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Higher Education and Economic Growth in Haryana: An Application of Cointegration and Vector Error Correction Model (VECM) Approach

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Abstract

It is widely recognised that higher education promotes economic development by enhancing human and technical capabilities of any economy like Haryana. Investment in education leads to the formation of human capital, comparable to physical capital & social capital, and that makes a significant contribution to economic growth (Dickens et al., 2006; Loening, 2004; Gylfason and Zoega, 2003; Barro, 2001).Many studies have been conducted from time to time all over the world, by Becker, Denison, Dholakia, Harbison and Myers, Mukerji and Krishna Rao, Psacharopoulos, Schultz, Solow, Tilak and Todaro.Keeping in above backdrop, the present paper is a humble attempt to investigate the relationship between higher education and economic growth in Haryana, by using a data for the period 1990 to 2014. Higher education expenditure (HEE) and Gross State Domestic Product (GSDP) are used as a proxy for higher education and economic growth in Haryana. The study employed lag regression model because expenditure on education does not yield immediate return to the individual as well as to the economy and Johensen cointegrating technique to determine the order or the cointegrating equation. And then Vector Error Correction Model (VECM) was used to check for a short-run or long-run relationship among the two variables (GSDP, HEE). The results indicate that variables under consideration are cointegrated and VECM suggested long-run and short-run relationship among the variables. Test for adequacy performed on the residuals of the VECM indicates that both models are homoscedasticity and normally distributed but serial correlation exists in one model. For improving the quality of higher education and enhancing the economic growth of Haryana, there is an urgent need to increase the expenditure on education in general and higher education in particular.

Keywords: GSDP, HEE, Cointegration and VECM

Introduction

Education in general and higher education in particular has always been considered as the only key component of human resource development (HRD). It is the greatest liberating force in any region including Haryana. It is considered as fundamental to all round development of the individual both at material and spiritual levels. Education creates human capital which is the core of economic progress and assumes that the externalities generated by human capital are the source of self-sustaining economic process. It hardly needs any justification that higher education is an engine of economic growth as well as human development which improves physical quality of life index (PQLI) in the knowledge economy of today. In order to become prosperous economy, Haryana has to qualitatively strengthen her education in general and higher and technical education in particular. Higher Education is very vital to achieve sustainable growth and development of any country. Noble Laureate, Amartya Sen (1999) argued that it is higher education besides elementary and secondary education that forms a “human capability” and a “human freedom” that helps in attaining other “freedoms”. In this regard, higher education has significant role in supporting knowledge driven economic growth strategies. It contributes to national development through dissemination of specialized knowledge and skills. Investment in education leads to the formation of human capital, comparable to physical capital &

social capital, and that makes a significant contribution to economic growth (Dickens et al., 2006; Loening, 2004; Gylfason and Zoega, 2003; Barro, 2001).The major contribution to the issue on the relationship between education and economic growth was first made by Adam Smith, followed by Marshall, Schultz, Bowman and others (Tilak, 2005). In this regard, many studies have been made from time to time all over the world, by Becker, Denison, Dholakia, Harbison and Myers, Mukerji and Krishna Rao, Psacharopoulos, Schultz, Solow, Tilak and Todaro. Keeping in above backdrop, the present paper is a humble attempt to analyse the relationship between higher education and economic growth of Haryana by applying Cointegration and Vector Error Correction Model (VECM). Second section of the paper reviews the related literature on present issue. Section 3 describes the objective of the paper, sources of data and research methodology. Results to examine the relationship between higher education and economic growth of Haryana are presented in Section4. Analysis or Discussions are given in section 5. And lastly, Section 6 concludes the study with policy implications.

Review of Related Literature

There is no dearth of literature on the present issue of relationship between higher education and economic growth. To justify the need of present study or to fill the gap, following literature has been reviewed:

Ranis et al. (2000) analysed the effects of economic growth due to human capital development and the effects of human capital development as the result of economic growth. The study showed that economic growth had positive and strong impact on human capital development as well as higher human capital development leads to significant and strong GDP per capita income growth. **Abbas (2001)** studied the impact of education on the countries of Pakistan and Sri Lanka. It showed that the primary education has a negative effect on economic growth, while secondary and higher education have a positive and statistically significant impact on economic growth in both the countries. **Jaoul (2002)** in his study analysed the causal relationships between higher education and economic growth of France. In the study he applied Johansen cointegration and Granger causality analysis. The study found that there exists cointegrated and bi-directional causality between higher education and economic growth. **Tilak J.B. (2003)** shows the considerable effect of higher education on the economic growth of nations of 49 countries of the Asia Pacific region. This research concludes that the larger the stock of the population with higher education, the higher will be the chances of economic growth. **Self and Grabowksi (2004)** used time series techniques to study the causal impact of primary, secondary and tertiary education on Indian growth performance by considering data from 1966 to 1996, The results confirmed the importance of primary education with weaker evidence for secondary education and no evidence that tertiary education has a beneficial impact on growth. But the most interesting finding of Self and Grabowski is the importance of female education (at all levels) in the growth process. **Adefabi (2005)** examine the long run relationship between education and economic growth in Nigeria by using Johansen Cointegration and Vector Error Correction technique. The study argues that human capital leads to economic growth when it uses as an input in the production function. In this way, well-educated labour force leads to economic growth. **Bakare (2006)** examined the growth implications of human capital investment in Nigeria. He used vector autoregressive error corrections mechanism. The study concluded that there is an important functional as well as institutional relationship between the investments in human capital and economic growth. It was also found that during the period 1970 to 2000, 1% fall in human capital investment caused 48.1% fall in the rate of growth in gross domestic output. **Bhandari and Curs (2007)** examined the effect of higher education expenditures on economic growth in U.S. They used simple regression analysis. The study found that there is no significant relationship from higher education expenditures to economic growth. But economic growth accelerates higher education expenditures. **Chatterji (2008)** examined the returns to education in India and then analysed the role of education on economic growth and economic development in India. The consensus of the study appears that all rates of return to education are higher in those areas where development is low. The results suggest that female education has particular importance in India. The study also suggested that because of the externalities, primary education is more important than might be deduced from its relatively low private rate of return. **Pradhan (2009)** analyzed the causal relationship between education and economic growth in India during 1951 to 2001. The findings confirmed that there is uni-directional relationship between education and economic growth in the Indian economy. And the direction of causality is from economic growth to education but there is absence of reverse causality. The cointegration test confirmed that economic growth and education are cointegrated, depicting an existence of long run equilibrium relationship between the education and economic growth in India. **Chandra (2010)** has examined causal relationship between investment in education and economic growth for India covering the time period 1951-2009. The study used linear and non-linear Granger causality methods. The study found bi-directional causality between education spending and GDP for India. It can also be seen that empirical evidence regarding this relationship for India is too mixed. **Shaihani et al. (2011)** studied the relationship of education and economic growth of Malaysia and concluded that in the secondary education has a positive and statistically significant coefficient in the short run. The primary and tertiary education shows negative and statistically significant results. The higher education has only positive and statistically significant impact in the long run. **Muktdair-Al-Mukit (2012)** applied econometric model with time series data from 1995 to 2009 period in order to investigate the long run relationship between

public expenditure on education and economic growth in Bangladesh. The study found that public spending on education has a positive and significant impact on economic growth in the long run. Further study also observed by employing Cointegration technique and found one per cent increase in public expenditure contributes 0.34 per cent increase in GDP per capita in the long run. **Ray (2013)** empirically investigated the causality between education expenditure and economic growth in India for the period 1961-62 to 2009-10. The study did not found the causality that runs from economic growth to education and vice versa. **Mekdad et al. (2014)** inspected the relationship between education and economic growth. The study used multiple entrances (dimension) information relating education and economic growth on theoretical and empirical background in Algeria over the period 1974-2012. The study applied endogenous growth model. In this model, gross domestic product (GDP) is in the form of Cobb Douglas. In this function five variables were adopted: Real Gross National Product (GDP), Capital (K), Expenditure on Education (SEDU), Labour (L). Two unit root tests (Philips-Perron Test) have been applied to test the integration order of the variables. The study uses Ordinary Least Squares (OLS), Johansen Co-integration and Causality Test. The empirical results verify the main hypothesis that public spending on education positively affects economic growth in Algeria. The education has most important effect on economic growth, the other three explanatory variables also affect economic growth positively but their effect is relatively less important. **Bindu D.H. and Mathews A.M. (2015)** examined the long run equilibrium and causal relationship between Gross Domestic Product (GDP) and the enrolment rate in India for period 1990-91 to 2013-14. The study used Johansen's co-integration test and Granger Causality test. The Johansen's co-integration test established a long run relationship between primary and secondary education with GDP in India. The Granger Causality test proved that GDP and GCF has an impact on primary enrolment and not vice versa, whereas secondary enrolment causes GDP and employment in the economy. The study concludes that there exists a bi-directional relationship between primary and secondary enrolment, where in both cause each other. Secondary education causes economic growth which depends on the level of primary education.

It is clear from above literature that the various studies have been conducted in relation to education and economic growth in different economies. Many studies concluded that there exists some degree of relationship between education and economic growth.

Objective of the Study & Research Methodology

The objective of present paper is to analyse the relationship between higher education and economic growth of Haryana by applying Cointegration and Vector Error Correction Model (VECM). The present study is based on secondary data, which has been collected from Various Issues of Statistical Abstract of Haryana, Economic Survey of Haryana. The data has been collected for 25 years from 1989-90 to 2013-14. In order to examine the relationship between higher education and economic growth in Haryana, higher education expenditure (HEE) is used as a proxy for higher education and gross state domestic product (GSDP) for economic growth. And this relationship has been analyzed through simple linear regression model of the form as follows:

$$GSDP_t = \alpha_0 + \alpha_1 HEE_t + U_t \ldots\ldots\ldots (1)$$

The above model depicts that current year expenditure on higher education influences the current year GSDP and it has no time lag. Since, expenditure on higher education does not yield immediate return to the individual as well as to the economy.

Regression Model with Time Lag:

To identify the time lag, through the explanatory power of the independent variable, viz. the higher education expenditure, we have used regression models with varying time lag as under:

$$GSDP_t = \alpha_0 + \alpha_1 HEE_{t-k} + U_t \ldots\ldots\ldots\ldots (2)$$

Where, k=1, 2, 3, 4…..22

The above lag model depicts that GSDP of period't' depends on HEE of period 't-k' where k goes from 1 to 22. In the above model $GSDP_t$ is regressed on each HEE individually through Ordinary Least Square (OLS). In the above model, the lagged values higher education expenditures are used because expenditure on education does not yield immediate return to the individual as well as to the economy. GSDP of current period is regressed on past values of HEE one by one through Ordinary Least Square (OLS) method to avoid the problem of multicollinearity. The estimated value of the regression coefficients (α_K), constant term (α_0), standard error of the regression coefficient ($SE\alpha_K$), Value of t-statistics, Coefficient of determination (R^2 & adjusted R^2), Karl Pearson coefficient of correlation (R) and Value of F- statistic are computed.

Results of this lagged regression model (equation 2) may or may not be reveal that past values of HEE (higher education) do lead to GSDP (economic growth). However, on this basis it cannot be said that HEE causes GSDP.

In order to examine the causality between HEE and GSDP, the appropriate test i.e. Vector Error Correction Model (VECM) is used. The empirical process comprises two parts:

Testing for the number of Cointegrating Vectors

Engle and Granger (1987) observe that even though economic time series may wander through time, that is, may have the feature of non-stationary in their level, there may exist some linear combination of these variables that converges to a long run relationship over time. If the series individually are stationary only after differencing but one finds that a linear combination of their levels is stationary, then the series are said to be cointegrated.

Estimating and Testing for Causality through Vector Error-Correction Model (VECM)

According to Engel and Granger (1987), in case variables are cointegrated then there exists a related error correction model wherein short term movements of variables are affected by the deviation

from the equilibrium. If the variables are cointegrated, VECM is useful for both long-term and short-term [Ratanapakorn and Sharma (2007)]. The VAR is incapable of exploring long-term relations as well as it is deficient in discovering short-term relations in presence of cointegration [Mukherjee and Naka (1995)]. VECM is more appropriate to model for several macro-economic variables as it distinguishes between stationary variables with transitory (temporary) effects and non-stationary variables with permanent (persistent) effects (Juselius, 1991).

After applying VECM, Wald test have been used to know the short-run relationship among variables. Breusch-Godfrey Serial Correlation LM Test, Breusch-Pagan-Godfrey Heteroskedasticity test and Jarque-Bera Normality test has used for residual analysis of VECM estimates. For applying test or obtaining results, E-Views 9.5 is used.

Results and Discussions

Results

Table 1
Lag Regression Model ($GSDP_t = \alpha_0 + \alpha_1 HEE_{t-k} + U_t$)

Lag (K)	Estimated α_0	Estimated α_1	t- statistic	R	R^2	Adjusted R^2	F-statistic
Without Lag	-6891.752 (4381.356)	379.275* (10.363)	36.599	0.992	0.983	0.982	1.34E3
Lag-1	-5397.837 (5009.111)	427.385* (13.183)	32.420	0.990	0.979	0.979	1.051E3
Lag-2	-3421.130 (6934.986)	481.597* (20.390)	23.620	0.982	0.964	0.962	557.886
Lag-3	-218.753 (9186.650)	537.433* (30.065)	17.876	0.970	0.941	0.938	319.545
Lag-4	-1142.010 (12278.734)	631.674* (46.267)	13.653	0.953	0.907	0.903	186.400
Lag-5	-24802.699 (12861.707)	885.128* (59.387)	14.904	0.962	0.925	0.921	222.141
Lag-6	-39242.629 (15654.313)	1102.702* (82.836)	13.312	0.955	0.912	0.907	177.208
Lag-7	-44160.557 (19124.232)	1266.732* (111.487)	11.362	0.943	0.890	0.883	129.097
Lag-8	-40853.327 (19912.585)	1367.170* (123.721)	11.050	0.944	0.891	0.883	122.111
Lag-9	-39155.573 (21583.112)	1502.332* (144.428)	10.402	0.941	0.885	0.877	108.200
Lag-10	-31759.091 (16307.167)	1575.062* (113.730)	13.849	0.968	0.937	0.932	191.798
Lag-11	-25118.704 (18502.919)	1700.987* (138.857)	12.250	0.962	0.926	0.920	150.060
Lag-12	-13212.876 (14828.919)	1771.026* (117.078)	15.127	0.977	0.954	0.950	228.823
Lag-13	-7257.936 (19736.114)	1968.240* (171.451)	11.480	0.964	0.929	0.922	131.787
Lag-14	-59089.755 (10697.012)	2909.351* (109.336)	26.609	0.994	0.987	0.986	708.059
Lag-15	-73030.684 (13320.524)	3460.676* (149.511)	23.147	0.993	0.985	0.983	535.767
Lag-16	-62139.160 (21140.789)	3726.554* (254.455)	14.645	0.984	0.968	0.964	214.483
Lag-17	-73061.334 (28469.292)	4389.621* (374.780)	11.713	0.979	0.958	0.951	137.184
Lag-18	-63627.236 (44554.215)	4802.315* (631.714)	7.602	0.959	0.920	0.904	57.791
Lag-19	-136387.262 (56452.991)	6653.261* (879.322)	7.566	0.967	0.935	0.918	57.250
Lag-20	-108207.349 (83335.809)	6879.710* (1372.488)	5.013	0.945	0.893	0.858	25.126
Lag-21	-136855.121 (154330.556)	8144.842* (2702.330)	3.014	0.905	0.820	0.729	9.084
Lag-22	-95774.989 (462558.429)	8159.170* (8515.222)	0.958	0.692	0.479	-0.043	0.918

Source: Author's Computations
* Indicates at 1% level of significance and Figures in Parenthesis show standard errors.

Table 2
Johansen Cointegration Test & Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE (s)	Eigen Value	Max-Eigen Statistic	Critical Value	Prob.**
None *	0.778326	34.65055	14.26460	0.0000
At most 1 *	0.346067	9.769261	3.841466	0.0018
Source: Authors Computation (2017) using E-Views 9.5 Max-eigenvalue test indicates 2 cointegrating equation (s) at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values				

Hypothesized No. of CE (s)	Eigen Value	Trace Statistic	Critical Value	Prob.**
None *	0.778326	44.41981	15.49471	0.0000
At most 1 *	0.346067	9.769261	3.841466	0.0018
Source: Authors Computation (2017) using E-Views 9.5 Trace test indicates 2 cointegrating equation (s) at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values				

Table 3
Vector Error Correction Estimates

Cointegrating Eq:	CointEq1	
HEE(-1)	1.000000	
GSDP(-1)	-0.003606 (0.00048) [-7.54174]	
C	83.17694	
Error Correction:	**D(HEE)**	**D(GSDP)**
CointEq1	-1.656997 (0.53448) [-3.10021]	-117.4240 (36.5081) [-3.21638]
D(HEE(-1))	1.355135 (0.52974) [2.55810]	127.4016 (36.1845) [3.52089]
D(HEE(-2))	1.066910 (0.50096) [2.12971]	17.17388 (34.2188) [0.50188]
D(GSDP(-1))	-0.011651 (0.00531) [-2.19622]	-0.334678 (0.36237) [-0.92359]
D(GSDP(-2))	-0.002258 (0.00225) [-1.00248]	0.427054 (0.15388) [2.77523]
R-squared	0.594167	0.975663
Adj. R-squared	0.467344	0.968058
Sum sq. resids	30053.45	1.40E+08
S.E. equation	43.33983	2960.364
F-statistic	4.685020	128.2884
Log likelihood	-110.6332	-203.5611
Akaike AIC	10.60302	19.05101
Schwarz SC	10.90058	19.34857
Mean dependent	42.88091	17469.22
S.D. dependent	59.38324	16563.96
Determinant resid covariance (dof adj.)		1.31E+10
Determinant resid covariance		6.93E+09
Log likelihood		-311.6873
Akaike information criterion		29.60794
Schwarz criterion		30.30224
Source: Authors Computation (2017) using E-Views 9.5 and '( )' shows Standard errors & '[ ]'shows t-statistics.		

Table 4
Vector Error Correction Model (VECM)

System Equations				
D(HEE) = C(1)*(HEE(-1) - 0.00360616840944 *GSDP(-1) + 83.1769367454) + C(2)*D(HEE(-1)) + C(3)*D(HEE(-2)) + C(4)*D(GSDP(-1)) + C(5)*D(GSDP (-2)) + C(6) **[Equation: A]**				
D(GSDP) = C(7)*(HEE(-1) - 0.00360616840944*GSDP(-1) + 83.1769367454) + C(8)*D(HEE(-1)) + C(9)*D(HEE(-2)) + C(10)*D(GSDP(-1)) + C(11)*D(GSDP(-2)) + C(12) **[Equation: B]**				
Estimation Method: Least Square (Included observations: 22 after adjustments)				
	Coefficient	**Standard Error**	**t-Statistic**	**Prob.**
C(1)	-1.656997	0.534480	-3.100205	0.0069
C(2)	1.355135	0.529742	2.558102	0.0211
C(3)	1.066910	0.500964	2.129711	0.0491
C(4)	-0.011651	0.005305	-2.196216	0.0432
C(5)	-0.002258	0.002253	-1.002476	0.3310
C(6)	161.5485	50.99041	3.168213	0.0060
C(7)	-117.4240	36.50810	-3.216382	0.0054
C(8)	127.4016	36.18450	3.520888	0.0028
C(9)	17.17388	34.21881	0.501884	0.6226
C(10)	-0.334678	0.362367	-0.923590	0.3694
C(11)	0.427054	0.153881	2.775227	0.0135
C(12)	11516.36	3482.944	3.306501	0.0045
D(HEE) = C(1)*(HEE(-1) - 0.00360616840944*GSDP(-1) + 83.1769367454) + C(2)*D(HEE(-1)) + C(3)*D(HEE(-2)) + C(4)*D(GSDP(-1)) + C(5)*D(GSDP(-2)) + C(6)				
R-squared	0.594167	Log likelihood	-110.6332	
Adjusted R-squared	0.467344	F-statistic	4.685020	
S.E. of regression	43.33983	Prob (F-statistic)	0.007964	
Sum squared resid	30053.45			
D(GSDP) = C(7)*(HEE(-1) - 0.00360616840944*GSDP(-1) + 83.1769367454) + C(8)*D(HEE(-1)) + C(9)*D(HEE(-2)) + C(10)*D(GSDP(-1)) + C(11)*D(GSDP(-2)) + C(12)				
R-squared	0.975663	Log likelihood	-203.5611	
Adjusted R-squared	0.968058	F-statistic	128.2884	
S.E. of regression	2960.364	Prob (F-statistic)	0.000000	
Sum squared resid	1.40E+08			
Source: Authors Computation (2017) using E-Views 9.5				

Table 5
Wald Test

Test Statistic	**Value**	**D.F.**	**Probability**
Chi-square	6.119405	2	0.0469

Null Hypothesis: C (4) =C (5) = 0
Null Hypothesis Summary:

Normalized Restriction (= 0)	**Value**	**Std. Error**
C(4)	-0.011651	0.005305
C(5)	-0.002258	0.002253

Test Statistic	**Value**	**Df**	**Probability**
Chi-square	32.88749	2	0.0000

Null Hypothesis: C (8) =C (9) =0
Null Hypothesis Summary

Normalized Restriction (= 0)	**Value**	**Std. Error**
C(8)	127.4016	36.18450
C(9)	17.17388	34.21881

Restrictions are linear in coefficients
Source: Authors Computation (2017) using E-Views 9.5

Table 6
Residual Analysis [Equation: A]

Tests	**Values**	**P-Values**
Breusch-Godfrey Serial Correlation LM Test	4.503410	0.1052
Heteroskedasticity Test: Breusch-Pagan-Godfrey	4.044657	0.6706
Jarque-Bera Normality	5.093150	0.078350

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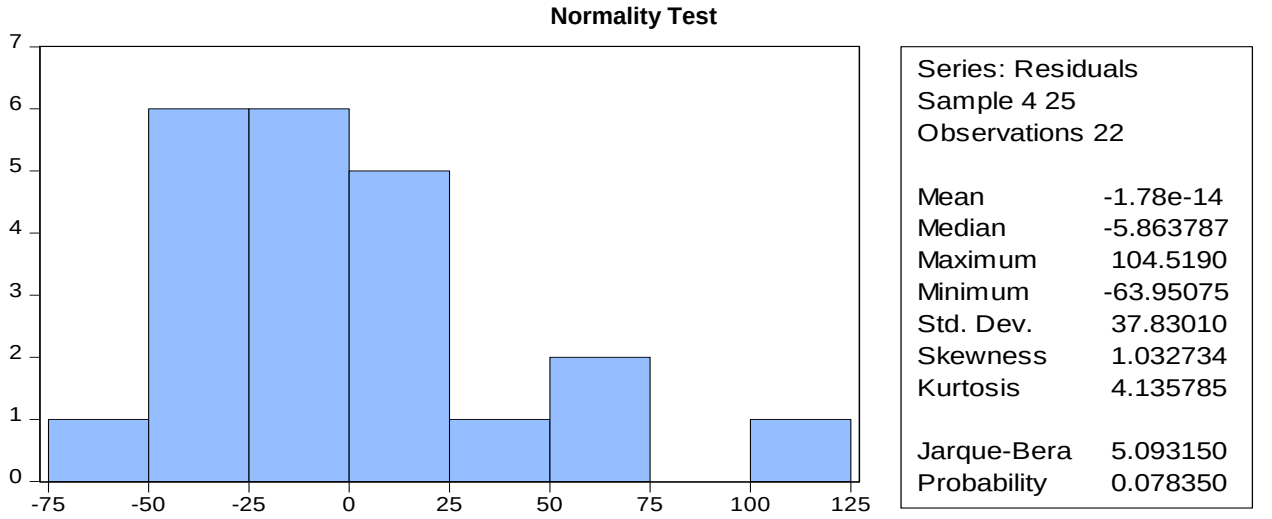

Figure 1

Table 7: Residual Analysis [Equation: B]

Tests	Values	P-Values
Breusch-Godfrey Serial Correlation LM Test	10.52241	0.0052
Heteroskedasticity Test: Breusch-Pagan-Godfrey	5.072074	0.5346
Jarque-Bera Normality	1.599210	0.449507

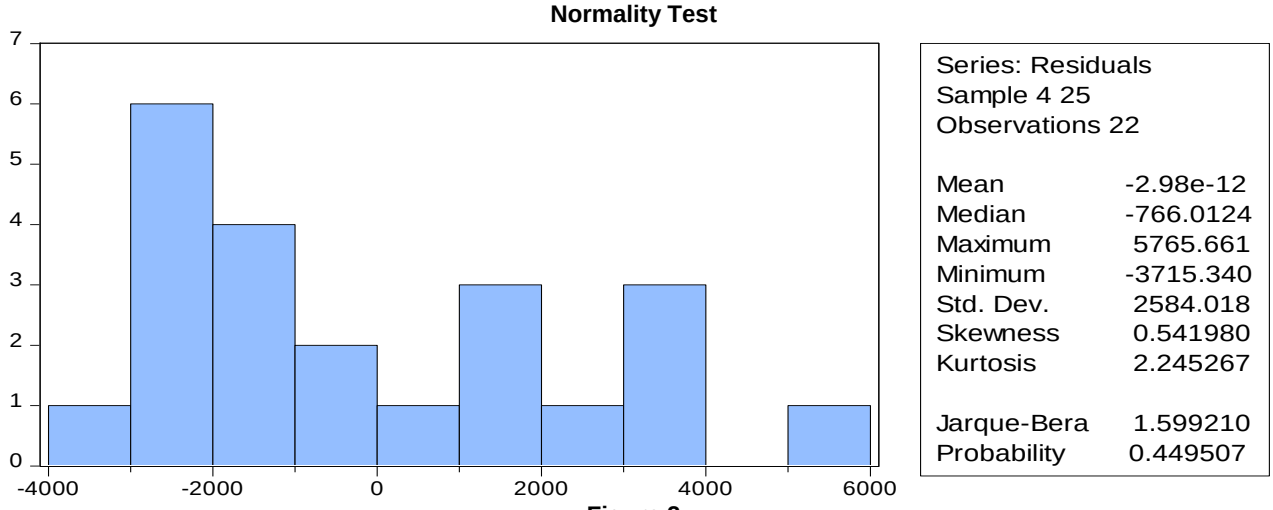

Figure 2

Discussions

The results of lag regression model indicate (Table1) that public expenditure on education is positively related to GSDP of Haryana when time lag ranges between 1 to 22 years. **Regression coefficient** is relatively smaller in the initial stages and as the time lags increases, regression coefficient start increases. This is due to the fact that the value of GSDP in recent years is relatively higher compared to the value of the expenditure on education in the earlier period. The regression coefficient increases from 427 to 8159 approximately when time lag (k) increases from 1 to 22. **Standard error** is an indicator of the variance of the parameter. An estimator is regarded as the 'best' estimator if it has minimum variance. Therefore, the model in which the standard error is less will be the better model. The standard error of parameter (α_k) is relatively low i.e. 13.183, when the time lag (k) is one. And as the time lag increases from 1 to 22, standard error of regression parameter (α_k) in increasing. **Value of t-statistics** explains the level of significance. All the regression coefficients are statistically significant at 1 per cent level of significance. This implies higher education expenditure (HEE) is significant variable affecting the GSDP, in each time lag. The value of t-statistic ranges between 1 and 32. The highest value of t is 32.420 when k=1. $\mathbf{R^2}$ reveals the fact that higher education expenditure is capable of explaining 98 per cent of variations in GSDP when time lag is fourteen. However, the value of adjusted R^2 shows that HEE is capable of explaining 98 per cent of variations in GSDP and the highest value of adjusted R^2 is 0.98, when k=14.Correlation coefficient is around 0.9 in all the time lags. This implies in each time lag HEE is significantly related with GSDP. Correlation coefficient reaches 0.99 when the time lag is 14 years. Hence the degree of co-variation between GSDP and higher

education expenditure is the highest when the time lag is 14. **Value of F-statistics** is significant in each time lag. This implies HEE is significant explanatory variable in each time lag. The F statistic touches the highest value i.e. 708.059when the time lag is 14. Thus, it can be concluded that value of R, R^2, adjusted $R^2$and F-statistics is highest when time lag is fourteen (K=14) means that after fourteen years higher education expenditure affects GSDP in Haryana significantly. It can be concluded that there is a relationship between past values of HEE (higher education) and GSDP (economic growth) and the results of this regression suggest that past values of HEE do lead to economic growth in Haryana. However, on the basis of the above results it cannot be said that HEE causes economic growth in Haryana. In order to examine the causality between HEE and GSDP, Cointegration and Vector Error Correction Model (VECM) is used which is more authentic than lag model approach.

The prime condition for applying VECM is that variables under consideration must be cointegrated, meaning that must exists long run relationship. Johansen test of Cointegration (Table 2) presents the Trace and Maximum Eigenvalue performed to determine the order of integration; which both indicates that we reject the null hypothesis that none of the variables is cointegrated and at most one variable is cointegrated since p-value 0.0000<0.05, but revealed that both variables under consideration are cointegrated since p-values is greater than 0.05 for both Trace and Maximum Eigenvalue that is variables GSDP, HEE have long run relationship meaning that whenever GSDP goes up HEE goes. Now, since the variables (GSDP, HEE) are cointegrated we can run the VECM.

(Table 4) contains the results of VECM and its coefficients as well as their t-statistics and p-value. Here, C(1) is the coefficient of the cointegrated model (long run) with HEE as the dependent variable while C (2), C(3), C(4) and C(5) are short run coefficients. C(1) is the speed of adjustment towards long run equilibrium which is negative and significant (-1.656997); meaning GSDP has long run influence on the HEE. Similarly, C (7) is the coefficient of the cointegrated model (long run) with GSDP as the dependent variable while C(8), C(9), C(10) and C(11) are short run coefficients. C (7) is the speed of adjustment towards long run equilibrium which is negative and significant (-117.4240); meaning HEE has long run influence on the GSDP.

(Table 5) presents the results of the Wald test performed to test whether GSDP has any short run effect on HEE or HEE has any short run effect on GSDP which revealed that both GSDP has short run effect on HEE and HEE has short run effect on GSDP. In both cases, null hypothesis is rejected that is values of C(4) =C(5) = 0 and C(8) =C(9) = 0. Rather than values of C(4) and C(5) and C(8) and C (9) are other than zero and significant.

The results of residual analysis performed to test for the adequacy of the model contained in (Table 6) and (Table 7). (Table 6) revealed that results of [Equation: A] that the residuals have no serial correlation, they are homoscedastic and normally distributed since all are the p-values are greater than 0.05, the results of the regression analysis performed indicated a R square (0.594167) meaning total variability in HEE is being explained by variations in GSDP and figure I show the outcome of normality test.(Table 7) revealed that results of [Equation: B] that the residuals have serial correlation because p-values are less than the 0.05, but they are homoscedastic and normally distributed since the p-values are greater than 0.05, the results of the regression analysis performed indicated a high R square (0.975) meaning total variability in GSDP is being explained by variations in HEE and figure II show the outcome of normality test.

From the above discussion, it is clear that long run causality as well as short run causality exists from GSDP to HEE and similarly long run causality as well short run causality also exists from HEE to GSDP, but there is a presence of serial correlation.

Conclusion and Policy Implications

The present paper investigated the relationship between higher education and economic growth in Haryana, by using a data for the period 1990 to 2014. For this purpose, higher education expenditure (HEE) and Gross State Domestic Product (GSDP) are used as a proxy for higher education and economic growth in Haryana. The study employed lag regression model, Johensen cointegrating technique and then Vector Error Correction Model (VECM). The results indicate that variables GSDP and HEE are cointegrated meaning that whenever GSDP goes up HEE goesand VECM also suggested long-run and short-run relationship exists among the variables. Test for adequacy performed on the residuals of the VECM indicates that both models are homoscedasticity and normally distributed but serial correlation exists in one model. No doubt, over the period of time, significant growth have been taken place in Haryana in terms of state income, per capita income, agriculture production, service sector, infrastructural development etc. To develop economy of Haryana as a knowledge hub, Haryana has to qualitatively strengthen its education in general and higher education with research and development in particular. To improve the quality of higher education for enhancing the economic growth of Haryana, there is an urgent need to increase the expenditure on education in general and higher education in particular. India including Haryana has demographic advantage in the form of huge number of young people. To make the best, these young minds need to be provided opportunities for accessing quality higher education. For better contribution of higher education in Haryana economy, there is emergence of paradigm shift from traditional type of education to productive, up to date, job oriented education as per requirements of present times. We need job led growth and for this, the thrust should be on quality of vocational/technical education as per needs and requirements of an economy like Haryana.

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