Does Government Expenditure on Education Promote Economic Growth? An Econometric Analysis

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Does Government Expenditure on Education Promote Economic Growth? An Econometric Analysis

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Abstract

Education being an important component of human capital has always attracted the interests of economists, researchers and policy makers. Governments across the globe in general and in India in particular are trying to improve the human capital by pumping more investments in education. But the issue that whether improved level of education resulting from more education spending can promote economic growth is still controversial. Some economists and researchers have supported the bi-directional relation between these two variables, while it has also been suggested that it is the economic growth that stimulates governments spend more on education, not the other way. Considering this research issue, the present paper uses linear and non-linear Granger Causality methods to determine the causal relationship between education spending and economic growth in India for the period 1951-2009. The findings of this paper indicate that economic growth affects the level of government spending on education irrespective of any lag effects, but investments in education also tend to influence economic growth after some time-lag. The results are particularly useful in theoretical and empirical research by economists, regulators and policy makers.

Keywords: Education expenditure, Economic growth, Indian economy, Granger Causality, Non-linearity.

JEL Classification Codes: C22, E62, H52, I21.

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Introduction

It is well known and widely accepted that investment in education is critical for economic growth and social cohesiveness of society. Many of the potential payoffs to society from various types of public investment in education are not immediately apparent but are nevertheless important. One of the best examples relevant to the Indian context is the much hyped software boom that itself reflects at least partly the earlier public investment in Indian Institutes of Technology (IITs). Further, there are huge advantages to society in improving the general level of education, not only because the quality of workforce improves, but because various other aspects such as health, nutrition and sanitation are positively affected, and also because educated citizens can be more effective participants in a democratic civil society.

Expenditure on education is supposed to bring into the economic system the externalities and other indirect effects such as higher education attainment and achievement of children, better health and lower mortality of children, better individual health and lower number of birth which subsequently cause higher productivity in terms of increased earnings, more participation in the labour force i.e. increased labour force; all these coupled with lower population growth and better health of population tend to positively influence higher economic growth (Michaelowa, 2000). The relationship between economic growth and various macroeconomic factors has attracted the interest of many economists and policy makers since long ago. The history of the issue led back to the era of the classical economist Adam Smith, followed by neoclassical economists such as Alfred Marshal and Henry Schultz (Tilak, 2005). The macroeconomists has concentrated on the effects of several government policies on the sustainable economic growth. This emphasis can be attributed to the recognition of the fact that the difference between prosperity and poverty in a country depends on how quickly it grows over the long term. Although all the standard macroeconomic policies are important for economic growth, understanding their individual impact on the economic growth is even more significant.

Economics offers a variety of theories and models relating education to economic growth. Education increases an individual's earning potential, but also produces a 'ripple effect" throughout the economy by way of series of positive externalities. Katharina Michaelowa (2000) of the Hamburg Institute for International Economics diagrams the impact of education on both micro and macro level as follows (refer Figure 1):

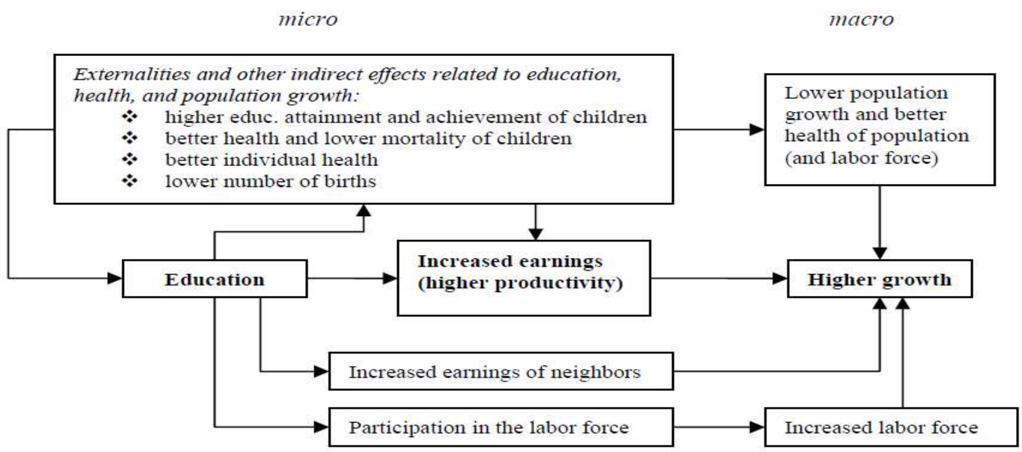

Figure 1: Micro and Macro Level Effects of Education on Economic Growth

(Source: Michaelowa, Katharina (2000), "Returns to Education in Low Income Countries: Evidence for Africa)

This paper is an attempt to understand the relationship between government expenditure on education and economic growth in Indian context. Using time series data from 1951 through 2009 on education expenditure and economic growth in India, the researcher examines the causation between these two factors. The empirical methodology adopted for this purpose includes the Granger Causality test within an error-correction framework. The findings suggest strong evidence for a unidirectional causality from economic growth to education expenditure, but moderate evidence of causality from education expenditure to economic growth is observed.

Rest of the paper is organised as follows: next section is dedicated on the concentrated review of concerned literature on the issue. Following section consists of detailed methodological issues and data description, followed by analysis of test results and discussions and interpretation of the findings. The last section concludes with summarising remarks.

Review of Literature

In the empirical literature, relation between public spending and economic growth has found much attention of economists and researchers in public economics and finance. O'Neill (1995) reports in his findings that convergence in education levels have resulted in a reduction in income dispersion. He further states that for the world as a whole, income has diverged despite substantial convergence in education levels. This is a result of increases in the return to education that favour the developed countries at the expense of the less developed countries. Sylwester (2000) explores the transition mechanism that might link the income inequality and economic growth. He found that public education expenditures are positively associated with future economic growth, although the contemporaneous effect upon growth is negative. Barro (2001) examines a panel data of around 100 countries observed from 1965 to 1995 and finds that growth is positively related to the starting level of average years of school attainment of adult males at the secondary and higher levels. Growth is insignificantly related to school attainment of females at the secondary and higher levels, and also to male schooling at the primary level.

Blankenau et al (2005) carried out an empirical study on expenditure–growth relationship in the context of an endogenous growth model. They found that the response of growth to public education expenditure may be non-monotonic over the relevant range. The relationship depends on the level of government spending, the tax structure and the parameters of production technologies. Review of extensive literature in this respect is beyond the scope of the present paper, the researcher, therefore, focuses on only most relevant and contemporary studies on the relationship of education expenditure and economic growth. The literature has focused on the link between level of public expenditure on education and economic growth; majority of the studies deal with endogenously generated economic growth and stress on the role of human capital accumulation in economic growth (Chakraborty, 2005), and that an investment in education is very beneficial to the society, both at the micro level as well as macro level and affects the economic growth both directly and indirectly (Dahlin, 2005).

In their attempt to determine the causation between education expenditure and economic growth, most of the researchers applied linear Granger Causality tests, which have proved to be essential for identifying the predictive ability of the time series models (Alexakis and Siriopoulos, 1999). More specifically, all studies on causal relationships rely exclusively on traditional linear Granger Causality tests with error correction models, though their proxy for education varied from public expenditure on education to school enrolments, to school attainment age and so on. A survey of the literature reveals that there is much controversy as far as the nature and the direction of causality between education spending and growth is concerned.

The uniqueness of the present study lies in the fact that it uses the actual government spending on education and gross domestic product at current prices at its two variables and run the linear and non-linear Granger Causality tests in order to understand the patterns of relationship between these variables. Detailed methodology is discussed in the following section.

Data and Methodology

In this section, details of the linear and the non-linear Granger Causality tests are discussed followed by the data variables and their respective sources are presented. Mainly the Granger Causality tests (Granger, 1969), and the statistical technique – developed by Baek and Brock (1992) and modified by Hiemstra and Jones (1994) – are used to test for linear and non-linear Granger Causality relationships respectively.

Data Description

The empirical investigation has been carried out in the case on Indian economy with a dataset of the period 1950-51 to 2008-09. The present study uses the secondary data which have been collected from the National Accounts Statistics, Central Statistical Organisation, Ministry of Statistics and Plan Implementation, Government of India, New Delhi (http://www.mospi.gov.in) and the Budget Expenditure on Education, Department of Secondary and Higher Education, Government of India, New Delhi (http://www.education.nic.in/secondary.htm). The reliability of the data for empirical research can be attributed to the fact that all the data sources used in this study are government sources and thus, data is very much reliable and perfect for policy research.

The data variables used in the present study are government expenditure on education (henceforth referred to as EDEX) and gross domestic product at current prices (GDP). The researcher attempts to test the direction of causation between these two variables. All data used are expressed in current prices. The use of current prices is incumbent in the case of non-linear causality tests. This is because the transformation in constant prices filters time-series and the results are distorted. For reasons of mathematical consistency, filtering should be avoided. The cross correlation between the two variables are given in the Table (3).

The test is to reject the null hypotheses of "*GDP does not Granger cause EDEX*" and "*EDEX does not Granger cause GDP*" against alternative hypotheses of bidirectional Granger causality between these two variable. Statistical description of the relationship is described in the following sub-section.

Empirical Methodology

The Linear Granger Causality Test: A time-series x_t causes another time series y_t in the Granger sense if the present value of y can be predicted better using past values of x than by not doing so, considering also other relevant information, including, past values of y. in mathematical terms, x is said to cause y, provided some βj is non-zero in the full regression equation (1):

$$y_t = \delta_0 + \sum_{i=1}^{r} a_i y_{t-i} + \sum_{j-1}^{s} \beta_j x_{t-j} + \varepsilon_t \quad (1)$$

The relevance of x is indicated when comparing the error in equation (1) to that of the reduced equation (2):

$$y_t = \delta_0 + \sum_{i=1}^{r} a_i y_{t-i} + \varepsilon \quad (2)$$

The error terms are compared formally with the F-statistics.

The Non-linear Granger Causality Test: A non-parametric statistical model is proposed by Baek and Brock (1992) for detecting non-linear causal relations that is beyond the scope of standard linear tests. They follow an approach that employs the correlation integral, which provides an estimate of spatial dependence across time. For instance, consider two stationary and weekly dependent time-series $\{X_t\}$ and $\{Y_t\}$, t = 1, 2, 3, …., n. Let the m-length lead vector X_t be designated by X_t^m, and the Lx-length and the Ly-length lag vectors of X_t and Y_t be designated by X_{t-Lx}^{Lx} and Y_{t-Ly}^{Ly}, respectively.

For given values of m, Lx, and $Ly \geq 1$ and for $e > 0$, Y does not strictly Granger Cause X if:

$$\Pr(\left\|X_t^m - X_s^m\right\| < e \mid \left\|X_{t-Lx}^{Lx} - X_{s-Lx}^{Lx}\right\| < e, \left\|Y_{t-Ly}^{Ly} - Y_{s-Ly}^{Ly}\right\| < e)$$

$$= \Pr(\left\|X_t^m - X_s^m\right\| < e \mid \left\|X_{t-Lx}^{Lx} - X_{s-Lx}^{Lx}\right\| < e) \quad (3)$$

where Pr (.) denotes probability and $\|.\|$ denotes the maximum norm (the maximum norm for $Z \equiv (Z_1, Z_2, \ldots, Z_K)$ is defined as max (Z_i), $i = 1, 2, 3, \ldots, K$).

The probability on the left-hand side of the above equation is the conditional probability that the two arbitrary m-length lead vector $\{X_t\}$ are within a distance e of each other, given that the corresponding L_x-length lag vectors of $\{X_t\}$ and L_y-length lag vectors of $\{Y_t\}$ are within e of each other. The probability on the right-hand side of the equation is the conditional probability that two arbitrary m-length lead vectors of $\{X_t\}$ are within a distance e of each other, given that their corresponding L_x-length lag vectors are within a distance e of each other.

For testing of non-linear Granger causality, first it requires to remove the linear dependence. For this reason, a Vector Autoregression (VAR) model is applied and the estimate residuals are used to test for non-linear causality. Following VAR model is estimated for our sample dataset, where $\varepsilon_{i,t}$ is the innovation at time t and p the lag length:

$$GDP_{i,t} = \sum_{k=1}^{p} \delta_{i,k} GDP_{i,t-k} + \sum_{k=1}^{p} \beta_{i,k} EDEX_{i,t-k} + \varepsilon_{i,t} \quad (4a)$$

$$EDEX_{i,t} = \sum_{k=1}^{p} \chi_{i,k} GDP_{i,t-k} + \sum_{k=1}^{p} \gamma_{i,k} EDEX_{i,t-k} + u_{i,t} \quad (4b)$$

A significantly positive test statistics of the coefficients in the above equations suggest that lagged values of EDEX help to predict GDP and also lagged values of GDP help to predict EDEX, whereas a significant negative value of the coefficients suggests that knowledge of the lagged values of EDEX and GDP confounds the prediction of GDP and EDEX respectively. For this reason, Hiemstra and Jones (1994) argue that the test statistics in the above equation should be evaluated with right-tailed critical values when testing for the presence of granger causality. In order to test for non-linear Granger causality the above test is applied to the two estimated residual series from the VAR models.

Empirical Results and Analysis

The trend of India's economic growth (expressed as GDP) and public spending on education (EDEX) during the sample period of 1950-51 and 2008-09 is represented in Figure (2) below. It reflects that there exists a gap in the linearity in the relationship between the two variables.

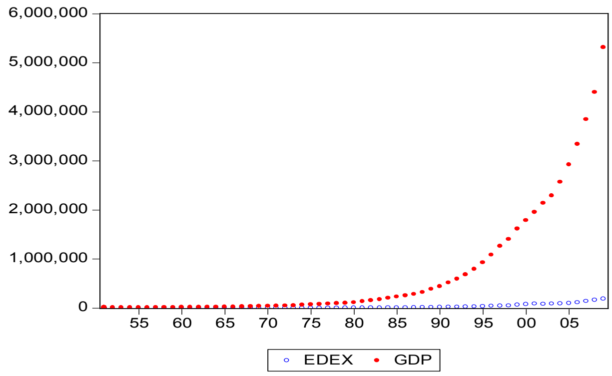

Figure 2: Trend in India's GDP and Education Expenditure

Linear Granger Causality Test Results

The foremost step of the Granger Causality test is to perform stationarity tests for each of the relevant variables. There have been a variety of proposed methods for implementing stationairity tests and each has been widely used in the applied economics literature. Tests of stationarity that have become popular over the past several years is the Unit Root test and Dickey-Fuller test. However, there is now a growing consensus that the stationarity test procedure due to the Dickey and Fuller (1979) has superior small properties compared to each alternative. The present study, therefore, employs the augmented Dickey-Fuller (ADF) test procedure for implementing stationarity tests. The ADF test consists of estimating the following regression:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-i} + \varepsilon_t \qquad (5)$$

where ε_t is a pure white noise error term and where $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$, $\Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$, etc. The number of lagged difference terms to include is often determined empirically, the idea being to include enough terms so that the error term in the above equation (5) is serially uncorrelated. In ADF, we test whether $\delta = 0$. The ADF statistics in the present case suggest that all variables are integrated of order one, I(1), whereas the first difference is integrated of order zero, I(0). In the null hypothesis, the examined variable has a unit root which means that it is non-stationary. Following the above procedure, the series have been proved to be stationary in the first differences.

The Granger Causality test is applied in order to test for the causal flow between government expenditure on education and economic development, expressed by the Indian GDP. The null hypothesis states that no Granger causality exists; thus no linear relationship between education expenditure and GDP is observed in India from 1951 to 2009. On the other hand, the alternative hypothesis suggests that linear Granger causality exists. A bidirectional flow of causality indicates that as the public spending on education grows there is a tendency for economic growth to further improve.

To test whether the Granger causality exists or not, we need to compare the probability that the null hypothesis exists with the critical value. If the critical value is greater than the probability, the null hypothesis stands to be rejected and the alternative hypothesis gets accepted. In case of the probability value is greater than the critical value, the null hypothesis is considered as significant and we accept it as the true case.

Table 1: Granger Causality Test Statistics

Granger Causality Test Statistics						
	EDEX does not Granger Cause GDP			GDP does not Granger Cause EDEX		
Lags	Obs	F-Stats	P-value	Obs	F-Stats	P-value
1	58	5.10987	0.0278	58	38.185	8.00E-08
2	57	1.13655	0.3288	57	51.1819	5.00E-11
3	56	1.85007	0.1504	56	34.165	5.00E-12
4	55	1.4438	0.2348	55	22.9531	2.00E-10
5	54	1.00368	0.4272	54	26.288	5.00E-12
6	53	6.49722	8.00E-05	53	23.0422	1.00E-11
7	52	10.9997	2.00E-07	52	22.1279	2.00E-11
8	51	8.90142	2.00E-06	51	20.4525	7.00E-11

Obs: No. of Observations included in the test.

As can be inferred from the test statistics in the table (1) above, there are a significant indication of a linear unidirectional causal relationship running from economic development (expressed as GDP) to the education spending (EDEX). Thus, in India, GDP determines public spending on education in a linear way. But at the same time, it is also observed that with a lag value of 6 or more, this causal relationship between public education expenditure and economic growth becomes bidirectional; in other word, the causation runs from GDP to EDEX and also from EDEX to GDP, as the P-values in both cases are less than the assumed critical values. It can be, therefore, said that public expenditure on education in past years is translated into and affects to some extent the economic growth.

In the light of the reported empirical results, it may be assumed that the growth of education expenditure by the government in India is dependent on and determined by economic growth to great extent, but the impact of education expenditure of past years on the economic growth also exists in our test results. Thus, there exists a bidirectional relationship between these two variables. The results of this study are comparable to those of other researchers. The direction of causation running from economic growth to education expenditure is identified by Blankenau and Simpson (2003), Bose, Haque and Osbon (2003), Basu and Bhattarai (2009) and Pradhan (2009), while the findings of causality running from education spending to economic growth are in lines with those of Al-Yousif (2005), Jiranyakul (2007), and Parmani (2009).

Non-linear Granger Causality Test Results

The model suggested by Baek and Brock (1992) and revised by Hiemstra and Jones (1994) is employed in order to test the non-linearity in the causal relationship between education expenditure and economic growth. It is important to mention that implementing that model requires a choice of values for various parameters such as the lead length, *m*, the lag lengths *Lx* and *Ly*, and the scale parameter, *e*. In this study, we have adapted the approach as followed by Karagianni and Pempetzoglu (2007) and set the lead length at *m* = 1 and *Lx* = *Ly* and a common lag length of 1 to 8 lags (the choice of the specific lag length is proposed by Kyrtsou and Labys, 2006). A common scale parameter of *e* = 1.5σ, where σ denotes the standard deviation of the standardised time series. The test statistics are presented in the Table (2) below:

Table 2: Non-linear Granger Causality Test Statistics

Granger Causality Test Statistics				
	EDEX →GDP		GDP →EDEX	
$L_x = L_y$	*Cs*	*T-value*	*Cs*	*T-value*
1	0.0241	1.0278	0.0201	1.134
2	0.0197	1.0288	0.0182	1.732*
3	0.0148	1.1074	0.0116	1.996*
4	0.0113	1.2348	0.0092	2.008*
5	0.0096	1.5272*	0.0076	2.102*
6	0.0093	2.0134*	0.0076	2.102*
7	0.0093	2.0134*	0.0076	2.102*
8	0.0093	2.0134*	0.0076	2.102*

Note: * statistically significant at 5% level.
The critical value for 5% is 1.523.

As can be inferred from the test statistics of non-linear Granger causality test, there exists a bi-directional causal relationship between the two variables. The results support to a great extent the findings of linear Granger causality tests. Here also, we can see that education expenditure is dependent on the country's economic growth, that is the causation runs from economic growth to education expenditure during the sample period. But it is also noteworthy to observe that with a lag value of 5 or more, the direction of causality between these two variables become dynamic. In simple words, a shock in education expenditure is expected to affect economic growth, even after some time, in a non-proportional way, due to the non-linear causality.

The relationship between government's expenditure on education and country's economic growth being non-linear makes it difficult to predict them with accuracy and precision, and also it is not possible to evaluate the extent and magnitude of the impact caused by the shocks in one variable on the other variable and vice versa.

Summary

The present paper made an attempt to explore the causal relationship between government spending on education and economic growth in respect of India employing a Granger Causality test with both a linear as well as a non-linear model framework. The period for which data have been used in this study is 1950-51 through 2008-09. The data sources used for this purpose are the concerned departments of the Government of India. The linear framework of Granger causality model proposed by Granger (1969) and non-linear models of Granger Causality test suggested by Baek and Brock (1992) and revised by Hiemstra and Jones (1994) are employed in order to test the relationship between the two macroeconomic variables. This study also relies for the methodological issues to much extent on the study carried out by Kyrtsou and Labys (2006).

The empirical findings of this study provide with the following conclusions: *first,* the time-series data used in the present study are found to be non-stationary at the level data, but stationary after first differences, indicating that they are integrated of order one (Pradhan, 2009). *Second*, there is a strong support for the observation that the causation between education expenditure and economic growth is bi-directional, i.e. the causality runs from economic growth to education expenditure and vice versa. *Third*, the results also show that the direction of causation is from education expenditure to economic growth is not immediate to take effect, rather it can be said that investment in education is expected to affect economic growth of a country after some period, 5 or 6 years in present study. *Fourth*, economic growth has always remained the major influencing factor as a determinant of education expenditure made by any government as obvious from the relevant literature. In the case of present study also, the causality running from economic growth to education expenditure is persistent irrespective of lead or lag values. *Finally*, it is also observed that more studies comprising of cross-countries (especially developing countries) time-series data could contribute to the better and improved understanding of the relationship of economic growth and investments in education.

Since, education is an important constituent of the human capital, improved education scenario certainly influences a country's economic growth. Governments should feel the need to focus on increased investments in education which contributes to economic growth, both directly and indirectly. The findings of the present study may be helpful to future theoretical and empirical research on the relation between these specific variables, by warning policy makers to pay attention to the shocks they induce in the economy (Kyrtsou and Labys, 2006).

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Appendix: Table 3

Table 3: Cross-Corrlogram – an Autocorrelation Plot of GDP and EDEX data series (Source: Author's Calculations using E-Views 6)

Sample: 1951 2009
Included observations: 59
Correlations are asymptotically consistent approximations

<table>
<tr><th>EDEX,GDP(-i)</th><th>EDEX,GDP(+i)</th><th>i</th><th>lag</th><th>lead</th></tr>
<tr><td>. |**********</td><td>. |**********</td><td>0</td><td>0.9978</td><td>0.9978</td></tr>
<tr><td>. |*********|</td><td>. |*********|</td><td>1</td><td>0.8598</td><td>0.8654</td></tr>
<tr><td>. |******** |</td><td>. |******** |</td><td>2</td><td>0.7517</td><td>0.7508</td></tr>
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<tr><td>. *| . |</td><td>. *| . |</td><td>20</td><td>-0.0516</td><td>-0.0516</td></tr>
<tr><td>. *| . |</td><td>. *| . |</td><td>21</td><td>-0.0669</td><td>-0.0683</td></tr>
<tr><td>. *| . |</td><td>. *| . |</td><td>22</td><td>-0.0801</td><td>-0.0830</td></tr>
<tr><td>. *| . |</td><td>. *| . |</td><td>23</td><td>-0.0924</td><td>-0.0954</td></tr>
<tr><td>. *| . |</td><td>. *| . |</td><td>24</td><td>-0.1041</td><td>-0.1076</td></tr>
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