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Human capital and Economic Growth in Indian Economy and its interrelation

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Abstract
Higher education, Human capital and economic growth and the relationship between these variables are very much complicated and the direction of causality is unclear. Different endogenous theories indicate that improvement in efficient human capital leads to higher economic growth of the economy. There is an important question as whether there is a causal link between higher education and economic performance, and if so, in what direction? It may be that the two are associated, but not causally linked. In this paper an attempt is made to use the proxy for higher education is Gross Enrollment Ratio (GER) and also used per capita GNP for economic growth. The co-integration test and VECM are used to check the association and causality between the selected variables.

Keywords: *Economic growth, co-integration, Development, gross enrollment ratio, higher education and VECM.*

1. Introduction: Education is associated with long-term improvement in economic performance. The linkage between education and economic performance can be conceived of into three broad ways. First, the basic human capital approach in which the education improves the overall skills and abilities of the workforce which leads to greater productivity and improve ability to use existing technology, and thus contributes to economic growth. The second approach is innovative approach which links the education for improving the capacity of an economy to develop new ideas and technologies.

The third one is the knowledge transfer approach in which education as a medium of spreading the knowledge to apply new ideas and make use of new technologies.

Research indicates that an improved higher education leads to higher economic performance (more so than the other way around). However, it is the quality of learning, rather than the amount of time spent in education is the most important. The direction of the relationship between higher education and growth is not fully clear. There is an important question that whether there is a causal link between higher education and economic performance, and if so, in which direction? It might be showing that these two are associated, but not causally linked.

It also could be that better economic performance leads to an increase in educational participation and achievement. Or it could be that having of more people with education leads to an improved economic performance.

In general, education and economic performance are likely to be interlinked. Having of a more educated workforce enables firms to take advantage of new economic opportunities, leading to better performance. Also, economic growth can lead to greater national and personal wealth, which increases the resources available and opportunities for education.

2. Review of Empirical Studies: Empirical Studies investigated The relationship between higher education and economic development was studied by Rochat, Jean-Luc De (1995) and found a significant causality from national higher educational effort (proxied by the number of students per capita, i.e. not engaged in productive activities) and economic development for four countries, such as Sweden (1910--1986), United Kingdom (1919-1987), Japan (1885-1975) and France (1899-1986). However, such a causality link has not been found for Italy (1885-1986) and Australia (1906-1986). This suggests that this relationship is indeed not mechanistic as already pointed out by some social scientists.

Negative relationship between education and economic growth is not a new finding. Several factors have been highlighted in the literature on this issue. First, education might not be an effective in influencing productivity. Some educated people might be working in illegal sector that will affect growth in the future (Pritchett, 2001). Second, the education is not a factor of production that contributes to growth in the short-run (Benhabib and Spiegel, 1994). Although this is not a new issue worldwide, but it is an interesting to investigate them how education does really has a negative effect on growth in India?

Mercan & Sezer (2004) investigated in the Turkish economy for the period from 1970 to 2012 and found a positive relationship between an educational expenses and economic growth. Thus, it appeared that education expenses in Turkey had a positive effect on economic growth.

Self & Grabowski (2004) examined the causal impact of education on income growth in India for the time period of 1966–1996. As per their study the education was divided into the categories of primary, secondary, and tertiary; due to non-availability of data, the territory level education has been excluded. Time series techniques were used to determine whether education, for each category, has an impact on growth performance.

The literature on the Indian economy has had a mixed response. Bosworth, Collins and Virmani (2007) observed that the education's contribution to India's economic growth has been negligible. In another study by Chandra (2010) tested the causality between investment in education and economic growth in India and found a bi-directional causality between them. Pradhan (2009) used a data set from 1951 to 2001 and confirmed that there exists a long and short term relationship between education and economic growth in the Indian economy and the direction of causality is from economic growth to education and also found that there is an absence of reverse causality. Pravesh (2011) also tried to investigate the relationship between expenditure in education and economic growth in the Indian economy with an econometric model to the analysis of time series data from 1980 to 2008 and the results indicate that there exist a long-run relationship between education expenditure and economic growth. The error-correction estimates show that educational expenditure per labour have a lesser impact on economic growth as compared to physical capital per labour.

The reason of mixed responses may be the variables or the methods have been used. So many studies have used the proxy of education is the expenditure but may be the expenditure on education is not the right proxy. So many studies have taken the study on primary or secondary education, but the tertiary education is more important factor for the economic growth of any economy. So, now it is very interesting to study about the impact of higher education on economic growth in India. The study focuses with the following specific objectives.

3. Objectives:

1. To study the relationship between the higher education and economic growth in the short -run and long -run in India
2. To examine the causality between the higher education and economic growth in India

4. Estimation Method: To study the above objectives it is used the proxy for higher education as the Gross Enrollment Ratio (GER) and per capita GNP for economic growth. For this the co-integration test and VECM are used to check the association and causality between the variables. The data for analysis has been used from the years 1971 to 2013.

4.1. Variables and Data Sources: The per capita GNP at factor cost at constant price of base year 2004-05 (in Rupees) is the dependent variable. The data of GNP per capita are taken from the Handbook of Statistics of India, RBI. The independent variables are gross capital formation as percentage of GDP and gross enrollment ratio at tertiary level of India. The data set of 43 years i. e. from 1971 to 2013 used for the analysis in this paper. The data of GER at tertiary education level are taken from Institute for Statistics, UNESCO and the data on gross capital formation as percentage of GDP of India have been taken from World Bank (World Development Indicators). The collected data on all the variables under consideration has been converted into natural logarithm to check the elasticity.

4.2. Model Specification: Generally, the regression of a non-stationary time series data on another non-stationary time series data may cause a spurious regression. In such a case Durbin-Watson (DW) statistics may be less than the value of R^2. If R^2 value is found greater than DW statistic (R^2 > DW statistics), then this is the symptom of the spurious regression. But, if the residual of the model is found stationary level, then the model under consideration would not be no longer spurious regression. So, if the model is non-spurious, then the variables in the model are co-integrated or they have long run association or equilibrium relationship between them. Then, it is a long run model and estimated coefficients are long run coefficients. The model is given by

$GNI_t = \ b0 + b1\ \ GCI_t + b2\ \ GERT_t +$

ε_t

1)

Where, GNI = Per Capita GNP at factor cost at constant price of base year 2004-05 (in Rupees) of India

GCI = Gross Capital Formation as % of GDP of India

GERT= Gross Enrollment Ration at Tertiary level of India

U = Error Term (Residual-difference between observed and estimated values)

t = Time

b0 = (intercept) b1, b2 (slop coefficient) are parameters to be estimated and they represent long run coefficients.

4.2.1. Unit Root Test: First we test the nature of the time series data to determine whether they are stationary or non stationary. If the time series are not stationary, then generally we can say that the time series data contains unit root. There are so many tests are available like Phillip-Perron unit root test, Augmented Dickey Fuller (ADF) test (1979). It was applied the commonly used Augmented Dickey-Fuller (ADF) unit root tests to determine the variables' order integration. Infect, a variable is said to be integrated of order d, written 1(d), if it requires differencing d times to achieve stationarity. Thus, the variable is non-stationary, if it is integrated of order 1 or higher. Akaike criterion has been followed to lag selection. The model to check the unit root is:

$$\Delta X_t = \lambda_0 + \lambda_1 X_{t-1} + \lambda_2 T + \ \sum_{i=1}^{n} \propto_i \Delta X_{t-i} + \epsilon_t$$

(2)

There is the difference of operator X is the natural logarithm of the series. T is a trend variable λ and $\propto$ are parameters to be estimated and ϵ is the error term.

4.2.2. Johansen Co-integration Test: If two variables are co integrated, then they are stationary of the same order and there is an equilibrium relationship between the two variables. Also, a linear combination of the two series produces residuals that are stationary. In order to test the co-integration of the analyzed variables, It is used the maximum likelihood estimation method of Johansen and Juelius (1990, 1995). Johansen co-integration test procedure consists of estimating a vector autoregressive (VAR) models which includes difference as well as the levels of the non-stationary variables. The equation for Johansen co-integration test is given by

$$\Delta X_t = \delta_1 \mathit{\Delta} X_{t-1} \ldots \ldots + \delta_{k-1} \mathit{\Delta} X_{t-k+1} + \ \ \pi X_{t-k} + \ \ \epsilon$$

(3)

Where ϵ is Gaussian random variable δ_1 and π are matrices of parameters estimated using OLS. The component πX_{t-k} produces different linear combinations of levels of the time series X_t as such the matrix π contains information about the long run properties of the system describe by the model. if the rank of the matrix πis 0, then there is no long run relationship among the series of the VAR model. So a rank of 0 means integration is rejected and if the rank of the coefficient matrix π is 1, or greater than 1 then there exists 1 or more co-integrating vectors. It means there is a long run relationship or the series are behaving as a co-integrated system.

4.2.3. Error Correction Model: The short and long run equilibrium has been investigated with the help of Error Correction Model (ECM). The error-correction equation to test for long-run causality when the two variables are co-integrated and the variables are stationary only after differencing is formulated as

$$\Delta GNI = \alpha + \sum_{i=1}^{k} \gamma_i \, \Delta GNI_{t-1} + \sum_{i=1}^{k} \delta_i \, \Delta GERT_{t-1} + \sum_{i=1}^{k} \lambda_i \, \Delta GCI_{t-1} + \eta_1 \varepsilon_{t-1} + \mu_t$$

(4)

ΔGNI = First difference of Per Capita GNP at factor cost at constant price of base year 2004-05 (in Rupees) of India

ΔGERT= First difference of Gross Enrollment Ration at Tertiary level of India

ΔGCI= First difference of Gross Capital Formation as % of GDP of India

ε_{t-1} =One period lag of residual obtained from the OLS estimation (equation 1).

μ = Error term

The parameters, δ and λ irrespective of its sign, but should be individually significant and represent short run equilibrium between the variables. However, parameter η represents long run equilibrium between the same variables. The sign of η should be negative and significant as well for holding long run equilibrium. The t statistic on the coefficient of the lagged error-correction term represents the long-run causal relationship and the F-statistic on the explanatory variables represents the short-run causal effect (Narayan and Smyth, 2006). The non-significance of ECT is referred to as long-run non-causality, which is equivalent to saying that the variable is weakly exogenous with respect to long-run parameters. The absence of short-run causality is established from the non-significance of the sums of the lags of each explanatory variable. Finally, the non-significance of all the explanatory variables, including the ECT term in the VECM, indicates the econometric strong-exogeneity of the dependent variable that is the absence of Granger-causality (Hondroyiannis and Papapetrou 2002).

5. Empirical Findings: The variables of GNP, GCI and GERT are non-stationary. First set of graphs represent the non-stationary series. In the similar way, second set of graphs represent the stationary series.

5.1: Graphs of Non-stationary Series: A graphical view of non-stationary series is given in Figure-1. The graph of all the three variables indicated by GNP, GCI and GERT are non-stationary.

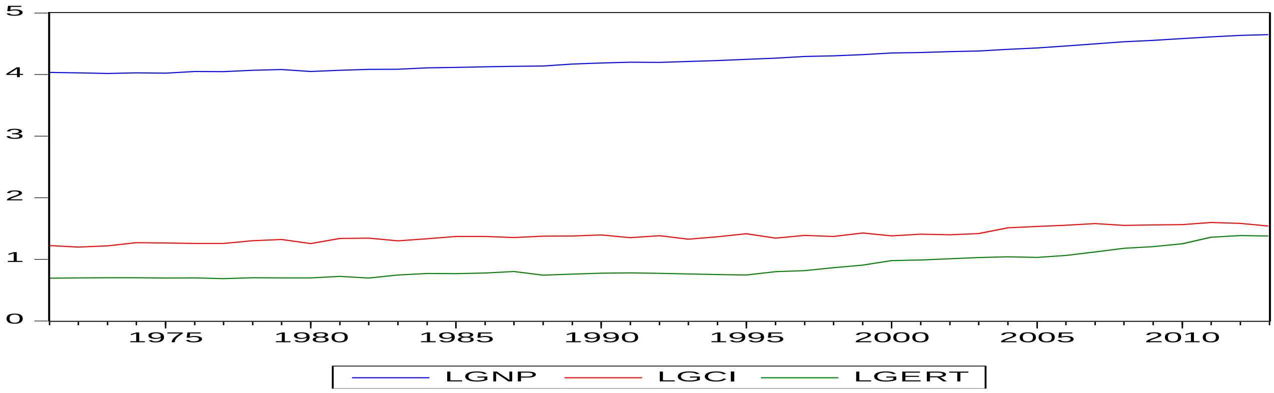

Figure -1: Graph of GNP, GCI and GERT at their level

5.2: Graphs of Stationary Series: Figure 2 is a graphical view of stationary series. Presented graph of all the series indicated by DGNP, DGCI and DGERT are being drawn after the corresponding data set has been converted into first difference.

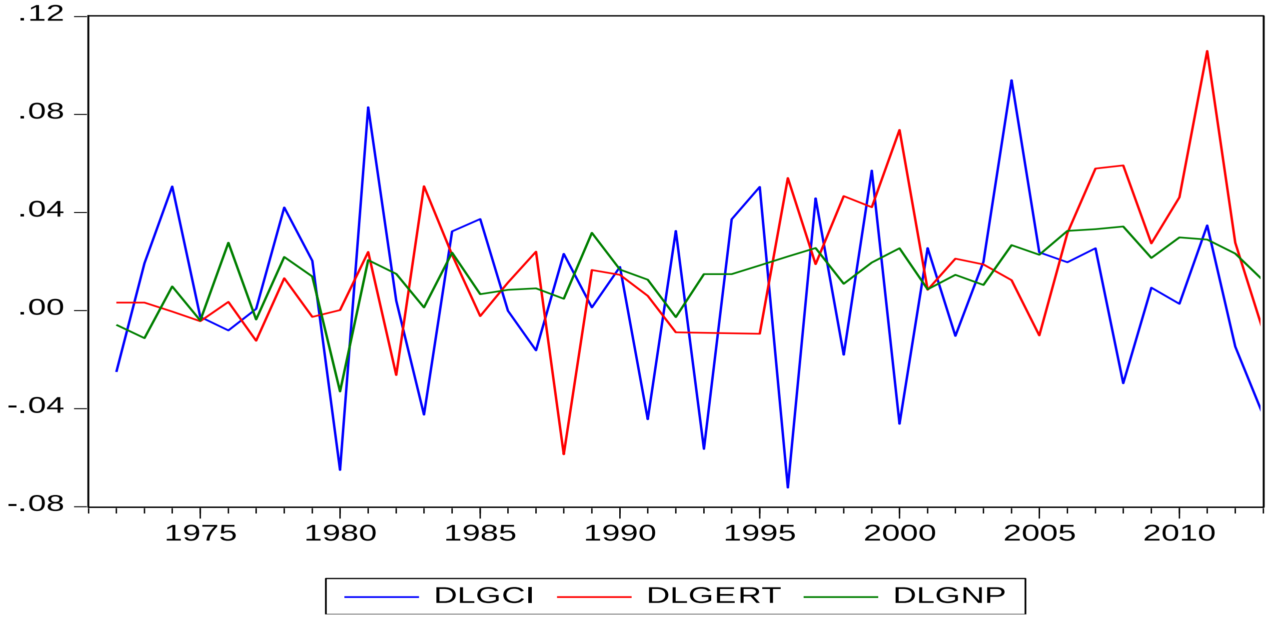

Figure 2 Series become stationary at first difference

5.3: Spurious Regression:

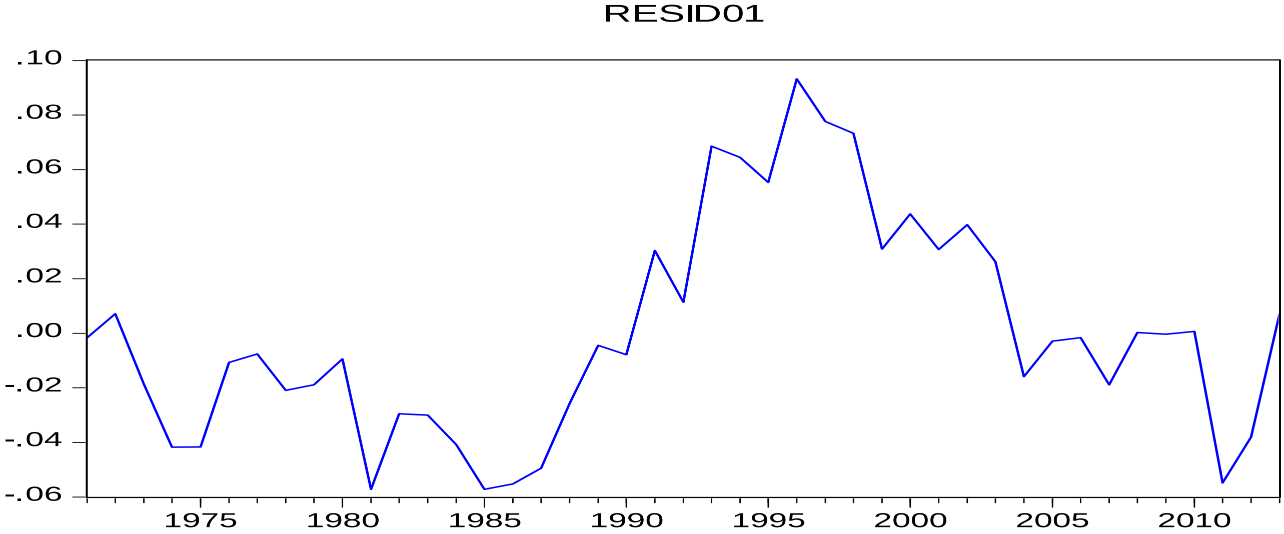

Figure- 3: Stationary of residual at level

5.4: OLS Estimation Results at Level: The purpose of OLS estimation in level is to detect the spurious regression. If the results found spurious, they will not be able to further processing or use. Such results if used to apply wrong things will guide to formulate policies in the economy. The estimated result shows that R-square is greater than the DW statistics which is the fundamental criteria for having spurious regression. The results of these statistics estimated using equation (1) is given in table-1.

Table-1: R-square and DW Statistics.

Test statistics	**Estimated coefficient**
R-square	0.958300
DW statistic	0.372041

These results (table -1) clearly prove that the OLS estimation is seriously affected by the spurious regression as the estimated coefficient R-square (0.95) is greater than the estimated coefficient of DW Statistics (0.37). The estimated coefficients from such regression cannot be called best estimation. According to Breusch-Godfrey Serial Correlation LM Test shows that there is serial correlation. So, the moving average is being applied in order to correct the OLS estimation. The results are presented in table -2.

Table-2: Results of OLS parameter estimation at level.

Dependent Variable: LGNP				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.899826*	0.079533	36.46047	0.0000
LGCI	0.587225*	0.078991	7.434121	0.0000
LGERT	0.610100*	0.040444	15.08502	0.0000
MA	0.822561*	0.093780	8.771157	0.0000
R-squared				0.985781
Adjusted R-squared				0.984658
F-statistic	878.1411*		Probability	0.000000
LM test (Obs*R-squared)	o.313665		Probability	0.8738

(*) Significance at 1% level.

Table -2 represents the results from the OLS estimation of the relationship between GNP, GCI and GERT. F-statistic (878.1411 with probability 0) shows that the overall estimation is significant at 1 percentage of significance level and has a strong explanatory power (R-squared is 0.98). Individual coefficients are also significant at 1percentage of significance level as indicated by t-statistic. Both LM test and DW tests show that the estimations are not affected by the serial correlation. It appears from these results that the economic growth and higher education are positively correlated for the period of 1971-2013. The growth elasticity of higher education during that same period is 0.61. It indicates that the 1% change in higher education will change the gross national income by 0.61%. The elasticity coefficient of GERT is less than 1 indicating a less proportional change in GERT associated with the change in GNI. From this finding, it can be inferred that expenditure in higher education has not been used in productive sector which helps to achieve higher economic growth rate. It is because of an increase in expenditure has not helped to increase economic growth that in turn helped to increase Gross National Income.

6. Unit Root Test:

6.1. Observed Variable: The finding of the ADF test exhibits that the series of GNP, GCI and GERT are non-stationary in their level. However, stationarity is found after first deference. It indicates that they are in the same order that is I (1). It is the fundamental criteria to examine the long run relationship between the variables GNP, GCI and GERT. The appropriate lag order is 1 selected by using Akaike criteria, Schwarz information criterion, Hannan-Quinn information criterion, final prediction error and sequential modified LR test statistic as presented in table 3. The ADF test results estimated by using equation (2) are given in table -4.

Table-3: Lag length criteria.

VAR Lag Order Selection Criteria						
Endogenous variables: LGNP LGCI LGERT						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	141.0600	NA	1.40e-07	-7.266314	-7.137031	-7.220316
1	284.5400	256.7538*	1.19e-10*	-14.34421*	-13.82708*	-14.16022*
2	288.7600	6.885274	1.54e-10	-14.09263	-13.18765	-13.77065
3	297.1328	12.33889	1.63e-10	-14.05962	-12.76679	-13.59964
4	300.0082	3.783390	2.37e-10	-13.73727	-12.05659	-13.13930
5	309.5884	11.09290	2.49e-10	-13.76781	-11.69928	-13.03185
* indicates lag order selected by the criterion						
LR: sequential modified LR test statistic (each test at 5% level)						
FPE: Final prediction error				AIC: Akaike information criterion		
SC: Schwarz information criterion				HQ: Hannan-Quinn information criterion		

Table-4: ADF test (unit root test)

Variable	Level		First Difference	
	Value	Prob.	Value	Prob.
LGNP	3.795647	1.00000	-5.487713*	0.0000
LGCI	-0.993364	0.7468	-9.2634*	0.0000
LGERT	2.7055	1.0000	-4.7500*	0.0004

*significant at 1% level

6.2. Residual: As shown in table - 1, the results show that R-squared value is greater than DW statistic value, showing a symptom of spurious regression. The corrective measure is that if the residual denoted by U of equation 1 which is stationary at that level, then it would be desirable to accept the model for further analysis even at a situation in which R-squared value is greater than DW statistic. It is the established alternative criteria for accepting the model if spurious as proved by R-squared value and DW statistic. Table -5 shows the stationarity of residual (U) which was obtained from the estimation of equation 1 at the level as shown by ADF test with null hypothesis U has a unit root.

Table-5: Residual unit root test

Variable	Statistics	Probability
Risidual	-2.046639	0.0403**

(**) significant at 5% level of significant.

6.3. Co-integration Test: The variables GNP, GCI and GERT are I (1) as indicated by ADF test that allow us to estimate the co-integration test to determine the long run relationship. Table -6 represents the Johansen co-integration test results estimated by using equation (3). The purpose of this equation is to determine the long run relationship or co-movement between the series under consideration. Test results shows that there is one co-integrating equation indicating a long run relationship between variables (GNP, GCI and GERT).

Table-6: Results of co-integration test.

H0	H1	Results					
		Trace	CV(0.05)	Prob.	Max Eigenevalue	CV(0.05)	Prob.
r=0	r=1	38.57696*	24.27596	0.0004	30.12903*	17.79730	0.0004
r=1	r=2	8.447928	12.32090	0.2040	8.173346	11.22480	0.1636

(*) Indicates rejection of hypothesis at 1% level; Trace statistics and Max-eigen value statistics indicates 1 co-integrating equation at the 0.01 level.

Series: LGNP, LGCI and LGERT.

6.4. Error Correction Model (ECM): Co-integration and non-spurious regression are the fundamental requirements of ECM. Results of co-integration test (table -7) provide enough evidence on the long run relationship between the variables under consideration as there is one co-integration equation. Result of ADF test provides enough evidence of stationarity of residual (table -5) at level. Both these two conditions have proved that GNP, GCI and GERT are co-integrated and non-spurious and formed a basis to estimate ECM (equation 4). The results of ECM are given in Table -7.

D(LGNP) = C(1)*(LGNP(-1) + 3.73491605078*LGCI(-1) - 1.82343790674*LGERT(-1) - 7.84511184558) + C(2)*D(LGNP(-1)) + C(3)*D(LGCI(-1)) + C(4)*D(LGERT(-1)) + C(5)

Table-7: Results of OLS parameter estimation in first difference.

Dependent Variable: D(LGNP)				
Variables	Coefficient	Std. Error	t-Statistic	Prob.
Ut-1, (C_1)	-0.038908*	0.008909	4.367333	0.0001
D(LGCI(-1)) , (C_3)	0.123151**	0.049844	2.470757	0.0181
D(LGERT(-1)), (C_4)	0.244934*	0.065171	3.758303	0.0006
(C_5)	0.020152*	0.003073	6.557455	0.0000
R-squared				0.324561
Adjusted R-squared				0.271237
Durbin-Watson stat				1.842673
F-statistic				6.086580
Prob (F-statistic)				0.001734

(*) and (**) indicate significant at1% and 5% level respectively.

The ECM has no spurious regression model as indicated by the R-squared and DW statistics. The coefficient C_4 is positive and indicating that there is a positive relationship between DGERT and DGNP. C_4 is significant at 1% level as indicated by t-test. This represents the short run equilibrium coefficient. The coefficient C_1 is long run equilibrium coefficient which is also known as the error correction coefficient. It is negative and significant as desired (Table- 7). C_4 and C_1 are the coefficients of DGERT and Ut-1 respectively as shown in equation (4). This is an indication shows that there exist s a long- run relationship between real GDP growth rate and the explanatory variables and it takes more number of years to attain equilibrium. Therefore, 03% disequilibrium in the previous period is corrected in the current period.

7.1. The Short -run Equilibrium: The estimated value of C_4 is 0.244. It is individually significant at 1percentage level (table -7).This coefficient represents the short -run coefficient and represent the short run equilibrium. It indicates that the rate at which the previous period disequilibrium of the system is being corrected. The value of C_4 is 0.244 which suggests that the system corrects its previous period disequilibrium at a speed of 24.4percentage between variables of GNI and GERT.

7.2. The Long-run Equilibrium: In case of long-run equilibrium, Ut-1 is one period lag error correction term or residual. It guides the variables (GNI and GERT) of the system to restore back to equilibrium or it corrects disequilibrium. To happen this, the sign of this should be negative and significant. Parameter C_1 represents its coefficient. It indicates that the rate at which it corrects the previous period disequilibrium of the system, if it is negative and significant. The coefficient of C_1 is negative (-0.038908, table- 7) and is significant at 1% level meaning that system corrects its previous period disequilibrium at a speed of 3.89% annually. It implies that the model identified the sizable speed of adjustment by 3.89% of disequilibrium correction on yearly for reaching the long run equilibrium steady state position.

8. Conclusion: In view of the above results, it shows that there is a strong relationship exists between Gross National Income and tertiary education during period of 1971-2013. The regression model is not spurious as tested. The time series data of these variables contain unit root and they become stationary at first difference after conducting ADF test. They have long run relationships as indicated by Johansen co-integration test. The statistically significant elasticity coefficient of OLS estimation at the level expresses that the 1% change in gross enrollment ratio at tertiary level will change the gross national per capita income by 61%. Thus, India should formulate policies which can help to increase the impact of higher education on economic growth in order to achieve desired growth of the economy that can increase human capital and in turn create gainful employment in the economy. The results of ECM indicate that there is both short and long run equilibrium in the system. The coefficient of one period lag residual coefficient is negative and significant which represent the long run equilibrium. The coefficient is -0.0389 which indicates that the system corrects its previous period disequilibrium at a speed of 3.89% annually in the economy.

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