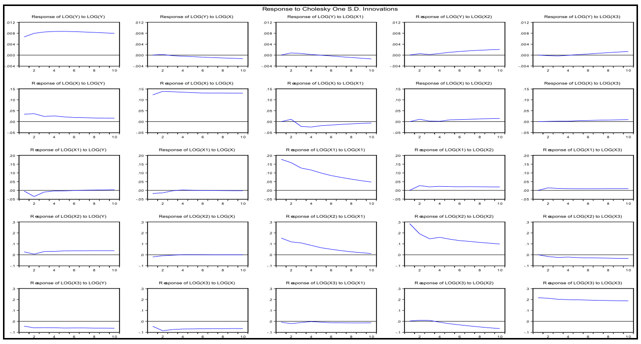
Table 4: Normality test

Component	Skewness	Chi-sq	df	Prob.
1	0.845374	20.04776	1	0.0000
2	-1.022993	27.02784	1	0.0000
3	-0.020615	0.015229	1	0.9018
4	0.569661	10.24691	1	0.0014
5	0.874162	21.15521	1	0.0000
Joint		78.49296	5	0.0000
Component	Kurtosis	Chi-sq	df	Prob.
1	6.841999	19.37432	1	0.0000
2	7.874697	19.48967	1	0.0000
3	7.046887	76.18438	1	0.0000
4	19.86583	407.9549	1	0.0000
5	14.60989	201.4040	1	0.0000
Joint		724.4073	5	0.0000
Component	Jarque-Bera	df	Prob.	
1	39.42208	2	0.0000	
2	46.51751	2	0.0000	
3	76.19961	2	0.0000	
4	418.2018	2	0.0000	
5	222.5592	2	0.0000	
Joint	802.9003	10	0.0000	

Source- Calculated by Author

The impulse response functions of the VECM implied that exogeneous shocks from $x_{t-1}, x_{t-2}, x_{1t-1}, x_{1t-2}, x_{2t-1}, x_{2t-2}$ and x_{3t-1}, x_{3t-2} on y_t, x_t, x_{1t}, x_{2t}, and x_{3t} do not move the system into equilibrium which are observed in the twenty five figures.

Figure 3: Impulse Response Functions



Source-Plotted by Author

From the estimated system equation-1 in VECM, we can infer that:

[1] There is long run causality from x_{2t-1}, x_{3t-1} to y_t in which c(1)= -0.0127 which is significant at 5% level(t=-4.07). Cointegrating equation tends to equilibrium whose speed of adjustment is 1.27% per annum. Again there is long run causality running from $x_{t-1}, x_{1t-1}, x_{2t-1}, x_{3t-1}$ on y_t but these are insignificant. They are not moving towards equilibrium which were found by Wald test.

EC_1=-0.0127logy_{t-1}-0.1722logx_{2t-1}-0.0827logx_{3t-1}-0.00055t+0.604
(-4.07)* (-3.303) * (-1.83) (-1.31)

EC_2=-0.000206logx_{t-1}+6.878logx_{2t-1}+1.206logx_{3t-1}+0.000197t-5.89
(-1.44) (3.71)* (0.75) (0.013)

EC_3=-0.00126logx_{1t-1}-0.161logx_{2t-1}-0.1156logx_{3t-1}-0.00177t-0.698
(-0.828) (-1.26) (-1.042) (-1.72)

[2] There is no short run causality running from $x_{t-1}, x_{1t-1}, x_{2t-1}, x_{3t-1}$ on y_t Wald Test .

Table 5: Short Run Causality on y_t

Short run causality, H0=no causality	$\chi^2(2)$	prob	F stat	prob	Accepted/ Rejected	Causality/no Causality
Causality from y_{t-1}, y_{t-2} to y_t	13.32	0.001	6.661	0.001	Rejected	Causality
Causality from x_{t-1}, x_{t-2} to y_t	1.80	0.40	0.90	0.40	Accepted	No causality
Causality from x_{1t-1}, x_{1t-2} to y_t	2.63	0.26	1.31	0.27	Accepted	No causality
Causality from x_{2t-1}, x_{2t-2} to y_t	2.58	0.27	1.29	0.27	Accepted	No causality
Causality fromx_{3t-1}, x_{3t-2} to y_t	1.21	0.54	0.68	0.54	Accepted	No causality

Source- Calculated by Author

Considering the system equations of the coefficients, the estimated VECM equation-2, we can conclude:

[1] There is long run causality from x_{2t-1}, x_{3t-1} to x_t in which c(15)=-0.0931which is not significant at 5% level (*t*=-1.56) and Chi -square(2)=0.0653(*p*=0.96). Cointegrating equation is tending to equilibrium insignificantly whose speed of adjustment is 9.31% per annum as found from Wald test. Again, there is no long run causality from x_{t-1}, x_{2t-1}, x_{3t-1} to x_t and no long run causality from $x_{1t-1}, x_{2t-1}, x_{3t-1}$ on x_t. But they all moving towards equilibrium but they are not insignificant. The speeds of error corrections are 0.45% and 0.14% per year respectively.

EC_1=-0.0931logx_{t-1}-0.1722logx_{2t-1}-0.0827logx_{3t-1}-0.00055t+0.604
(-1.56) (-3.303)* (-1.83) (-1.31)

EC_2=-0.00454logx_{t-1}+6.878logx_{2t-1}+1.206logx_{3t-1}+0.000197t-5.89
(-0.167) (3.71)* (0.75) (0.013)

EC_3=-0.001428logx_{1t-1}-0.161logx_{2t-1}-0.1156logx_{3t-1}-0.00177t-0.698
(-0.049) (-1.26) (-1.042) (-1.72)

[2] There is no short run causality running from y_{t-1}, y_{t-2}, $x_{2t-1}, x_{2t-2}, x_{3t-1}, x_{3t-2}$ to x_t but there is causality from x_{1t-1}, x_{1t-2} to x_t confirmed by Wald Test .

Table 6: Short Run Causality on x_t

Short run causality, H0=no causality	$\chi^2(2)$	prob	Accepted/ Rejected	Causality/no Causality
Causality from y_{t-1}, y_{t-2} to x_t	0.709	0.70	Accepted	No causality
Causality from x_{t-1}, x_{t-2} to x_t	3.953	0.138	Accepted	No causality
Causality from x_{1t-1}, x_{1t-2} to x_t	8.327	0.015	Rejected	Causality
Causality from x_{2t-1}, x_{2t-2} to x_t	2.36	0.307	Accepted	No causality
Causality fromx_{3t-1}, x_{3t-2} to x_t	0.0176	0.99	Accepted	No causality

Source- Calculated by Author

Considering the system equations of the coefficients, the estimated VECM equation-3, we can conclude:

[1] There is no long run causality from, $y_{t-1}, x_{2t-1}, x_{3t-1}$ to x_{1t} in which c(29)=0.108 which is not significant at 5% level(*t*=1.28) and Chi-square(2) =12.667(*p* =0.0018). Cointegrating equation does not tend to equilibrium whose speed of adjustment is 10.8% per annum as found from Wald test.

There is no long run causality from $x_{t-1}, x_{2t-1}, x_{3t-1}$ to x_{1t} but there is long run causality from $x_{1t-1}, x_{2t-1}, x_{3t-1}$ to x_{1t}.

EC_1= 0.108logy_{t-1}-0.1722logx_{2t-1}-0.0827logx_{3t-1}-0.00055t+0.604
(1.28) (-3.303)* (-1.83) (-1.31)

EC_2= 0.002883logx_{t-1}+6.878logx_{2t-1}+1.206logx_{3t-1}+0.000197t+5.89
(0.75) (3.71)* (0.75) (0.013)

EC_3=-0.131logx_{1t-1}-0.161logx_{2t-1}-0.1156logx_{3t-1}-0.00177t-0.00177
(-3.2)* (-1.26) (-1.042) (-1.72)

[2] There is no short run causality running from $x_{t-1}, x_{t-2}, x_{2t-1}, x_{2t-2}, x_{3t-1}, x_{3t-2}$ to x_{1t} but there is short run causality from y_{t-1}, y_{t-2} to x_{1t} as found by Wald Test.

Table 7: Short run causality on x_{1t}

Short run causality, H0=no causality	$\chi^2(2)$	prob	Accepted/ Rejected	Causality/no Causality
Causality from y_{t-1}, y_{t-2} to x_{1t}	0.7.535	0.024	Rejected	Causality
Causality from x_{t-1}, x_{t-2} to x_{1t}	1.047	0.59	Accepted	No causality
Causality from x_{1t-1}, x_{1t-2} to x_{1t}	0.39	0.82	Accepted	No causality
Causality from x_{2t-1}, x_{2t-2} to x_{1t}	2.536	0.28	Accepted	No causality
Causality from x_{3t-1}, x_{3t-2} to x_{1t}	0.88	0.64	Accepted	No causality

Source- Calculated by Author

Considering the system equations of the coefficients, the estimated VECM equation-4, we can conclude:

[1] There is no long run causality from, $y_{t-1}, x_{2t-1}, x_{3t-1}$, on x_{2t} in which c(43)=0.3059 which is significant at 5% level(t=2.011) and Chi -square(2)=9.87(p=0.0018). Cointegrating equation s do not tend to equilibrium whose speed of adjustment is 30.5% per annum as found from Wald test.

There is insignificant long run causality from $x_{t-1}, x_{2t-1}, x_{3t-1}$, on x_{2t} and from $x_{1t-1}, x_{2t-1}, x_{3t-1}$, on x_{2t}, yet both of them are tending to equilibrium. Their speed of error corrections is 1.04% and 9.19% per annum respectively.

$$EC_1=0.3059\log y_{t-1}-0.1722\log x_{2t-1}-0.0827\log x_{3t-1}-0.00055t+0.604$$
$$(2.011)^* \quad (-3.303)^* \quad (-1.83) \quad (-1.31)$$
$$EC_2=-0.0104\log x_{t-1}+6.867\log x_{2t-1}+1.206\log x_{3t-1}+0.000197t+5.89$$
$$(-1.51) \quad (3.71)^* \quad (0.75) \quad (0.013)$$
$$EC_3=-0.0919\log x_{1t-1}-0.161\log x_{2t-1}-0.115\log x_{3t-1}-0.00177t-0.698$$
$$(-1.24) \quad (-1.26) \quad (-1.042) \quad (-1.72)$$

Table 8: Short run causality on x_{2t}

Short run causality, H0=no causality	$\chi^2(2)$	prob	Accepted/ Rejected	Causality/no Causality
Causality from y_{t-1}, y_{t-2} to x_{2t}	1.204	0.54	Accepted	No causality
Causality from x_{t-1}, x_{t-2} to x_{2t}	0.0168	0.99	Accepted	No causality
Causality from x_{1t-1}, x_{1t-2} to x_{2t}	3.197	0.20	Accepted	No causality
Causality from x_{2t-1}, x_{2t-2} to x_{2t}	7.72	0.02	Rejected	Causality
Causality from x_{3t-1}, x_{3t-2} to x_{2t}	0.37	0.82	Accepted	No causality

Source- Calculated by Author

Considering the system equations of the coefficients, the estimated VECM equation-5, we can conclude:

[1] There is no long run causality from, y_{t-1}, x_{2t-1} to x_{3t} in which c(57)=0.0362 which is not significant at 5% level(t=0.34) and Chi -square(2)=2.577(p=0.27). Cointegrating equation does not tend to equilibrium whose speed of adjustment is 3.62% per annum as found from Wald test.

Similarly, there is no long run causality running from $y_{t-1}, x_{1t-1}, x_{2t-1}, x_{3t-1}$ on x_{3t} and there is no long run significant causality from $x_{t-1}, x_{2t-1}, x_{3t-1}$ on x_{3t} as suggested by Wald test.

$$EC_1=0.0362\log y_{t-1}-0.1722\log x_{2t-1}-0.0827\log x_{3t-1}-.00055t+0.604$$
$$(0.34) \quad (-3.303)^* \quad (-1.83) \quad (-1.31)$$
$$EC_2=0.00717\log x_{t-1}+6.87\log x_{2t-1}+1.206\log x_{3t-1}+0.000197t-5.89$$
$$(-1.49) \quad (3.71)^* \quad (0.75) \quad (0.013)$$
$$EC_3=0.0237\log x_{1t-1}-0.161\log x_{2t-1}-0.115\log x_{3t-1}-0.00177t-0.6989$$
$$(0.46) \quad (-1.26) \quad (-1.042) \quad (-1.72)$$

[2] There is no short run causality running from $y_{t-1}, y_{t-2}, x_{1t-1}, x_{1t-2}, x_{2t-1}, x_{2t-2}$ to x_{3t} but there is a short run causality from x_{t-1}, x_{t-2} to x_{3t} as tested by Wald Test.

Table 9: Short run causality on x_{3t}

Short run causality, H0=no causality	$\chi^2(2)$	prob	Accepted/ Rejected	Causality/no causality
Causality from y_{t-1}, y_{t-2} to x_{3t}	0.51	0.77	Accepted	No causality
Causality from x_{t-1}, x_{t-2} to x_{3t}	7.05	0.029	Rejected	Causality
Causality from x_{1t-1}, x_{1t-2} to x_{3t}	1.420	0.49	Accepted	No causality
Causality from x_{2t-1}, x_{2t-2} to x_{3t}	3.123	0.209	Accepted	No causality
Causality from x_{3t-1}, x_{3t-2} to x_{3t}	0.098	0.95	Accepted	No causality

Source- Calculated by Author

Therefore, [i] there is significant long run causality running from health expenditure percentage of GDP and unemployment rate to human development index of the ASEAN during 1990-2016. [ii] There is significant short run causality running from education expenditure to GDP, from HDI to education expenditure and from GDP to unemployment rate of ASEAN during 1990-2016. [iii] There is significant short run causality running from education expenditure on GDP, from HDI on education expenditure and from GDP on unemployment rate of ASEAN during 1990-2016.

Limitations and future scope of research

The paper suffers from some limitations. Firstly, there are few variables which may affect HDI in ASEAN like inflation rate, fiscal policy indicators say fiscal deficit, and other investment like private sectors' investment in health and education in the economy. Even, FDI in education and health would surely affect HDI in the regions. Due to non-availability of data, we exclude Myanmar and as we had no data on health expenditure of Laos for all years and Vietnam from 1990 to 2004 respectively. Therefore, the figures of the three cointegrating equations showed broken lines. Lastly, the results could be compared with SAARC or GCC in Asia about the human development so that the backwardness of the Asian regions might be compared with Euro Area or NAFTA. This is left for future research.

Policies to improve HDI in ASEAN

ASEAN bloc is advised to follow the following measures to improve HDI:

[I] to accelerate GDP growth rate, [ii] poverty-led growth is preferable in long term policy, [iii] to hike education and health expenditure, [iv] ASEAN regions needs better training and research to increase competitiveness, [v] to invest more for betterment of physical capital, [vi] to increase education index, income index and health index, [vii] needs balanced macro-economic policy.

CONCLUSION

The paper concludes that fixed effect panel regression showed one percent increase in GDP, 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 insignificantly in ASEAN during 1990-2016. Panel cointegration suggested that there are three cointegrating equations in which two are moving towards equilibrium. In panel VECM, it was found that [i] There is significant long run causality from health expenditure percentage of GDP and unemployment rate to the human development index of ASEAN during 1990-2016. [ii] There is significant long run causality from health expenditure percentage of GDP and unemployment rate to the education expenditure percentage of GDP of the ASEAN during 1990-2016. [iii] There are significant short run causality from education expenditure to GDP, from HDI to education expenditure and from GDP to unemployment rate of ASEAN during 1990-2016 respectively.

REFERENCES

Arisman, A. (2018). Determinant of Human Development Index in ASEAN countries. *Journal Ilmu Ekonomi*, 7(1), pp 113-122.

Bangun, W. (2014). Human Development Index: Enhancing Indonesian Competitiveness in ASEAN Economic Community (AEC). *International Journal of the Computer, the internet and Management*, 22(1), pp 42-47.

Binder, M. & Georgiadis, G. (2010). Determinants of Human Development: Insights from State Dependent Panel Models. *Human Development Research Paper* 2010/24. Retrieved from: http:// citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.420.6863&rep=rep1&type=pdf

Breusch, T.S. & Pagan, A.R. (1979). A Simple Test for Heteroscedasticity and Random Coefficient Variation. *Econometrica*, 47(5), pp 1287-1294.

Fisher, R.A. (1932). *Statistical Methods for Research Workers*. 4th Edition. Oliver & Boyd. Oxford, England.

Hausman, J.A. (1978). Specification Tests in Econometrics. *Econometrica*, 46(6), pp 1251–1271.

Johansen, S. (1991). Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models. *Econometrica*, 59(6), pp 1551-1580.

Kumar, S. (2017). Trade and Human Development: Case of ASEAN. *Pacific Business Review International*, 9(12), pp 48- 57.

Lucas, R.E. (1988). On the Mechanics of Economic Development. *Journal of Monetary Economics*, 22(1), pp 3-42.

Pesaran, M.H. (2004). General Diagnostic Tests for Cross Section Dependence in Panels. University of Cambridge & USC, Faculty of Economics, Cambridge Working Papers in Economics No. 0435. June 2004. Retrieved From: https:// www. repository. cam.ac.uk/bitstream/handle/ 1810/446/ cwpe0435. pdf?sequence=1&is Allowed=y

Pesaran, M.H. (2004). General Diagnostic Test for Cross Section Dependence in Panels, *CESifo*, Working Paper Series No. 1229, IZA Discussion Paper No. 1240. August, Germany. Retrieved From: http://ftp.iza.org/dp1240.pdf

Pesaran, M., Ullah, A. & Yamagata, T. (2008). A Bias-Adjusted LM Test of Error Cross-Section Independence. *Econometrics Journal*, 11(1), pp 105-127.

Roshaniza, N.A.B.M. & Selvaratnam, D.P. (2015). Gross Domestic Product (GDP) Relationship with Human Development Index (HDI) and Poverty Rate in Malaysia. *Prosiding Perkem*, 10(2015), pp 211-217.

Sarkar, M.S.K., Sadeka, S. & Sikdar, M.M.H. (2012). Human Development Scenario of Malaysia: ASEAN and Global Perspective. *Asian Journal of Applied Science and Engineering*, 1(1), pp 23-34.

Sen, A. (1999). *Development as Freedom*. Oxford University Press. London. UK.

Shah, S. (2016). Determinants of Human Development Index: A Cross Country Empirical Analysis. MPRA Paper 73759, University Library of Munich, 16th September, Germany. Retrieved From: https://mpra.ub.uni-muenchen.de/73759/ 1/ MPRA_paper _73759.pdf

Shome, S. & Tondon, S. (2010). Balancing Human Development with Economic Growth: A Study of ASEAN-5. *Annals of the University of Petroşani, Economics*, 10(1), pp 335-348.

Wald, A. (1943). Test of Statistical Hypotheses Concerning Several Parameters When the Number of Observations is Large. *Transactions of American Mathematical Society*, 54(3), pp 426-482.