Theoretical and Applied Economics
Volume XXII (2015), No. 4(605), Winter, pp. 63-74

Does Expenditure on Education Affect Economic Growth in India? Evidence from Cointegration and Granger Causality Analysis

Lingaraj MALLICK
School of Economics, University of Hyderabad, India
lingaraj.pu@gmail.com
Devi Prasad DASH
Department of Humanities and Social Science, IIT Ropar, India
devi100.dash@gmail.com

Abstract. *The study investigates causal relationship between expenditure on education and economic growth in India form the period 1951 to 2012. The econometric approach of the paper is based on the bivariate VAR model, co-integration, granger causality, variance decomposition and impulse response. The vector error correction result revels long run equilibrium relationship exists between expenditure on education and economic growth while only a unidirectional causality runs from expenditure on education to economic growth in India. Shocks due to expenditure on its own is positive throughout the tenth period and one unit standard deviation shock have positive impact on economic growth up to 10th periods while no significant impact is witnessed economic growth to expenditure on education. The study arrives it policy implication that the government has to focus more on expenditure in education in order to create better human development which can have better contribution to economic growth.*

Keywords: education expenditure, economic growth, VECM, Impulse response, granger causality.

JEL Classification: H52, O4, C22.

1. Introduction

Researches on growth models and empirics took a sharp U turn from 1980s. The growth literatures and models experienced a boom with the work of Romer (1986) and Lucas (1988). The key motivation behind this issue was the determinant for long run economic growth. From 1980s to till date, a number of papers have formalized the relation between education and economic growth. Many papers have deeply been featured with the accumulation of human capital and its effect on growth dynamics. A galaxy of literatures in recent years has awakened the dream of reviving the research in this field. The origins of the researches in human capital, knowledge production functions, spill-over into the productive capacity date back to the new theory of endogenous growth (Romer, 1986, 1990, 1994; Grossman and Helpman 1991, 1994). Overall higher education expenditures bring higher growth rate in an economy. Lot of researches have practically proved with respect to different economies. Examples include MacMohan (1998), Kim and Lau (1996), Popescu (2012), Cassou and Lansing (2001), Gustaffson, (2004), Mercan and Sezer (2014). Being in the era of development, the application and initiation of educational level in attaining human capital help spur growth rate. Being an important indicator, it infuses the qualitative and quantitative labour for the development process.it has both forward and backward linkages. Effective labour force participation help initiate the production process and start the transitional dynamics process in subsequent sector. Dissemination of knowledge production function and improvement in manufacturing base are its other key features. Ultimately, it leads to the competitiveness among the economies and also facilitates the criteria for openness. (Mercan, 2014).

India's strategy and vision of 2022 of becoming a sustainable, developed economy always requires the elements of quality human capital. The perspective of such an economy is conditioned with efficient human capital framework. This efficient pattern requires some fundamental internal factors like political instruments, policy modelling, sustainable growth and optimal socio-economic patterns and proper saving-investment dynamics.

The objective of our study is to trace the relationship between educational expenditure as by the government and its effect upon the growth rate. Unlike China, India needs to invest greater chunk of its resources in social infrastructures. The share of expenditure in education to GDP has increased each year but quite marginally. With recent reforms in primary education structures in form of Sarva Shiksha Abhiyan (SSA), innovative changes in secondary education pattern and much needed reforms in higher education in form of setting a uniform access of quality education, India is definitely proceeding to the era of knowledge economy. This study will look at state-wise and country's educational expenditure pattern and its effect on growth through a rigorous panel data frame work.

The rest of this study is organized as follows. The subsequent sections provide the literature reviews on expenditure on education and its impact on economic growth. In section 3 we have discussed the econometric modeling and data sources. The econometric techniques will be presented in Section 4. Then, Section 5 will discuss the empirical results of the study. Finally in the last Section 6 we provide conclusion and policy implications.

2. Brief review of literature

Several studies have conducted many macroeconomic simulations on educational expenditure and economic growth in cross country, cross states analysis within an economy and cluster wise country analysis based on the development paradigm. With the inception of analysis of knowledge production function, technological spill-over, the growth and education pattern have undergone a momentous change in terms of their applicability and policy implications. With the rising capital investment in education, the changing horizon of growth pattern will be quite evident with the years to come. This section summarizes and provides certain insights into the existing framework of this research. Shindo (2010) examined the impact of education subsidies upon the economic growth at 2 provinces in China. He used the six period overlapping generation model to analyse the effect and got the significant result. But ultimately, the outcome proves to be ineffective due to the large differences in the productivity. Burza and Burza (2013) have studied the pattern of investment in human capital in form of education and economic growth by panel data structure from 1997 to 2011. 12 nations of the European Union have been taken. The result is also found to be significant in those economies. Gustaffson and Shi (2004) undertook the study of rural China by taking 18 provinces regarding the effect of health and education expenditure upon the growth rates. The analysis was based upon the data taken from 1988 to 1995. The conclusion was not in favour of Western China showing a grossly unequal spending pattern in the human capital formation. The study was significant for Eastern and Coastal China. Jalil and Idrees (2013) have analysed in context of Pakistan by using error correction model on educational expenditure and economic growth. The periods taken into the consideration are from 1960 to 2010. The study found significant relation at different points between these 2 variables. Non-linear two stage least square estimators are used to estimate the error correction mechanism. Zhang (1996) developed a model of optimal investment in education and economic growth via subsidizing the private education. But this conditionality overall improves the welfare aspect and the quality of distributional perspective is never touched upon so seriously. Social with high income inequality may resort to the subsidisation of private education in future. Afzal et al (2010) have examined the impact of expenditure on school education and economic growth in Pakistan. The data taken are from 1970 to 2008 and in time series framework. The results show the significant positive relation between these 2 variables in both short run and long run. The ARDL Bounds testing model of co-integration is being implemented by them. Chen and Feng (1999) analysed the case of private education, openness and economic growth in China across 29 provinces. With the data ranging from 1978 to 1989, the analysis derived a significant relation with private education and economic growth. But in the analysis, the data of Tibetan region was not there due to non-availability. Hanushek and Weissman (2008) made theoretical contributions in different mechanisms, how educational expenditure affected economic growth. Higher education always leads to quality labour supply, thus increase in total factor productivity and growth towards equilibrium output. Secondly, education promotes the innovative techniques, which also promotes growth. Kituara (2014) developed a mathematical model for education borrowing constraint upon welfare and economic growth by using three period over-lapping generation model. The results produced the effect that with a binding constraint looming ahead, the growth rate of an economy would remain constant.

Our analysis here seeks to identify the relationship between economic growth and educational expenditure for a developing economy like India. The main motivation behind this study is the challenges faced by the Indian educational sectors at all spheres- whether it is primary, secondary or tertiary. Government has by far achieved the requisite goals in the primary education attainment ration. The next biggest challenge is the secondary education. Higher education sector also needs to be focused deeply. With the recent initiatives of setting some premier higher educational institutions across the nations, government has spent a huge chunk of the budget in higher education sector. Though this study does not primarily address any particular segment of education, still an overall education sector's feature is being represented in our analysis. As far our knowledge, no other study has delved to find out a detailed analysis of education expenditure and economy growth in case of developing economy like India.

3. Model Specification and Data source

To verify the relationship between educational expenditure and economic growth we have collected data on total expenditure on education and training and GDP at constant prices over the period 1951 to 2012. Data related to expenditure on education are taken from Indiastat.com which is compiling data from Department of higher education, Govt. of India. GDP is collected from Hand Book of Statistics on Indian economy, Reserve Bank of India. We adopt a log liner model for the estimation. The model can be explained as:

$$LNGDP_t = \alpha_1 + \beta_2 \, LNEE_t + \varepsilon_t. \quad (1)$$

4. Methodology

4.1. Unit root test

The first and foremost step is to test the stationary properties of the data in the study. All the time series data performs seasonality and hence have different trend. The vector error correction and Cointegration are used to investigate the relationship between nonstationary variables. So the first condition of VAR is the stationarity of the variables. The study uses the ADF test in order to test the unit root in the data. The modeling procedure has been explained as follows.

$$\Delta Y_t = \alpha + \alpha_2 Y_{t-1} + \sum_{i=1}^{p} \beta_i \, \Delta Y_{t-1} + \varepsilon_t. \quad (2)$$

Where Y is the choice variable; Δ is the first difference operator; α_i (for i = 1&2) and β_i (for i = 1, 2, …, p) are constant parameters; and ε_t is a non-stochastic. The lags have been chosen by Akaie Information Criteria (AIC).To determine the order of integration of a particular series, the equation has to be modified and include the second difference on lagged first and p lags of second differences which follows

$$\Delta^2 Y_t = \vartheta_1 \, \Delta Y_{t-1} + \sum_{i=1}^{p} \vartheta_i \, \Delta^2 Y_{t-1} + \xi_t \quad (3)$$

Where Δ^2 is the second difference operator; ϑ_1 and ϑ_1 are constant parameters; and ξ_t is a stationary stochastic process. Due to inclusion of difference lagged term i.e. 'p' the error terms (ε_t and ξ_t) in the respective equations is serially independent. To test stationary, the augmented Dickey fuller (ADF) [Dickey and Fuller, 1891] and Phillips and Perron (1988) tests are applied to equations 1 and 2. The null hypothesis are H_0: $\alpha_2 = 0$ against H_0: $\alpha_2 \neq 0$ and H_0: $\vartheta_1 = 0$ against H_0: $\vartheta_1 \neq 0$ respectively which signifies non-stationarity of both Yt-1 and ΔYt-1.

4.2. The Co-integration Approach

It is to be noted that for the time series data, we have to make sure of stationarity of the variables. Only after checking the stationarity properties of the data we can proceeds for cointegration test which is used to assess the long run equilibrium linkages among the variables in the study. Hence the cointegration test examines weather there is a linear combination of variables or not. Examining the linear combination or equilibrium relationship among the related variables the cointegration test has been applied widely in the empirical literatures. It represents that two variables or more series would never drift too far apart. A non-stationary variable, exhibits significant trends over time, but in case of different pairs of series have the property that a particular linear combination would make them together in such a way that the series will not have drift from each other. In such a circumstances, the two series can be cointegrated, or possess a long run (equilibrium) relationship. Whether the variables are cointegrated or not we have used the Johansen (1991, 1988) maximum likelihood test. The test can be explained in the followings.

$$\Delta Y = \mu + \Gamma_1 Y_{t-1} + \Gamma_2 X_{t-2} + \dots + \Gamma_{k-1} X_{t-k+1} + \Pi Y_{t-k} + \zeta_t. \quad (4)$$

Where Y_t is and 5 X 1 vector of the first order integrated [i.e., I (1)] variables; Γi are 5 X 5 coefficient matrices; ζt is a vector of normally and independently distributed error terms. The existence of cointegrating vectors (r) implies Π is rank coefficient. The number of distinct cointegrating vectors in the VAR can be estimated by the maximum eigenvalue and trace statistics (Johansen (1991). Appropriate critical values are tabulated in Osterwald- Lenum (1992). If Π is of rank r ($0 < r < 5$), then it can be decomposed as: $\Pi = \alpha\beta'$, where α (5Xr) and β (5Xr); and the equation (3) can be rewritten as:

$$\Delta Y = \mu + \Gamma_1 Y_{t-1} + \Gamma_2 X_{t-2} + \dots + \Gamma_{k-1} X_{t-k+1} + \alpha (\beta^{1} Y_{t-k}) + \zeta_t. \quad (5)$$

The cointegrating vectors are represented in the rows of β whereby $t\ k\ Y - \beta'$ form the linear processes of stationarity. In equation (5), α indicates the speed of adjustment coefficients towards the long run equilibrium. Unrestricted vectors are presented in β of (4). We cannot find any long run equilibrium relationship among the variables if there will be not any cointegrating vectors (i.e. r =1). Because the linear combination of cointegrating vectors forms another stationary linear relationship among the variables. So the VAR can be written as

$$\Delta Y = \mu + \Pi Y_{t-p} + \sum_{i=1}^{k-1} A_i \Delta Y_{t-i} + \varepsilon_t. \quad (6)$$

And from the vectors of residuals, two likelihood ratio test statistics (trace and maximum eigenvalue) can be estimated. The trace statistics is presented as

$$\lambda_{Tra} = -T\sum_{i=r+1}^{n} Log(1 - \hat{\lambda}_i) . \quad (7)$$

Whereas $\hat{\lambda}_{r+1,..}.\hat{\lambda}_n$ *(n-r)* are the smallest estimated eigenvalue. Our null hypothesis would be at most r unique cointegration vectors. We can estimate the second one (maximum eigenvalue statistics)

$\lambda_{max} = -T\,Log\,(1-\hat{\lambda}_i)$. (8)

The null hypothesis for this test is that there are r cointegrating vectors in Yt. For both tests, the alternative hypothesis is that there are g > r co-integration vectors in Yt. Johansen and Juselius (1990) suggested that the maximum eigenvalue test is relatively more powerful than of trace test, but trace test is more robustness to the non-normality of errors.

4.3. Lag length Criteria Selection

The lag length for the VAR (p) model may be determined using model selection criteria. The general approach is to fit VAR (p) models with orders p = 0, …, 0_{max} and choose the value of p which minimizes some model selection criteria. Model selection criteria for VAR (p) models have the form.

$IC(p) = In\,|\tilde{\sum}(p)| + c_T\,.\ \varphi\,(n, P)$

Where $\tilde{\sum}(p) = T^{-1}\sum_{t=1}^{T}\hat{\varepsilon}_t\,\hat{\varepsilon}'_t$ is the residual covariance matrix without a degree of freedom correction from a VAR (p) model, cT is a sequence indexed by the sample size T, and (n, p) is a penalty function which penalizes large VAR (p) models. The three most common information criteria are the Akaike (AIC), Schwarz-Bayesian (BIC) and Hannan-Quinn (HQ):

$AIC\,(p) = In\,|\tilde{\sum}(p)| + \frac{2}{T}pn^2$

$BIC\,(p) = In\,|\tilde{\sum}(p)| + \frac{InT}{T}pn^2$

$HQ\,(p) = In\,|\tilde{\sum}(p)| + \frac{2In\,In\,T}{T}pn^2$

where AIC overestimates the order with positive probability asymptotically, the BIC and HQ criteria estimate the order consistently under fairly general conditions if the true order p is less than or equal to p_{max}.

4.4. Vector Error Correction Model

The Granger representation theorem (Granger, 1988) states that if two variables (say GDPt and EEt) are cointegrated and each is individually I (1), then either Y1t Granger causes Y2t or Y2t to Y1. The dynamics both short run and long run causality of the variables is captured in Vector Error Correction Model (VECM). The model is expressed as follows:

$\Delta LNGDP_{1t} = \Omega_1 + \sum_{k=1}^{p-1}\alpha_{11,k}\,\Delta GDP_{1,t-k} + \sum_{k=1}^{p-1}\alpha_{12,j}\,\Delta EDE_{2,t-k} + \sum_{h=1}^{r}\alpha_{1,h}\,EC_{h,t-1} + \xi_{1t}$ (9)

$\Delta LNEDE_{2t} = \Omega_2 + \sum_{k=1}^{p-1}\alpha_{21,k}\Delta LNEDE_{21,\,t-k} + \sum_{k=1}^{p-1}\alpha_{22,\,j}\,\Delta LNGDP_{2,\,t-k} +$

$+ \sum_{h=1}^{r}\alpha_{1,h}EC_{h,t-1} + \xi_{2t}$ (10)

Where, $h,t-1\ EC$ is the h^{th} error correction term, the residuals from the h^{th} co-integration equation, lagged one period, and αij,k describes the effect of the k^{th} lagged value of variable j on the current value of variable of i: I,j = GDP_1 , EDE . The vector error correction approach captures both between short- and long- run causality. In the above setting (Equations 9 and 10), long run Granger causality from variable GDP_i to variable EDE_j in the presence of co-integration is evaluated by testing the null hypothesis that α_j, h = 0 for h = 1,… r, whereas the short run Granger causality from variable GDP_i to variable GDP_j is evaluated by testing the null hypothesis that αij, 1= … αij, p-1 = 0, using F statistics. We can reject null hypothesis of either one or both and can conclude that variable GDP_i Granger causes variable EDE_j.

4.5. Impulse Response Function

Impulse Response Function (IRF) of a dynamic system is its output when presented with a brief input signal, called an impulse, more generally, an impulse response refers to the reaction at any dynamic system in response to any external change. A VAR was written in vector MA infinite form as

$$Y_t = \mu + \varepsilon_t + \psi_1 \varepsilon_{t-1} + \psi_2 \varepsilon_{t-2}. \quad (11)$$

Thus, the matrix ψ_s has the interpretation $dy_{t+s} / d\varepsilon_t = \psi_t$ that the row 1, column j element of ψ_s identifies the consequences of one unit increase in the j^{th} variables. Innovation of data t (ε_{jt}) for the value of the i^{th} variable time t+s (y_{it+s}) holding all other innovations at all data are constant. dy_i t + s/dε^1jt as a function "s" is called impulse response function. It describes the response j_{it+s} to a one time impulse in y_{jt} with all other variables dated t or earlier held constant. Impulse response function trace out the response of current and future values of each of the variables to one unit increase in the current value of the VAR errors, assuming that this error returns to zero in subsequent periods and that all other errors are equal to zero. Specifically, an impulse response function refers to the reaction of any dynamic system in response to some external change. The impulse response function of a dynamic system is its output when presented with brief input signal, called impulse. In both cases, the impulse response describes the reaction of the system as a function of time.

5. Results and Discussion

Table.1 shows unit root test in which we have adopted both ADF test and PP test for the stationarity of the variables in the study. All the variables are non-stationary in their level and hence require difference to be stationary. In the first difference all variables are stationary representing order of integration which is very vital in examining the cointegrating relationship among all.

Table 1. *Unit root test*

Variables	ADF Test		Test		Order of Integration
	C	C and T	C	C and T	
LNGDP	5.29(1.00)	2.07(1.00)	6.74(1.00)	3.37(1.00)	(I)
LNEDE	0.22(0.97)	-2.48(0.33)	0.19(0.97)	-2.29(0.43)	
ΔLNGDP	-2.76(0.07)	-9.31(0.00)	-6.90(0.00)	-9.22(0.00)	(I)
ΔLNEDE	-6.20(0.00)	-6.14(0.00)	-6.20(0.00)	-6.14(0.00)	

All the t-statics are provide for both ADF and PP test. C and C and T: Constant and Trend. Probability values are in parenthesis, *** represents significance at 1% level.

The lag-length determination is carried out by applying the above three criterion which suggests one lag should be undertaken in the model in order to establish the cointegration relationship among the variables. The lag length is one as per the SBC and we have taken one lag for the cointegration analysis. Table 2 presents the selection of lag length criteria based on different criteria.

Table 2. *Lag Length Determinations*

Lag	LOGL	LR	FPE	AIC	SBC	HQ
0	1.369432	NA	0.022520	0.094854	0.50564	0.050564
1	316.8671	597.192	05.177708	-11.10240	-10.88539*	-11.01827
2	322.8847	10.9606	24.811108	-11.17445	-10.81278	-11.03424
3	326.8061	6.86235	94.844408	-11.17164	-10.66531	-10.97534
4	329.9981	5.358125	4.999908	-11.14279	-10.49178	-10.89040
5	331.0599	1.706385	5.577708	-11.03785	-10.242118	-10.72937

* indicates lag order selected by the criterion.

AIC: Akaie Information Criterion, SC: Schwarz Information Criterion and Hannan- Quinn information criterion

Table 3. *Results of Johansen's Cointegration test*

Unrestricted Cointegration Rank Test (Trace)				
Null Hypothesis	Eigenvalue	Trace	Critical Value	P. Value
r =0	0.224915	15.49471	15.49471	0.055***
r ≤1*	0.007426	0.432290	3.841466	0.510
Unrestricted Cointegration Rank test (Maximum Eigenvalue)				
r = 0	0.224915	14.77738	14.26460	0.0415***
r ≤1*	0.007426	0.432290	3.841466	0.5109

(*denotes rejection of the hypothesis at the 0.05 level, **MacKinnon-Haug-Michelis (1999) p-values).

From the table 3 it is evident that the unrestricted cointegration test is both trace and maximum eigenvalue indicate there is an existence of cointegration relationship among the variables in the study. We conclude that there are at most one long-run equilibrium relationships among variables. However the relationship does not itself identify the dynamic mechanism among the variables. Such dynamics are captured by the VECM results which is discussed in the below and presented in the tables 4 and 5.

Table 4. *Normalized Cointegration Coefficients*

Variables	coefficients	Standard error
LNGDP	1.000000	-------------
LNEDE	-0.080170	(0.05642)

Table 4 presents normalized equation from cointegration relationship between variables. That means there is an equilibrium relationship between the variables. The Vector error Correction Model (ECM) is indicated by the cointegration result and thus we have tested for Vector Error Correction Estimate (VECM) that indicates the short-run dynamics of the model. We have also tested VECM in order to know the short-run and long-run relationship between the variables. The results of the ECM confirm the cointegration results and hence indicate the presence of error correction term for EEE. The error correction equation shows correct positive sign for GDP, as it should be and negative sign for EED. It represents that 0.009 per cent and 0.02 per cent of the previous disequilibrium have been removed in the present period for EED and real GDP respectively which needs adjustment to be in equilibrium path. The dynamics of GDP implies that there is no problem of adjustment in the long-run in case of shock in the short-run.

Table 5. *Error Correction Mechanism*

	Δ LNGDP	Δ LNEDE
CointE	0.024325 (0.00677) [3.59159]	-0.009361 (0.01941) [-0.48230]

P.values is in parenthesis and t-value in brackets.

Table 6. *Vector Error Correction Model for short run analysis*

	Δ LNGDP	Δ LNEDE
ΔLNGDP (-1)	-0.224624	0.328428
	(0.13537)	(0.38799)
	[-1.65930]	[0.84649]
ΔLNGDP (-2)	-0.215669	0.094063
	(0.13431)	(0.38495)
	[1.60573]	[0.24435]
ΔLNEDE (-1)	0.081666	0.165569
	(0.04971)	(0.14246)
	[1.64302]**	[1.16223]
ΔLNEDE (-2)	-0.126265	-0.036351
	(0.05068)	(0.14526)
	[-2.49124]***	[-0.25024]
Constant	0.024085	0.045755
	(0.00503)	(0.01443)
	[4.78401]	[3.17099]

Standard error is in parenthesis and t-value in brackets. *, ** and *** presents significance level at 10%, 5% and 1%.

Table 7. *Diagnostic Test of the VECM*

Statistics	1	2
Serial Correlation	6.22 (0.5539)	10.63
X^2 (LN)	16.56(0.4837)	16.32
Normality Test (Jarque Bera)	0.18	1.45
R^2	0.56	0.57
F	3.53	3.65

The results from estimation of VAR model is shown in the above Table 6. The estimated coefficient shows that there is a positive and significant impact of educational expenditure (EDE) on economic growth (GDP). Due to 1% increase in expenditure on education the economic growth will increase by 80% at 5 per cent level significance. In case of GDP there no significant impact on EDE.

From (Table 7) above diagnostic test of the VECM model clearly presents no specification errors, structural stability of the model, normality of the residuals and homoscedasticity. The model is free of all above problems and hence explores all the dynamics of the variables without error.

Table 8. Granger causality/ Wald Test

Null Hypothesis	Lags	Observation	F-Statistics
DLNGDP does not Granger Causes DLNEDE	2	58	0.24974(0.7799)
DLNEE does not Granger Cause DLNGDP	2	58	4.38962(0.0172) ***
DLNGDP does not Granger Causes DLNEDE	4	56	0.10026(0.9818)
DLNEE does not Granger Cause DLNGDP	4	56	2.96807(0.0289) ***

Granger causality results are reported in Table 8. From the results the study concludes that the variable expenditure on education (EDE) is Granger causes of economic growth with a 5 % significance level. Economic growth (GDP) is not Granger causes educational expenditure. So we conclude that there is a unidirectional causality running from EDE to GDP in the short run in India. It is very necessary and important to perform the Granger casualty test for different lag selection and the results should not be sensitive to the different lag structures (Pindyck and Rubinfled, 1991; Shan and Sun, 1997). We preformed the Granger causality with different lags to know if any changes in lag can affect the causality between the variables. But the results are almost same (for 4 lags, expenditure on education is Granger causes economic growth with 5% significant level).

Table 9. Results of variance decomposition

Period	VDC of GDP		VDC of EDUE	
	GDP	EDE	GDP	EDE
1	100.0000	0.000000	6.91763	93.08232
2	97.28226	2.717744	9.994773	90.00523
3	97.66982	2.330181	11.27775	88.72225
4	98.08017	1.919832	12.25930	87.74070
5	97.77799	2.222015	12.79384	87.20616
6	97.78674	2.213257	13.19175	86.55058
7	97.62573	2.374267	13.44942	86.55058
8	97.56206	2.437945	13.65356	86.34644
9	97.44382	2.556182	13.80558	86.19442
10	97.35231	2.647690	13.93179	86.06821

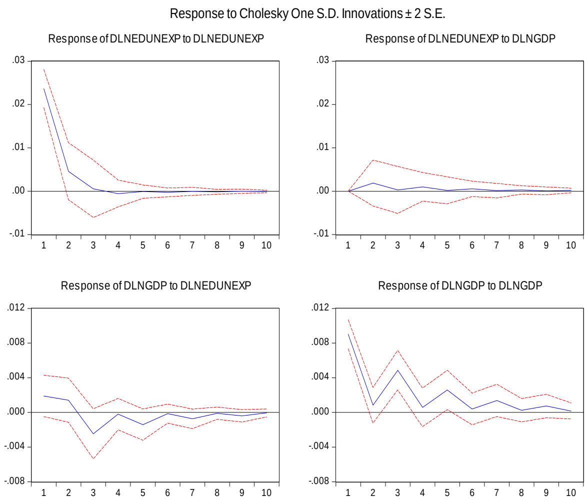
Variance decomposition (VCD) is described as the breaking down of the variances of unanticipated changes in dependent variable as per the innovations contributed to each variables. The variance decomposition of the variables in the model shows that movements in each variable are largely explained by its own past values. The results of the VCD of the variables are presented in Table 9.

From Table 9 it is evident that variations in GDP of its own are gradually decreasing up to 5th forecast periods and then remains constant to 97% towards the 10th periods. In case of 4th period variances in GDP is 98 % due to its own impact. Hence the variations have not much impact on its own shocks to GDP. We observe that variation in GDP is explained by EDE is less by 1.9% in the 4th period and other consecutive periods have very significant increasing effect on GDP due to EDE. In case of variations in EDE is explained by GDP increases up to 10th periods. In 5th period it has variations about 12.79 % and remaining periods is at 13%. EDE has decreasing variations on its own.

Fig 1 illustrates impulse response function of the variables in the study. The first row of the figure shows responses of EDE to one standard deviation shocks of its own and GDP. EDE responds decreasingly to its own shocks up to 3rd periods and then it remains constant through the rest of the forecast horizon. EDE has positive respond to any shock emanating from GDP. The response of GDP to due to shocks in EDE is to increase initially during 7 year and thereafter it remains constant for all forecast period. The second row of the figure presents responses of economic growth due one unit standard deviation shocks in educational expenditure. The response is negative after second forecast periods and remains negative for all the periods where as there is positive response GDP due to of its own shocks.

6. Policy Implication and Conclusion

The study primarily investigates the dynamics of educational expenditure and economic growth in India from 1951 to 2012. The results of the econometric analysis confirm that there is a long run equilibrium relationship between expenditure on education and economic growth. We also find that there exists unidirectional granger causality from education to economic growth. Variations in GDP are much due to total expenditure on education and training. Shocks due to expenditure on its own is positive throughout the tenth period and one unit standard deviation shock have positive impact on economic growth up to 10^{th} periods while no significant impact is witnessed economic growth to expenditure on education. The study comes up with a policy implication that the government has to focus more on expenditure in education and training programme like vocational education in order to create better human capital which can have the significant contribution to economic growth. Our study is consistent with other studies (Shindo, 2010; Burza and Burza, 2013, Gustaffson and Shi, 2004; Jalil and Idrees, 2013; Chen and Feng, 1999; Hanushek and Weissman, 2008; Afzal et al., 2010).



References

Barro, R.J., 1996. Determinants of economic growth: a cross-country empirical study (No. w5698). *National Bureau of Economic Research.*

Burja, C. and Burja, V., 2013. Education's Contribution to Sustainable Economic Growth in Romania. *Procedia-Social and Behavioral Sciences*. 81. pp. 147-151.

Chen, B. and Feng, Y., 2000. Determinants of economic growth in China: Private enterprise, education, and openness. *China Economic Review.* 11(1). pp. 1-15.

Dickey, D.A. and Fuller, W.A., 1979. Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association.* 74 (366). pp. 427-431.

Dickey, D.A. and Fuller, A.W., 1981. Likelihood ratio test autoregressive time series with a unit root. *Econometrica.* 49 (4). pp. 1057-1072.
Dietzenbacher, E., 2007. An empirical examination of the pollution haven hypothesis for India: towards a green Leontief paradox? *Environmental and Resource Economics.* 36(4). pp. 427-449.
Enders, W., 2004. Applied econometric time series. Second ed. John Wiley and Sons. Inc. Daryaganj, New Delhi.
Engle, R.F., Granger, C.W.J., 1987. Cointegration and error correction: representation, estimation, and testing. *Econometrica.* 55 (2). pp. 251-276.
Glewwe, P., Maïga, E. and Zheng, H., 2014. The Contribution of Education to Economic Growth: A Review of the Evidence, with Special Attention and an Application to Sub-Saharan Africa. *World Development.* 59. pp. 379-393.
Gradstein, M. and Justman, M., 2002. Education, social cohesion, and economic growth. *American Economic Review*. pp. 1192-1204.
Griliches, Z., 1996. Education, human capital, and growth: a personal perspective. *National Bureau of Economic Research.* No. 5426.
Gruber, L. and Kosack, S., 2014. The Tertiary Tilt: Education and Inequality in the Developing World. *World Development.* 54. pp. 253-272.
Gustafsson, B. and Li, S., 2004. Expenditures on education and health care and poverty in rural China. *China Economic Review*. 15(3). pp. 292-301.
Johansen, S., Juselius, K., 1990. Maximum likelihood estimation and inferences on cointegration with applications to the demand for money. *Oxford Bulletin of Economics and Statistics.* 52 (2). pp. 169-210.
Johansen, S., 1991. Estimation hypothesis testing of cointegration vectors in Gaussian vector autoregressive models. *Econometrica.* 59 (6). pp. 1551-1580.
Knowles, S., Lorgelly, P.K. and Owen, P.D., 2002. Are educational gender gaps a brake on economic development? Some cross-country empirical evidence. *Oxford economic papers.* 54(1). pp. 118-149.
Lindahl, M. and Krueger, A.B., 2001. Education for Growth: Why and for Whom?. *Journal of Economic Literature.* 39(4). pp. 1101-1136.
Lutz, W., Cuaresma, J.C. and Sanderson, W., 2008. The demography of educational attainment and economic growth. *Science.* 319(5866). pp. 1047-1048.
McMahon, W.W., 1998. Education and growth in East Asia. *Economics of Education Review.* 17(2). pp. 159-172.
Mercan, M. and Sezer, S., 2014. The Effect of Education Expenditure on Economic Growth: The Case of Turkey. *Procedia-Social and Behavioral Sciences.* 109. pp. 925-930.
Nunes, A.B., 2003. Government expenditure on education, economic growth and long waves: the case of Portugal. *Paedagogica historica*. 39. pp. 559-581.
Papageorgiou, C. and Pérez-Sebastián, F., 2005. Matching up the data on education with economic growth models. *Topics in Macroeconomics*. 5(1).
Popescu, M. and Crenicean, L.C., 2012. Innovation and Change in Education-Economic Growth Goal in Romania in the Context of Knowledge-Based Economy. *Procedia-Social and Behavioral Sciences*. 46. pp. 3982-3988.
Shindo, Y., 2010. The effect of education subsidies on regional economic growth and disparities in China. *Economic Modelling.* 27(5). pp. 1061-1068.
Zhang, J., 1996. Optimal public investments in education and endogenous growth. *The Scandinavian Journal of Economics.* pp. 387-404.