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Assessing Causal relationship between Education and Economic Growth in India

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Abstract

The paper attempts to evaluate empirically the relationship between education expenditure and economic growth in India using annual data over the period 1961-62 to 2009-10. The paper is based on the following hypotheses for testing the causality and co-integration between economic growth via GDP growth and educational expenditure in India as to whether there is bi-directional causality between GDP growth and education, or whether there is unidirectional causality between the two variables or whether there is no causality between GDP and education in India or whether there exists a long run relationship between GDP and education in India. Time-series econometric techniques (Granger causality and Johansen cointegration test) are applied to test the hypothesis.The cointegration test confirmed that economic growth and education expenditure are co integrated, indicating the existence of long run equilibrium relationship between the two variables-education and economic growth as confirmed by the Johansen cointegration test results. The Granger causality test finally confirmed that there does not exist any short-run causality between economic growth and education and vice-versa. The error correction estimates indicates appropriate speed of convergence towards equilibrium position in case of any disequilibrium situation.

Keywords: Education, economic growth, India, causality, cointegration, error correction model.

1.Introduction:

Education has been regarded as one of the important determinants of economic growth since the time of Adam Smith. It is usually considered as the most direct way to liberate substantial number of people out of poverty owing to the propensity for employment opportunities especially for higher skilled workers to be created which eventually leads to growth. A basic way of generating sustainable economic growth has been educational development. The basic purpose of education is to facilitate individuals with knowledge to be better able to apply that knowledge. Therefore, it is significant to mention that returns on investment in education convert to economic growth and of course extend to improvement in the quality of the society because education can affect children's attitudes and assist them to grow up with social values that are more beneficial to themselves and the nation at large (see Pradhan, 2009; Yogish, 2006; Babatunde & Adefabi, 2005). Therefore, the role of education in any economy is more crucial today than ever before because of the knowledge based globalised economy. Such attention is also rooted in the fact that productivity greatly depends on the quantity and quality of human resource, which itself largely depends on investment in education. In other words, investment in education leads to the formation of human capital, comparable to physical and social capital, and that makes a significant contribution to economic growth (Pradhan, 2009; Dicken et al., 2006; Loening, 2004; Gylfason and Zoega, 2003; Barro, 2001).

The belief, that education promotes growth has led governments of many developing countries to invest in the education sector. Even the theoretical literature also provides support for such a policy. However, the empirical literature has failed to establish a robust relationship between education expenditures and growth. According to the economic theory, it is expected to have a positive causal relationship to exist between education expenditure and economic growth. But different empirical papers investigating the above mentioned relationship for India have come up with different results.

The paper is, therefore, a contribution to fill the gap that existed in the literature in developing countries like India.

The structure of the article is as follows: section 2 briefly reviews the existing literature, section 3 explains in brief the theoretical relationship between education and growth, section 4 discusses the methodological issues and section 5 depicts and interprets the results and finally section 6 presents summary and conclusions.

2. Review of existing literature

Relatively a few empirical studies have tried to study the relation between investment in human capital and economic growth. The relationship has been tested for countries such as USA (Jorgenson and Fraumeni, 1992), Pakistan (Aziz, Khan and Aziz, 2008), Tanzania and Zambia (Jung and Thorbecke, 2001), Nigeria (Ogujiuba and Adeniyi, 2005) and India (Chandra, 2010). The results from the above mentioned papers indicate that education expenditures do affect growth positively. Fiszbein and Psacharopoulos, 1992 conducted a study to assess the effects of education investments in Venezuela and found that primary education investments have the highest effects on growth whereas higher education investments exhibits the lowest returns among the three levels of education. This is mainly due to the fact that high cost of university education offsets the benefits accrued from a university degree. Further, according to Becker, Murphy et.al (1991), education expenditures since 1960 has been an important determinant of the subsequent growth in per capita incomes for around hundred countries since 1960. However, overall, the empirical evidence is quite mixed.

Ansari and Singh (1997) use annual time series data from 1951 to 1987 to study the relationship between public spending on education and growth. They found that there is no long run relationship between the two.Bosworth, Collins and Virmani (2007) test that what are the major contributors to India's economic growth and conclude that education's contribution has been negligible.Pradhan (2009) investigates the causality between public education spending and economic growth in India during 1951 to 2001. The empirical investigation has been carried out by Error Correction Modeling. The findings suggest that there is unidirectional causality between education and economic growth in the Indian economy. The direction of causality is from economic growth to education spending and not vice versa. Chandra (2010) has tested for a causal relationship between education investments and economic growth for India for the time period 1951-2009 using linear and non-linear Granger causality methods. He found that there is bi-directional causality between education spending and GDP for India. Thus, it can be seen that overall, the empirical evidence regarding this relationship for India too is quite mixed.

3. Theoretical relationship between Education and Growth:

It has been very apparent from the literature that the interest in economic growth and its causes dates back to the time of Adam Smith and David Ricardo, even though the formalization of growth theories did not take place until 1950s and 1960s. Denison (1967) was one of the first to lay importance on investing in education, which was thought to have impact on growth and Causal relationship between Education and Economic Growth in Indian development. Investment in education can enhance growth and development by encouraging activities that can help catch up with foreign technological progress (Berthelemy and Varoudakis, 1996). Generally, growth theory suggests that economic growth depends on the accumulation of economic (including human) assets, and the return on these assets, which in turn depend on technological progress, the efficiency with which assets are being used, and the institutional frameworks of production (Blackden et al., 2007). Specifically, the theoretical basis for the impact of education on economic growth takes its root in the endogenous growth theory, which emphasizes on the centrality of human capital for innovation and technological progress (Gundlach et al., 2001; World Bank, 2000). The theory emerges out of ‘policy ineffectiveness’, which characterizes the neo-classical growth theory by giving importance to the production of new technologies and human capital development, thereby focusing on factors within the model rather than relying on external factors. Endogenous growth economists believe that improvements in productivity are linked to a faster pace of innovation and extra investment in human capital (Babatunde & Adefabi, 2005). They emphasize on the need for government and private sector institutions and markets which nurture innovation to actively provide incentives for individuals to become inventive. They also identify the central role of knowledge as a determinant of economic growth. Endogenous growth theory therefore predicts positive externalities and spillover effects from development of a high valued-added knowledge economy to the development and maintenance of a competitive advantage across the globe.

4. Methodology:

4.1. Data and Variables:

The objective of this paper is to investigate the dynamics of the relationship between educational expenditure of Govt. and economic growth in India using the annual data for the period 1961-62 to 2009-10 which includes the 49 annual observations. The two main variables of this study are economic growth and educational expenditure of Govt. The real Gross Domestic Product (GDP)growth(GDP_t –GDP_{t-1}) is used as the proxy for economic growth in India and we represent the economic growth rate by using the constant value of Gross Domestic Product (GDP) measured in Indian rupee. All necessary data for the sample period are obtained from the Handbook of Statistics on Indian Economy, 2010-11 published by Reserve Bank of India. Expenditure on Education Figure is taken from our publication titled ’Analysis of Budgeted Expenditure on Education’ published by Dept. of Higher Education,Govt. of India. All the variables are taken in their natural logarithms to reduce, to some extent, the problems of heteroscedasticity.

Using the time period 1961-62 to 2009-10 for India, this study aims to examine the long-term and causal dynamic relationships between the level of education expenditure and economic growth. The estimation methodology employed in this study is the cointegration and error correction modeling technique.

The entire estimation procedure consists of three steps: first, unit root test; second, cointegration test; third, the error correction model estimation.

4.2. Econometric specification:

4.2.1.Hypothesis:

The paper is based on the following hypotheses for testing the causality and co-integration between GDP and education expenditure in India (i) whether there is bi-directional causality between GDP growth and EDU, (ii) whether there is unidirectional causality between the two variables, (iii) whether there is no causality between GDP and EDU in India (iv) whether there exists a long run relationship between GDP and EDU in India.

4.2.2.Model Specification :

The model specification draws inspiration from the earlier works of Pradhan (2009) and Babatunde and Adefabi(2005). The choice of the existing model is based on the fact that it allows for generation and estimation of all the parameters without resulting into unnecessary data mining.
The growth model for the study takes the form: GDP=f (EDU) -------------------(1)
Where GDP and EDU are the gross domestic product and education expenditure respectively.
Equation (1) is treated as a Cobb-Douglas function with investment in education, EDU, as the only explanatory variable.
The link between Economic growth (measured in terms of GDP growth) and EDU in India can be described using the following model in linear form:
$LnGDP_t = \alpha + \beta Ln\, EDU_t + \varepsilon_t$ -------------- (1.1)
α and $\beta>0$

The variables remain as previously defined with the exception of being in their natural log form. ε_t is the error term assumed to be normally, identically and independently distributed.
where, GDP_t and EDU_t show the Gross Domestic Product and educational expenditure of govt. at a particular time respectively while ε_t represents the "noise" or error term; α and β represent the slope and coefficient of regression. The coefficient of regression, β indicates how a unit change in the independent variable (educational expenditure) affects the dependent variable (gross domestic product). The error, ε_t , is incorporated in the equation to cater for other factors that may influence GDP. The validity or strength of the Ordinary Least Squares method depends on the accuracy of assumptions. In this study, the Gauss-Markov assumptions are used and they include; that the dependent and independent variables (GDP and EDU) are linearly co-related, the estimators (α, β) are unbiased with an expected value of zero i.e., E (ε_t) = 0, which implies that on average the errors cancel out each other. The procedure involves specifying the dependent and independent variables; in this case, GDP is the dependent variable while EDU the independent variable.

But it depends on the assumptions that the results of the methods can be adversely affected by outliers. In addition, whereas the Ordinary Least squares regression analysis can establish the dependence of either GDP on EDU or vice versa; this does not necessarily imply direction of causation. Stuart Kendal noted that "a statistical relationship, however, strong and however suggestive, can never establish causal connection." Thus, in this study, another method, the Granger causality test, is used to further test for the direction of causality.

Step –I: Ordinary least square method:

Here we will assume the hypothesis that there is no relationship between educational expenditure (EDU) and Economic Growth in terms of GDP. To confirm about our hypothesis, primarily, we have studied the effect of education expenditure on economic growth and vice versa by two simple regression equations:
$LnEDU_i = a + b * LnGDP_i$ ....(2)
$LnGDP_i = a_1 + b_1 * LnEDU_i$ ....(3)
GDP = Gross domestic product.
EDU = Educational expenditure of government in India.
t= time subscript.

This study aimed to examine the long-term relationship between educational expenditure and GDP growth in India between 1961-62 and 2009-10. Using co-integration and Vector Error Correction Model (VECM) procedures, we investigated the relationship between these two variables. The likely short-term properties of the relationship among economic growth and education were obtained from the VECM application. Next, unit root, VAR, cointegration and Vector Error Correction Model (VECM) procedures were utilized in turn. The first step for an appropriate analysis is to determine if the data series are stationary or not. Time series data generally tend to be non-stationary, and thus they suffer from unit roots. Due to the non-stationarity, regressions with time series data are very likely to result in spurious results. The problems stemming from spurious regression have been described by Granger and Newbold (1974). In order to ensure the condition of stationarity, a series ought to be integrated to the order of 0 [I(0)]. In this study, tests of stationarity, commonly known as unit root tests, were adopted from Dickey and Fuller (1979, 1981).As the data were analyzed, we discovered that error terms had been correlated in the time series data used in this study.

Step –II**:** The Stationarity Test (Unit Root Test)

It is suggested that when dealing with time series data, a number of econometric issues can influence the estimation of parameters using OLS. Regressing a time series variable on another time series variable using the Ordinary Least Squares (OLS) estimation can result in a very high R^2, although there is no meaningful relationship between the variables. This situation reflects the problem of spurious regression between totally unrelated variables generated by a non-stationary process. Therefore, prior to testing Cointegration and implementing the Granger Causality test, econometric methodology needs to examine the stationarity ;for each individual time series, most macro economic data are non stationary, i.e. they tend to exhibit a deterministic and/or stochastic trend. Therefore, it is recommended that a stationarity (unit root) test be carried out to test for the order of integration. A series is said to be stationary if the mean and variance are time-invariant. A non-stationary time series will have a time dependent mean or make sure that the variables are stationary, because if they are not, the standard assumptions for asymptotic analysis in the Granger test will not be valid. Therefore, a stochastic process that is said to be stationary simply implies that the mean $[(E(Y_t)]$ and the variance $[Var(Y_t)]$ of Y remain constant over time for all t, and the covariance $[covar(Y_t, Ys)]$ and hence the correlation between any two values of Y taken from different time periods depends on the difference apart in time between the two values for all $t \neq s$. Since standard regression analysis requires that data series be stationary, it is obviously important that we first test for this requirement to determine whether the series used in the regression process is a difference stationary or a trend stationary. To test the stationary of variables, we use the Augmented Dickey Fuller (ADF) test which is mostly used to test for unit root. Following equation checks the stationarity of time series data used in the study:

$$\Delta y_t = \beta_1 + \beta_1 t + \alpha\, y_{t-1} + \gamma\, \Sigma \Delta y_{t-1} + \varepsilon_t$$

Where ε_t is white noise error term in the model of unit root test, with a null hypothesis that variable has unit root. The ADF regression test for the existence of unit root of y_t that represents all variables (in the natural logarithmic form) at time t. The test for a unit root is conducted on the coefficient of y_{t-1} in the regression. If the coefficient is significantly different from zero (less than zero) then the hypothesis that y contains a unit root is rejected. The null and alternative hypothesis for the existence of unit root in variable y_t is H_o: $\alpha = 0$ versus H1: $\alpha < 0$. Rejection of the null hypothesis denotes stationarity in the series.

If the ADF test-statistic (t-statistic) is less (in the absolute value) than the Mackinnon critical t-values, the null hypothesis of a unit root can not be rejected for the time series and hence, one can conclude that the series is non-stationary at their levels. The unit root test tests for the existence of a unit root in two cases: with intercept only and with intercept and trend to take into the account the impact of the trend on the series.

Once the number of unit roots in the series was decided, the next step before applying Johansen's (1988) co-integration test was to determine an appropriate number of lags to be used in estimation. Second, Eagle-Granger residual based test tests the existence of co integration among the variables-EDU and GDP at constant prices for the economy. Third, if a co integration relationship does not exist, VAR analysis in the first difference is applied, however, if the variables are co- integrated, the analysis continues in a cointegration framework.

Step-III: Testing for Cointegration (Johansen Approach)

Cointegration, an econometric property of time series variable, is a precondition for the existence of a long run or equilibrium economic relationship between two or more variables having unit roots (i.e. Integrated of order one). The Johansen approach can determine the number of co-integrated vectors for any given number of non-stationary variables of the same order. Two or more random variables are said to be cointegrated if each of the series are themselves non – stationary. This test may be regarded as a long run equilibrium relationship among the variables. The purpose of the Cointegration tests is to determine whether a group of non – stationary series is cointegrated or not.

Having concluded from the ADF results that each time series is non-stationary, i.e it is integrated of order one I(1), we proceed to the second step, which requires that the two time series be co-integrated. In other words, we have to examine whether or not there exists a long run relationship between variables (stable and non-spurious co-integrated relationship) . In our case, the mission is to determine whether or not education expenditure(EDU) and economic growth(GDP) variables have a long-run relationship in a bivariate framework. Engle and Granger (1987) introduced the concept of cointegration, where economic variables might reach a long-run equilibrium that reflects a stable relationship among them. For the variables to be co-integrated, they must be integrated of order one (non-stationary) and the linear combination of them is stationary I(0).

The crucial approach which is used in this study to test r cointegration is called the Johansen cointegration approach. The Johanson approach can determine the number of cointegrated vectors for any given number of non-stationary variables of the same order.

Step-IV: The Granger Causality test:

Causality is a kind of statistical feedback concept which is widely used in the building of forecasting models. Historically, Granger (1969) and Sim (1972) were the ones who formalized the application of causality in economics. Granger causality test is a technique for determining whether one time series is significant in forecasting another (Granger. 1969). The standard Granger causality test (Granger, 1988) seeks to determine whether past values of a variable helps to predict changes in another variable. The definition states that in the conditional distribution, lagged values of Y_t add no information to explanation of movements of X_t beyond that provided by lagged values of X_t itself (Green, 2003). We should take note of the fact that the Granger causality technique measures the information given by one variable in explaining the latest value of another variable. In addition, it also says that variable Y is Granger caused by variable X if variable X assists in predicting the value of variable Y. If this is the case, it means that the lagged values of variable X are statistically significant in explaining variable Y. The null hypothesis (H_0) that we test in this case is that the X variable does not Granger cause variable Y and variable Y does not Granger cause variable X. In summary, one variable (X_t) is said to granger cause another variable (Y_t) if the lagged values of X_t can predict Y_t and vice-versa.

EDU and GDP are, in fact, interlinked and co-related through various channel. There is no theoretical or empirical evidence that could conclusively indicate sequencing from either direction. For this reason, the Granger Causality test was carried out on EDU and GDP.

The spirit of Engle and Granger (1987) lies in the idea that if the two variables are integrated as order one, I(1), and both residuals are I(0), this indicates that the two variables are cointegrated. The Granger theorem states that if this is the case, the two variables could be generated by a dynamic relationship from GDP to EDU and, vise versa.

Therefore,a time series X is said to Granger-cause Y if it can be shown through a series of F-tests on lagged values of X (and with lagged values of Y also known) that those X values predict statistically significant information about future values of Y. In the context of this analysis, the Granger method involves the estimation of the following equations:

If causality (or causation) runs from EDU to GDP, we have:

$$dLnGDP_{it} = \eta_i + \Sigma\alpha_{11} dLnGDP_{i,\ t-1} + \Sigma\beta_{11} dLnEDU_{i,\ t-1} + \varepsilon_{1t} \quad \text{.......(4)}$$

If causality (or causation) runs from GDP to EDU, it takes the form:

$$dLnEDU_{it} = \eta_i + \Sigma\alpha_{12} dLn\ EDU_{i,\ t-1} + \Sigma\beta_{12} dLnGDP_{i,t-1} + \lambda ECM_{i\ t} + \varepsilon_{2t} \quad \text{.......(5)}$$

where, GDP_t and EDU_t represent gross domestic product and educational expenditure respectively, ε_{it} is uncorrelated stationary random process, and subscript *t* denotes the time period. In equation 4,failing to reject: H_0: $\alpha_{11} = \beta_{11} = 0$ implies that educational expenditure does not Granger cause economic growth. On the other hand, in equation5,failing to reject H_0: $\alpha_{12} = \beta_{12} = 0$ implies that economic growth via GDP growth does not Granger cause educational expenditure.

The decision rule:

From equation (4), $dLnEDU_{i\ t-1}$Granger causes $dLnGDP_{it}$ if the coefficient of the lagged values of EDU as a group (β_{11}) is significantly different from zero based on F-test (i.e., statistically significant). Similarly, from equation (5), $dLnGDP_{i,t-1}$ Granger causes $dLnEDU_{it}$ if β_{12} is statistically significant.

Step V: Error Correcting Model (ECM) and Short Term Causality Test :

Error correction mechanism was first used by Sargan (1984), later adopted, modified and popularized by Engle and Granger (1987). By definition, error correction mechanism is a means of reconciling the short-run behaviour (or value) of an economic variable with its long-run behaviour (or value). An important theorem in this regard is the Granger Representation Theorem which demonstrates that any set of cointegrated time series has an error correction representation, which reflects the short-run adjustment mechanism.

Co- integration relationships just reflect the long term balanced relations between relevant variables. In order to cover the shortage, correcting mechanism of short term deviation from long term balance could be cited. At the same time, as the limited number of years, the above test result may cause disputes (Christpoulos and Tsionas, 2004). Therefore, under the circumstance of long term causalities, short term causalities should be further tested as well. Empirical works based on time series data assume that the underlying time series is stationary. However, many studies have shown that majority of time series variables are nonstationary or integrated of order 1 (Engle and Granger, 1987). The time series properties of the data at hand are therefore studied in the outset. Formal tests will be carried out to find the time series properties of the variables. If the variables are *I* (1), Engle and Granger (1987) assert that causality must exist in, at least, one direction. The Granger causality test is then augmented with an error correction term (ECT) and the error correcting models could be built as below:

$$dLnGDP_{it} = \eta_i + \Sigma\alpha_{11}dLnGDP_{i,\ t-1} + \Sigma\beta_{11}dLnEDU_{i,\ t-1} + \lambda ECM_{i\,t} + \varepsilon_{i\,t} \ldots\ldots\ldots\ldots\ldots\ldots(6)$$

$$dLnEDU_{it} = \eta_i + \Sigma\alpha_{12}dLn\ EDU_{i,\ t-1} + \Sigma\beta_{12}dLnGDP_{i,t-1} + \lambda ECM_{i\,t} + \varepsilon_{i\,t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.(7)$$

Where t represents year, d rerepresents first order difference calculation, ECM_{it} represents the errors of long term balance which is obtained from the long run co-integrating relationship between economic growth and educational expenditure. If $\lambda = 0$ is rejected, error correcting mechanism happens, and the tested long term causality is reliable, otherwise, it could be unreliable. If $\beta1=0$ is rejected, and then the short term causality is proved, otherwise the short term causality doesn't exist.

5. Analysis of the Result:

5.1.Ordinary Least Square Technique:

Table: 1:Result of OLS Technique

Variable	**Dependent variable is LnGDP**				
	Coefficient	SE	t ratio	R^2	F Statistic
Ln EDU	0.8743	0.011694	74.76	0.79	5589.34
	Dependent variable is LnEDU				
Ln GDP	1.134	0.015169	74.76	0.83	5589.34

Ho: There is no relationship between the variables; H1: There is relationship between the variables

In Ordinary least Square Method, we reject the hypothesis that there is no relationship between the variable and the results of the Ordinary Least Squares Regression are summarized in the Table 1. The empirical analysis on basis of ordinary Least Square Method suggests that there is positive relationship between EDU and GDP and vice versa.

5.2.Unit Root Test:

Table 2&3 present the results of the unit root test. The results show that both variables of our interest, namely LnGDP and LnEDU attained stationarity after first differencing, I(1), using ADF Test.

Table (2) presents the results of the unit root test for the two variables for their levels. The results indicate that the null hypothesis of a unit root can not be rejected for the given variable and, hence, one can conclude that the variables are not stationary at their levels.

Table 2: Unit Root Test: The Results of the Augmented Dickey Fuller (ADF) Test for Levels with an Intercept and Linear Trend

	Intercept only			Intercept&Trend		
Variable	**ADF(0)**	**ADF(1)**	**ADF(2)**	**ADF(0)**	**ADF(1)**	**ADF(2)**
LnGDP	2.144	1.359	1.825	-1.739	-1.625	-1.844
AIC	-3.665	-3.675	-3.679	-3.697	-3.697	-3.723
SBC	-3.588	-3.558	-3.521	-3.582	-3.542	-3.525
	1% critical value is -3.571*			1% critical value is -4.163		
Ln EDU	-1.175	-1.457	-1.635	-0.8058	-0.9472	-0.7412
AIC	-2.816	-2.805	-2.761	-2.787	-2.780	-2.728
SBC	-2.739	-2.688	-2.604	-2.671	-2.624	-2.531
	1% critical value is -3.568			1% critical value is -4.158		

Ho: series has unit root; H1: series is trend stationary
*MacKinnon critical values for rejection of hypothesis of a unit root.
AIC stands for Akaike info criterion
SBC stands for Schwarz Bayesian criterion

To determine the stationarity property of the variable, the same test above was applied to the first differences. Results from table (3) revealed that the ADF value is greater than the critical t-value at 1% level of significance for all variables. Based on these results, the null hypothesis that the series have unit roots in their differences is rejected, meaning that the two series are stationary at their first differences [they are integrated of the order one i.e I(1)]. The AIC (Akaike Information criterion) and SBC (Schwartz Bayesian criterion) are shown in the tables to determine the number of lags that makes the error term a white noise, which is one lag, as can be seen from table (3).

Table 3: Unit Root Test: The Results of the Augmented Dickey Fuller (ADF)Test for the First Difference with an Intercept and Linear Trend

	Intercept only			Intercept&Trend		
Variable	**ADF(0)**	**ADF(1)**	**ADF(2)**	**ADF(0)**	**ADF(1)**	**ADF(2)**
LnGDP	-5.29	-4.482	-4.491	-5.548	-4.998	-4.956
AIC	-3.677	-3.647	-3.689	-3.681	-3.688	-3.706
SBC	-3.598	-3.529	-3.530	-3.564	-3.530	-3.507
	1% critical value is -3.574*			1% critical value is -4.158		
LnEDU	-6.219	-4.882	-3.727	-6.409	-5.193	-4.631
AIC	-2.800	-2.743	-2.692	-2.801	-2.758	-2.693
SBC	-2.723	-2.625	-2.532	-2.684	-2.600	-2.494
	1% critical value is -3.571			1% critical value is -4.163		

Ho: series has unit root; H1: series is trend stationary.
*MacKinnon critical values for rejection of hypothesis of a unit root.
AIC stands for Akaike info criterion
SBC stands for Schwarz Bayesian criterion

5.3.Cointegration Test:

Having established the time series properties of the data, the test for presence of long-run relationship between the variables using the Johansen and Juselius(1992) LR statistic for cointegration was conducted. The crucial approach which is used in this study to test cointegration is called the Johansen cointegration approach. The Johanson approach can determine the number of cointegrated vectors for any given number of non-stationary variables of the same order. The results reported in table (4) suggest that the null hypothesis of no cointegrating vectors can be rejected at the 1% level of significance. It can be seen from the Likelihood Ratio (L.R.) that we have a single co-integration equations. In other words, there exists one linear combination of the variables.

Table 4:Johansen Cointegration Tests:

Hypothesized N0. Of CE (s)	Eigen value	Likelihood Ratio	5% critical value	1% critical value
None **	0.394976	31.16374	19.96	24.60
At most 1	0.136497	7.044376	9.24	12.97

Ho: has no co-integration; H1: has co-integration

*(**) denotes rejection of the hypothesis at 5%(1%) significance level

L.R. test indicates one cointegrating equation(s) at 5% significance level

The normalized cointegrating equation is

LnGDP = -15.77+ 0.9274 LnEDU -----------------------(7)

(0.3611)

The standard error is in the parentheses the behavioural parameter(EDU) are statistically significant at 5%.

Estimating the long-run relationship, the results are contained in equation (7) which show positive relationship between education and economic growth. Precisely, 1% increase in investment in education raises the level of GDP by 92.74%.Therefore,the Normalized cointegration equation reveals that there is a positive relationship between education expenditure(EDU) and GDP(Economic growth).Looking at the results, the normalized cointegrating equation (7) reveals that in the long-run, education expenditure affects economic growth positively in India. Interestingly, this result is impressive because 1% change in education expenses leads to about 93 percent change in economic growth via GDP growth in the same direction, over the long-run horizon. This of course is highly significant judging from the t-statistic.

5.4.Granger Causality Test :

The results of Pairwise Granger Causality between economic growth (GDP) and investment in education (EDU) are contained in Table 6. The results reveal that there does not have any causality which can run from economic growth (GDP) to investment in education (EDU) and vice versa.

We have found that both for the Ho of "LnEDU does not Granger Cause LnGDP" and Ho of "LnGDP does not Granger Cause LnEDU" , we cannot reject the Ho since the F-statistics are rather small and most of the probability values are close to or even greater than 0.1 at the lag length of 1 to 4. Therefore, we accept the Ho and conclude that LnEDU does not Granger Cause LnGDP and LnGDP does not Granger Cause LnEDU.

Table: 6: Granger Casuality test

Null Hypothesis	Lag	Observations.	F-statistics	Probability	Decision
LNEDU does not Granger Cause LNGDP	1	49*	0.3888	0.5360	Accept
	2	48	0.1551	0.8568	Accept
	3	47	0.2367	0.8703	Accept
	4	46	0.2683	0.8964	Accept
LNGDP does not Granger Cause LNEDU	1	49	0.00027	0.98718	Accept
	2	48	1.9111	0.1603	Accept
	3	47	1.5378	0.2196	Accept
	4	46	1.8543	0.1392	Accept

*Observations. after lag.

The above results generally show that there is no causal relationship between education expenditure indicators and economic growth in India.

5.5.Error Correction Mechanism(VECM):

In order to check the stability of the model we have estimated the vector error correction (VECM) model. The results of VECM model are presented in Table 7. The results indicate that the error correction term for GDP growth bears the correct sign i.e. it is negative and statistically significant at 5 percent significant level. It indicates 2.1 percent speed of convergence towards equilibrium position in case of any disequilibrium situation. The coefficient of error correction term for EDU bears the correct sign i.e. negative and statistically significant with the convergence speed of 1.24 percent towards equilibrium.

Table:7: Short term causality test for time series data(VECM)

variable	Model-1 D(LNGDP)	Model-2 D(LNFT)
ECM	-0.021425* (0.00477) (-4.49384)	-0.012422* (0.00390) (-3.18513)
D(LNGDP(-1))	0.276040 (0.14977) (1.84309)	0.359800 (0.24824) (1.44939)
D(LNGDP(-2))	-0.176615 (0.15254) (-1.15780)	0.127462 (0.25284) (0.50412)
D(LNEDU(-1))	0.000682 (0.09703) (0.00702)	0.092663 (0.16083) (0.57616)
D(LNEDU(-2))	-0.048089 (0.09501) (-0.50616)	-0.032624 (0.15748) (-0.20717)
R-squared	0.508753	0.308001
F-statistic	3.236361	3.390904

- indicates panel data pass the significance test by 95% level,

6. Conclusion:

The paper tries to assess empirically, the relationship between government expenditure in education and economic growth in India using annual data over the period 1961-62 to 2010-11. The unit root properties of the data were examined using the Augmented Dickey Fuller test(ADF) after which the cointegration and causality tests were conducted. The error correction models were also estimated in order to examine the short –run dynamics. The major findings include the following:

The unit root test clarified that both economic growth and education are non-stationary at the level data but found stationary at the first differences.Therefore,the series of both variables of our consideration-EDU and GDP, namely, education and economic growth were found to be integrated of order one using the ADF tests for unit root.

The cointegration test confirmed that economic growth and education are cointegrated, indicating an existence of long run equilibrium relationship between the two as confirmed by the Johansen cointegration test results.

The Granger causality test finally confirmed that there exist no causality that can runs from economic growth to education and vice-versa.

The error correction estimates indicates appropriate speed of convergence towards equilibrium position in case of any disequilibrium situation.

Use of new technologies and scientific knowledge in the delivery of education services and promotion of scientific and technological interventions in this social sector is likely to have a significant impact not only on the quality of education services but also on its accessibility to the rural poor, in particular the disadvantaged sections. Access to quality basic education is imperative not only to reduce social and regional disparities, but also to achieve balanced growth and development. Availability of resources alone does not guarantee faster social sector development. Efficacy of the programmes will depend a lot on the manner in which States implement various social sector programmes, which are primarily in the domain of the States. States, which have given high priority to investment in education, have shown greater economic progress in recent years. An early concentration on building schools and providing equipment has given way to greater focus on quality and content, with an emphasis on primary education, to improve access for those previously excluded from education, particularly girls and child labour, the rural poor and weaker sections of society or other excluded minorities.

Finally, it can be suggested that concerted effort should be made by policy makers to increase the level of human capital in India through which productivity can be enhanced in order to boost growth (GDP).Moreover , quality assurance in education should be given utmost priority in order to make it growth enhancing.

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Appendix:

Table 1: Relevant Statistical Data of GDP and Education expenditure of Govt. of India, 1961-62 to 2010-11(Rs crores)

Year	GDP at current prices(at factor cost)(Rs Crore)	EDU(Rs crores)	Edu. Exp. As a % GDP
1961-62	17116	260.3	1.52
1962-63	18302	278.76	1.52
1963-64	20916	313.93	1.50
1964-65	24436	369.29	1.51
1965-66	25586	432.61	1.69
1966-67	29123	487.83	1.68
1967-68	34225	593.14	1.73
1968-69	36092	649.13	1.80
1969-70	39691	760.23	1.92
1970-71	42222	892.36	2.11
1971-72	44923	1011.07	2.25
1972-73	49415	1150.43	2.33
1973-74	60560	1300.72	2.15
1974-75	71283	1570.67	2.20
1975-76	75709	1849.47	2.44
1976-77	81381	2039.09	2.51
1977-78	92881	2630.6	2.83
1978-79	99824	2994.69	3.00
1979-80	108927	3347.57	3.07

Year	GDP at current prices(at factor cost)(Rs Crore)	EDU(Rs crores)	Edu. Exp. As a % GDP
1980-81	130178	3884.2	2.98
1981-82	152056	4298.29	2.83
1982-83	169525	5509.17	3.25
1983-84	198630	6229.53	3.14
1984-85	222705	7455.88	3.35
1985-86	249547	8713.02	3.49
1986-87	278258	9479.13	3.41
1978-88	315993	11798.35	3.73
1988-89	378491	14069.82	3.72
1989-90	438020	17192.5	3.93
1990-91	510954	19615.85	3.84
1991-92	589086	22393.69	3.80
1992-93	673229	25030.3	3.72
1993-94	781345	28279.69	3.62
1994-95	917058	32606.22	3.56
1995-96	1073271	38178.09	3.56
1996-97	1243546	43896.48	3.53
1997-98	1390148	48552.14	3.49
1998-99	1598127	61578.91	3.85
1999-00	1786525	74816.09	4.19
2000-01	1925416	82486.48	4.28
2001-02	2100187	79865.7	3.80
2002-03	2265304	85507.34	3.77
2003-04	2549418	89079.25	3.49
2004-05	2855933	96694.1	3.39
2005-06	3275670	113228.71	3.46
2006-07	3952241	117312.00	2.97
2007-08	4581422	126532.04	2.76
2008-09	5282086	167996.03	3.18
2009-10	6133230	198939.52	3.24
2010-11	7306990	212317.43	2.91

Source: Author's own estimate based on Handbook of Statistics on Indian Economy,2010-11.

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