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Impact of educational expenditure on economic growth in major Asian countries: Evidence from econometric analysis

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Abstract. *The study investigates dynamics of expenditure on education and economic growth in selected 14 major Asian countries by using balanced panel data from 1973 to 2012. The results of Pedroni cointegration state the existence of long-run equilibrium relationships between expenditure on education and economic growth in all the countries. The FMOLS results revealed a positive and statistical significant impact of education expenditure on economic development of all the 14 Asian countries (Bangladesh, China, Hong Kong, India, Japan, Nepal, Pakistan, Malaysia, The Philippines, Saudi Arabia, Singapore, Sri Lanka, Thailand, and Turkey). Further, the panel vector error correction (PVECM) presents unidirectional Granger causality running from economic growth to expenditure on education both in the short- as well as in the long-run. But, expenditure on education only Granger causes economic growth in long-run in all the countries. As a group, the FMOLS shows a positive impact of educational expenditure on economic growth. The study argues that education sector is one of the important ingredients of economic growth in all 14 Major Asian countries. Education sector should be given priority, and a handsome share of total expenditure of the governments should be made on education sector by enhancing various elementary, higher and technical educations in the respective nations to have the skilled man power for the long-term economic development.*

Keywords: Expenditure on education, economic growth, FMOLS, panel VECM, causality.

JEL Classification: H52, O4, C33.

1. Introduction

Endogenous growth model by Lucas (1988) is one of the seminal works to understand the economic growth among different countries around the world. In his paper, he has put much emphasis on human capital as one of the major factors for economic growth. It is then very crucial to understand the human capital accumulation process and its impact on economic growth in the countries. For various countries, investment in education has been the primary and foremost objective to create better human resources which can bring economic development of the nation by providing skilled labour force. On this backdrop, some studies (Glomm and Ravikumar, 1992, 1998; Kaganovich and Zilcha, 1999; Blankenau, 2005; Blankenau and Simpson, 2004) argue that there is a direct effect of investments in education on economic growth. On other hands, some studies (Zhang, 1996; Milesi-Ferretti and Roubini, 1998; Hendricks, 1999; Brauninger and Vidal, 1999; Bouzahzah et al., 2002) argue contradictory results of the impacts of investment in education on economic growth. Cullison (1993) and Barro and Salai-Martin (1995) found a positive relationship between government investment in education and economic growth, but Levin and Renelt (1992) found that the government spending is not necessarily correlated with economic growth. Solow (1956) revealed that capital, labour, and technology can not only be the ingredients of economic growth. Education is also one of the prime factors to push economic growth as well. The impact of education on economic growth was emphasized by one of the pioneer economists, Denison (1967). He investigated that there was a tremendous importance of education on economic growth of a nation. Lucas (1967) elucidated an endogenous growth model which further explained human capital as one of the prime factors of economic growth. Human capital accumulation is possible through the expansion of education (Lucas, 1967). It has a positive impact on labour productivity. Labour having more educational qualification can be engaged in skilled works which envisage the economic growth and nation building. Barro (1991) demonstrated that economic growth and education are positively related. The relationship between human capital and economic development approach has been extensively examined (Romar, 1990; Rebelo, 1991; Grossman and Helpman, 1991; Barro, 1991) and it demonstrates that economic growth and education are positively related to each other.

There is a plethora of empirical research carried out in developed nations in relations to examining the impact of education expenditure on economic growth. But, in the case of Asian countries, there is a very limited study that has been carried out so far. Asian countries are now the emerging economies of the world and have a substantial impact on world economy also. Due to the growing economic activities of these nations, the development of education sector and its contribution to the economies are positively expected. In this context, this study aims at examining the causal relationship between expenditure on education and economic growth in selected 14 major countries and investigate whether expenditure on education by the respective economies have a substantial effect on their economic development.

The rest of this study is organized in the following sections. Section 2 provides the literature reviews on expenditure on education and its impact on economic growth.

Section 3 discusses theoretical aspect of education and economic growth. Section 4 deals with variable description and data sources. Section 5 presents the econometric techniques results and explanations of the study. Finally, Section 6 deals with conclusion and policy implications.

2. Empirical Literatures

Mankiw et al. (1992), by considering an extended Solow growth model, found a positive relationship between education and economic growth. Barro and Lee (1993) investigated that there is a positive relation between education and economic growth by taking 129 countries as their sample. In contrast to such above positive relationship, some empirical studies explain that education and economic growth are not significantly related. Benhabib and Spigel (1994) found the expansion of human capital not significantly associated the economic growth rate. Bils and Klenow (2000) viewed that it might be a positive correlation between education and economic growth, but the relationship between education and economic growth does not necessary explain the educational influence on the economic growth. As far as their views, both education and economic growth can be affected by the total factor productivity. Pritchett (2001) studied that schooling plays a minor role in the case of economic growth. But on other hand, Gylfason and Zoega (2003) counteract by using endogenous growth model for 87 countries. They found that gross secondary school enrolment, public expenditure on education and high expected schooling of girls varies directly with economic growth. Podrecca and Carmeci (2002) investigated feedback relationship between education and economic growth by using Granger causality for 86 counties over the period 1960-1990. They found that both education investment and educational institutions had a significant impact on economic growth. A study by Jaoul (2004) analysed causality between education and economic growth in France and Germany at the time of Second World War. He experienced that education had an impact on Gross Domestic product in France whereas education did not have any crucial effect on economic growth in Germany. Kui Liu (2006) investigated the causality and cointegration between education and domestic product in China, and the result shows that economic growth is the cause of higher education in China. Islam et al. (2007) analysed the relationship between education and economic growth in Bangladesh, using the multivariate causality during 1976 and 2003. It shows the existence of bidirectional causality between education and growth rate in Bangladesh. Huang et al. (2009) analysed causality between economic growth and higher education in China from 1972 to 2007. The result shows that there is a long-term relationship between higher education and GDP of the nation. Pradhan (2009) studied the relationship between higher education and economic growth by using error correction model in India from 1951 to 2002. He found unidirectional causality between education and economic growth. Chaudhary et al. (2009) analysed the role of higher education in economic growth by using Johansson Cointegration and Toda-Yamato causality approach in VAR analysis for Pakistan from 1972 to 2005. They found only unidirectional causality running from economic growth to higher education. Using Lucas's (1988) endogenous growth model, Gutema and Mekonnen (2004) analysed that the role of education had a significant and positive impact on economic growth in Sub-Saharan Africa. Another study by Loening (2004) found the effect of education on economic growth in Guatemala during 1951-2002. By using an error correction model, they found that better-educated labour has a positive and significant role in economic growth. A study made by Katircioglu. S (2009) in North Cyprus found the evidence of unidirectional causality that runs from higher education to economic growth.

3. Theoretical Modelling of education and its impact on economic growth

In this section, we have analysed the theoretical aspect of education expenditure and its impact on economic growth. The impact of expenditure on economic growth can be discussed by considering the classical theory of production function. Now we can discuss the following production function where output is a function of labour and capital.

$$O = F\ (L, K) \quad (1)$$

Where L is the amount of labour and K is the amount of capital that needed to produce 'O' level of output in the economy. For the impact of education on economic growth, we can include the government expenditure on education as an indispensable variable in the production function.

The study has used the following endogenous growth production function as:

$$GDP = F\ (EXE) \quad (2)$$

where, GDP represents the total economic growth and EXE refers to government expenditures on education. The expenditure on education presents human capital formation which can make skilled labour force. This skilled labour force in the country can enhance the productivity of physical and human capital and in return it would have positive impact on economic growth.

Now, we can estimate the Eq. 2 to observe the impact of expenditure on education on economic growth in the following econometric model:

$$GDP_t = \alpha_1 + \beta_2\ EXE_t + \varepsilon_t \quad (3)$$

Where:
GDP_t = Gross Domestic Product in time;
EXE_t = Public Expenditure on Education;
ε_t = Error term;

The parameter α_1 is the intercept term; and β_2 is the slope coefficients.

From the Eq. (3), it is expressed that education expenditure of government has a positive impact on economic growth of the respective countries. Both economic growth (GDP) and expenditure on education (EXE) are positively related to each other. We have considered only public expenditure on education (Public sector) because of the non-excludable nature of skills which is being created through education. But, in case of private sector, these sectors are considered as rent and profit maximizing entities whose main interest are concerned with maximum gain by their investment on education.

Generally, public sector always aims to maximize the welfare of the people by capturing positive externalities of expenditure on education.

4. Data Source and Variable Description

Data have been collected on education expenditure and economic growth for 14 selected Asian countries for the period 1973 to 2012. All the data are collected from World Development Indicators (WDI), World Bank. GDP represents economic growth. Education expenditure refers to current operating expenditures on education. The 14 major Asian countries comprise of Bangladesh, China, Hong Kong, India, Japan, Malaysia, Nepal, Pakistan, The Philippines, Saudi Arabia, Singapore, Sri Lanka, Thailand, and Turkey. The reason for selecting these countries is based on the availability of data on both the variables.

5. Model specification and econometric applications

In order to estimate the dynamics of the expenditure on education and economic growth of the respective countries, the following linear panel model has been applied where the expenditure on education is the independent variable, and economic growth is the dependent variable. We can modify the Eq. (3) for the empirical analysis of the impact of education expenditure on economic growth in the selected Asian countries. The Eq. (4) can be written in a panel data framework as follows:

$$\ln GDP_{it} = \alpha_i + \beta_{2i} \ln EXE_{it} + \varepsilon_{it}, \quad (4)$$

for t = 1,…, T; I = 1, …, N. Where T refers to the number of observations over time and N refers to the number of individual countries in the panel. ln GDP is the natural logarithm GDP and lnEXE is the natural logarithm of expenditure on education.

5.1. Panel Unit Root Test

For testing the panel cointegration among variables, the first step is to examine the units root properties of the data, because the variables must be integrated of the same order. In the present study we have used unit root tests by LLC (Levin et al., 2002), and IPS (Im et al., 2003). The null hypothesis of all these panel unit root tests has always been considered non-stationary of the data. Levin et al. (LLC, 2002) test are based on ADF test which assumes homogeneity in the dynamics of the autoregressive coefficients for all panel units with cross-sectional independence. The following equation has been considered by Levin et al. (2002) to test unit root of the data in the study.

$$\Delta X_{it} = \alpha_i + \beta_i X_{i,t-1} + \delta_i t + \sum_{j=1}^{k} \gamma_{ij} \Delta X_{i,t-j} + \vartheta_{it} \quad (5)$$

Where,

Δ is first difference operator, X_{it} is dependent variable, ϑ_{it} is the white-noise disturbance with a variance of $\sigma^2, i = 1,2,\dots,$ N indexes country and $t = 1,2,\dots,$ T indexes time.

Levin et al. (2002) has proposed the hypothesis to test the stationarity of the panel data are given as

$$\begin{cases} H_0 : \beta_i = 0 \\ H_1 : \beta_i \prec 0 \end{cases};$$

where alternative hypothesis corresponds to Y_{it} of being stationary. The test is based on the statistic $t_{\beta_i} = \hat{\beta}_i / \sigma(\hat{\beta}_i)$ (where $\hat{\beta}_i$ is the OLS estimate of β_i in Eq. (5) and $\sigma(\hat{\beta}_i)$ is its standard error). The test also finds that while comparing with the single equation ADF test, the panel approach substantially increases it power in finite samples. Levin et al. (LLC; 2002) also specified another equation (6) which restricts $\hat{\beta}_i$ while keeping it identical across the cross-countries. The equation (6) follows as:

$$\Delta X_{it} = \alpha_i + \beta X_{i,t-1} + \delta_i t + \sum_{j=1}^{k} \gamma_{ij} \Delta X_{i,t-j} + \vartheta_{it} \tag{6}$$

In this equation they assumed

$$\begin{cases} H_0 : \beta_1 = \beta_2 = \cdots = \beta = 0 \\ H_1 : \beta_1 = \beta_2 = \cdots = \beta < 0 \end{cases};$$

Where the statistic of test is $t_\beta = \hat{\beta}/\sigma(\hat{\beta})$, $\hat{\beta}$ is the OLS estimate of β in Eq. (6) and $\sigma(\hat{\beta})$ is its standard error.

Finally, Im et al. (IPS; 2003) is based on the mean group approach where Im et al. (IPS; 2003) has used the average of the t_{β_i} statistics from Eq. (5) in order to perform the following $\overline{Z}$ statistic.

$$\overline{Z} = \sqrt{N}[\bar{t} - E(\bar{t})]/\sqrt{V(\bar{t})}$$

Where $\bar{t}$ = $(1/N)\sum_{i=1}^{N} t_{\beta_i}$, $E(\bar{t})$ and $V(\bar{t})$ are the mean and variance of each t_{β_i} statistic. The $\overline{Z}$ statistic converges to standard normal distribution. So IPS test is based on average individual unit root test and is expressed by $\bar{t}$ = $(1/N)\sum_{i=1}^{N} t_{\beta_i}$.

Table 1. *Panel unit root test result*

Variables	LLC Test		IPS Test	
	C	C&T	C	C&T
lnY	1.13(0.87)	1.73(0.95)	5.21(1.00)	3.82(0.99)
lnexe	1.26(0.10)	1.26(0.10)	1.35(0.91)	2.73(0.00)***
ΔlnY	9.54(0.00)***	9.81(0.00)***	11.12(0.00)***	12.32(0.00)***
Δlnexe	17.49(0.00)***	18.79(0.00)***	16.05(0.00)***	17.38(0.00)***

Notes: Numbers in parentheses are p values. C refers to the specification with intercept; C&T refers to the specification with intercept and trend. ***, ** and * indicate 1%, 5% and 10% level of significance.

The results of Table 1 present both the Levin et al. (LLC, 2002) and Im et al. (IPS, 2003) tests which confirm that all the variables in the study are non-stationary at their level. So, we cannot reject the null hypothesis of non-stationary and hence the series contains a unit root. But, after the first order differentiation, the test statistics show that we can reject the null hypothesis of non-stationarity for all the series at 1% level of significance. In conclusion, all series are stationary on their first order difference i.e. they are I (1) variables. All the variables for the case of 14 major Asian countries are integrated of order one. Since, the variables are integrated of the order of one, the Pedroni's (1999, 2004) cointegration test will be applied to understanding the long run equilibrium relationship among the variables. The Pedroni (1999, 2004) analysis of cointegration has been explained in below.

5.2. Panel Cointegration Tests

Pedroni (1999, 2004) has proposed a heterogeneous panel cointegration test and has been used to estimate the cointegration between educational expenditure and economic growth in their study. This test allows various cross-sectional interdependences along with other different individual effects to establish the cointegration. He defines two kinds of test statistics, where the first one is based on pooling residuals within the dimension of the panel and second is without dimension. For testing long run equilibrium in the panels, Pedroni (1999, 2004) has proposed two types of residual-based tests.

The tests are as follows:

Panel v Statistic:

$$Z_v = \left(\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\ \hat{e}_{it-1}^{2}\right)^{-1} \tag{7}$$

Panel ρ-statistic:

$$Z_\rho = \left(\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\ \hat{e}_{it-1}^{2}\right)^{-1}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\ \left(\hat{e}_{it-1}\Delta\hat{e}_{it}-\hat{\lambda}_i\right) \tag{8}$$

Panel PP-statistic:

$$Z_t = \left(\hat{\sigma}^2\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\ \hat{e}_{it-1}^{2}\right)^{-1/2}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\ \left(\hat{e}_{it-1}\Delta\hat{e}_{it}-\hat{\lambda}_i\right) \tag{9}$$

Panel ADF-statistic:

$$Z_t^* = \left(\hat{s}^{*2}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\ \hat{e}_{it-1}^{*2}\right)^{-1/2}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\quad \hat{e}^{*}{}_{it-1}\Delta\hat{e}_{it}^{*} \tag{10}$$

Group ρ-statistic:

$$\tilde{Z}_\rho = \sum_{i=1}^{N}\left(\sum_{t=1}^{T}\hat{e}_{it-1}^{2}\right)^{-1}\sum_{t=1}^{T}\left(\hat{e}_{it-1}\Delta\hat{e}_{it}-\hat{\lambda}_i\right) \tag{11}$$

Group PP-statistic

$$\tilde{Z}_t = \sum_{i=1}^{N} \left(\hat{\sigma}^2 \sum_{t=1}^{T} \hat{e}_{it-1}^2 \right)^{-1/2} \sum_{t=1}^{T} \left(\hat{e}_{it-1} \Delta \hat{e}_{it} - \hat{\lambda}_i \right) \quad (12)$$

Group ADF-statistic

$$\hat{Z}_t^* = \sum_{i=1}^{N} \left(\sum_{i=1}^{N} \hat{s}_i^2 \, \hat{e}_{it-1}^{*2} \right)^{-1/2} \sum_{t=1}^{T} \left(\hat{e}^*{}_{it-1} \Delta \hat{e}_{it}^* \right) \quad (13)$$

Where $\hat{e}_{it}$ is the estimated residual from Eq. (4) and $\hat{L}_{11i}^2$ is estimated long run covariance matrix for $\Delta \hat{e}_{it}$. Similarly, $\hat{\sigma}_i^2$ and $\hat{s}_i^2$ $(\hat{s}_i^{*2})$ are, respectively, the long run and contemporaneous variances for individual *i.* The entire seven statistics are normally and asymptotically distributed.

Kao (C. C Kao, M.H., 2001) and combined Fisher ADF tests (are also applied for the panel cointegration.

Table 2. *Panel Cointegration Result*

Panel Cointegration Test	Individual Intercept	Individual Intercept and Trend
	Within Dimension	
Panel V-Statistic	1.848894(0.0322)**	-0162991(0.5647)
Panel rho-Statistic	-2.957009(0.0016)***	-2.471185(0.0067)***
Panel pp-Statistic	-3.656811(0.0001)***	-4.575060(0.0000)***
Panel ADF-Statistic	-3.297985(0.0005)***	-4.677787(0.0000)***
	Without Dimension	
Group PP-statistic	-1.253281(0.1051)	-0.394183(0.3467)
Group rho-statistic	-2.771828(0.0028)***	-3.005338(0.0013)***
Group ADF-Statistic	-2.330963(0.0099)***	-2.922686(0.0017)***

Table 3. *Kao Test*

ADF	-6.932253(0.0000)***
Residual Variance	0.004150
HAC Variance	0.004703

Table 4. *Combined Fisher-ADF Test*

No. of CE(s)	Trace Test	Prob.	Max-Eigen Value	Prob.
r=0	73.56	0.0000	58.90	0.0001***
r>1	54.21	0.0004	54.21	0.0004***

Probabilities are computed using asymptotic Chi-square distribution. *** indicates 1% level of significance.

Since all the variables are I (1), Pedroni cointegration test, Kao test, and Fisher-ADF test are employed to investigate the null hypothesis of no cointegrating relationship against the alternative hypothesis of the existence of a cointegrating relationship. The all six statistics indicate that null hypothesis of no cointegrating relationship can be rejected either at 1% level or 5% level of significance for all the countries. Hence, all the six test statistics support a panel cointegration between GDP and expenditure on education at the specified level of significance. Panel V statistics shows cointegration at 5% level of significance. In the case of Kao test, the cointegration is significant at 1% level. The combine Fisher-ADF test demonstrates the existence of cointegrating relationship between GDP and expenditure on education as the trace statistics is greater than the maximum Eigen value, which rejects the null hypothesis of no cointegration. All the statics are statistically significant at 1% level, confirming overwhelming support for panel cointegration. The cointegrating relationship does not speak about the long- and short-run dynamics of the variables. For the sake of knowing long-term elasticities, we have employed the Fully Modified Least Square.

5.3. Fully Modified Least Square

The study proceeds to estimate the Equation (1) by the method of Fully Modified OLS (FMOLS) developed by Pedroni (2001a, 2001b). The FMOLS allows consistent and efficient estimation of cointegrated vector and at the same time it addresses the problem of nonstationary regressors, as well as the issue of simultaneity biases in the heterogeneous cointegrated panels. OLS estimation is not as powerful as FMOLS, and it yields biased results of regressors that are endogenously determined in the I (1) cases. Pedroni (2001a. 2001b) has considered the following equation:

$$W_{i,t} = \alpha_i + \beta_i X_{i,t} + \tau_{i,t} \tag{14}$$

Where $W_{i,t}$ and $X_{i,t}$ are cointegrated with slope β_i, which can or cannot be homogeneous across i. In another equation Pedroni (2001a, 2001b) augmented the cointegrating regression with lead and lagged differences of the regressors to the endogenous feedback effect. Hence Eq. (12) becomes

$$W_{i,t} = \alpha_i + \beta_i X_{i,t} + \sum_{k=-k_i}^{k_i} \gamma_{i,k} \Delta X_{i,t-k} + \tau_{i,t} \tag{15}$$

where $\omega_{i,t} = (\hat{\tau}_{i,t},\ \Delta X_{i,t})$; and $\Omega_{i,t} = \lim_{T\to\infty} E\left[1/T(\sum_{t=1}^{T} \omega_{i,t})(\sum_{t=1}^{T} \omega_{i,t})'\right]$ is the long run covariance for the vector process. Hence the they have decomposed the long run covariance matrix as $\Omega_{i,t} = \Omega_i^0 + \Gamma_i + \Gamma_i'$, where Ω_i^0 is contemporaneous covariance and Γ_i is a weighted sum of autocovariances. Thus, the panel FMOLS estimator will be written by

$$\hat{\beta}^*_{FMOLS} = \frac{1}{N} \sum_{i=1}^{N} \left[\left\{ \sum_{t=1}^{T} (X_{i,t} - \overline{X}_i)^2 \right\}^{-1} \left\{ \sum_{t=1}^{T} (X_{i,t} - \overline{X}_i) W^*_{i,t} - T\hat{\gamma}_i \right\} \right] \tag{16}$$

Where $\mathrm{W}^*_{\mathrm{i,t}} = \mathrm{W}_{\mathrm{i,t}} - \overline{\mathrm{W}}_{\mathrm{i}} - (\hat{\Omega}_{2,1,\mathrm{i}} / \hat{\Omega}_{2,2,\mathrm{i}})\, \Delta \mathrm{X}_{\mathrm{i,t}}$ and $\hat{\gamma}_{\mathrm{i}} = \hat{\Gamma}_{2,1,\mathrm{i}} + \hat{\Omega}^0_{2,1,\mathrm{i}} - (\hat{\Omega}_{2,1,\mathrm{i}} / \hat{\Omega}_{2,2,\mathrm{i}})(\hat{\Gamma}_{2,1,\mathrm{i}} + \hat{\Omega}^0_{2,1,\mathrm{i}})$.

Table 5 shows the long-run elasticities estimated by adopting FMOLS. The study estimates long run elasticities for all the 14 individual countries along with panel group. Table 5 reports the results of individual and panel cointegrated cases for Eq. (1). All the countries have a positive relationship between expenditure on education and economic growth. The individual FMOLS results show a positive impact on economic growth due to expenditure on education. In the case of Bangladesh, one percent increase in educational expenditure has a positive and statistical significance which leads to 0.49 percent change in growth. China also shows positive and significant relationship between education expenditure and economic growth. In the case of China one percent change in overall expenditure on education results in 0.83 percent change in economic growth. Hong Kong, India, Japan show a positive relationship between economic growth and education where one percent increase in expenditure on education improves 0.49%, 0.71% and 0.36% in economic growth respectively in the long run. Malaysia has the highest impact of education expenditure on economic growth. It is evident from the results of FMOLS that 1 % increase in educational expenditure increases economic growth by 1.26%. In the case of Nepal, 1 % changes in education expenditure increase economic growth by 0.45 %. Pakistan also has significant and the positive impact of education on economic growth. As 0.60% changes occur in economic growth due to 1% increase in expenditure of education in the country in long run.

Table 5. *Long-run Elasticity coefficient of FMOLS*
Dependent variable is Economic Growth (ln GDP)

Country	ln EXE	t-Statistics	Prob.
Bangladesh	0.490664***	19.64759	0.0000
China	0.831739***	17.16586	0.0000
Hong Kong	0.499233***	17.60481	0.0000
India	0.717317***	19.93017	0.0000
Japan	0.363083***	15.21955	0.0000
Malaysia	1.263690***	16.69506	0.0000
Nepal	0.459166***	10.24898	0.0000
Pakistan	0.604312***	22.55872	0.0000
The Philippines	0.390422***	11.69433	0.0000
Saudi Arabia	0.323205***	10.01521	0.0000
Singapore	0.633775***	24.13147	0.0000
Sri Lanka	0.654206***	20.59328	0.0000
Thailand	0.559044***	36.57523	0.0000
Turkey	0.403915***	10.71567	0.0000
Panel Group	0.845141***	36.02967	0.0000

The null hypothesis for the *t*-ratio is $H0=\beta i=0$;*, **, and ***denotes10%, 5% and 1% level of significance.

Similarly in the cases of The Philippines, Saudi Arabia, Singapore, Sri Lanka, Thailand, and Turkey, expenditure on education have statistically significant impact on economic growth by 0.39%, 0.32%, 0.63%, 0.65%, 0.55% and 0.40 % respectively. All the countries experience positive influence of education expenditure on economic growth in long-run. The panel group FMOLS also shows statistically significant and positive impact on economic growth due to investment in education in these countries. A one percent increase in education expenditure enhances 0.84 % in stimulating economic growth in the long run. The high level of marginal changes of slope coefficients of educational expenditure can be investigated, further, by incorporating other potential variables which could have a substantial impact on economic growth. This study confirms a positive and statistically significant relationship between economic growth and education for all countries. Expenditure on education makes skilled human resources to engage them in different sectors towards the contribution of economic growth of the nations.

5.4. Panel Granger Causality (VECM)

This study has applied the model of Engle and Granger (1987). The model suggests two-step procedure to examine the short run and long run dynamic relationships between expenditure on education and economic growth. In the first step, the long-term model as specified in Eq. (4) is to be estimated and in the next step, we have to define the lagged residuals obtained as the error correction term (ECT). The estimation of dynamic Vector Error Correction Model (VECM) is as follows:

$$\begin{pmatrix} \Delta\, LNGDP_{i,t} \\ \Delta\, LNEXE_{i,t} \end{pmatrix} = \begin{pmatrix} \emptyset_{i,1} \\ \emptyset_{i,2} \end{pmatrix} + \sum_{I=1}^{m} \begin{pmatrix} \theta_{1,2,k} \\ \theta_{2,1,k} \end{pmatrix} \begin{pmatrix} \Delta\, LNGDP_{i,t} \\ \Delta\, LNEXE_{i,t} \end{pmatrix} + \begin{pmatrix} \lambda_1 \\ \lambda_2 \end{pmatrix} ECT_{i,t-1} \begin{pmatrix} \psi_{1,i,t} \\ \psi_{2,i,t} \end{pmatrix} \quad (17)$$

where the term Δ presents first differences, $\emptyset_{i,j}$ (j, k = 1, 2) present the fixed country effect; I (I=1,….m) is lag length determined by the Schwarz information Criterion (SIC), and ECT_{t-1} is the estimated lagged error correction term (ECT) derived from the long run cointegrating relationship (Eq.1) . The term λ_i is the adjustment coefficient, and $\psi_{1,i,t}$ is the disturbance term, which is assumed to have zero mean.

Table 6. *Panel Granger Causality Test result based on PVECM*

Dependent Variable	Source of causation (Independent variable)		
	Short run		Long run
	ΔLNGDP	ΔLNEXE	ECT
ΔLNGDP	....	7.81729(0.005)	-0.076342[-2.015098]***
ΔLNEXE	0.92888(0.395)	....	-0.286585[-4.943457]***

Lag lengths: 2, P-value listed in parentheses and t-statistic listed in brackets. ***, **& * indicates significance level of 1%, 5% and 10%.

Table 6 shows the dynamics of expenditure on education and economic growth in all the major Asian countries both in the short run and long run. The panel vector error correction supports the long-term Granger causality between expenditure on education and economic growth in all the countries. There is no short-run Granger causality witnessed from educational expenditure to economic growth. It is evident that only in long-run educational expenditure has a significant impact on economic growth. In the short term, expenditure on human resources (expenditure on education in the country) does not Granger cause economic growth. Therefore, the study confirms that in short run expenditure on education does not cause economic growth while in the long term it causes economic growth in the respective countries.

6. Policy Implication and Conclusion

The study has made an attempt to uncover the relationship between expenditure on education and economic growth in 14 major Asian countries. We employ a comprehensive data set of 14 major Asian countries (Bangladesh, China, Hong Kong, India, Japan, Malaysia, Nepal, Pakistan, The Philippines, Saudi Arabia, Singapore, Sri Lanka, Thailand, and Turkey) spanning from 1973 to 2012. With the help of panel cointegration tests, the study finds that there is an existence of a long-run relationship between education expenditure and economic growth in all the selected countries. For short- and long-term Granger causality, we have adopted the panel vector error correction mechanism (P-VECM). We find that all the countries have unidirectional Granger causality running from economic growth to educational expenditure both in the short- and long run. But, expenditure on education only Granger causes economic growth in the long-term in all the countries. We conclude that investment in the education sector in the respective countries is an essential determinants of economic growth in long-term. Hence, the government's spending on education sector is one of the investments which could generate skilled labour force and their productivity and would again result in economic growth by the improvements in output levels of the economy. Thus, it is witnessed that the various heads of expenditure of the governments in different Asian countries as taken in the study can be an indispensable factor for economic growth. The spending on education can create better human capital which can in return accommodate the use of modern technology in the production process by minimizing huge adoption costs. So, the nation's policies have to be prioritized on the improvements of various institutions to have economic development. The countries should make such policies which could boost high-quality education for all, and it would be only successful when the governments upsurge the expenditures on the education sector of their respective nations. But at the same time, the quality of education should be made affordable for all by subsidizing the education. This process could enhance the cost of providing education but would decrease the cost of education attainment; thereby increasing the demand for education and this, in turn, increase the stock of human capital (Idrees and Muhammad, 2013, p. 182). In the case of short run, expenditure on education does not Granger cause economic growth. From the study, it is clear that educational investment in human resources will have a significant impact on economic growth in long-run. The future research can be made to investigate the potential mechanism behind this observation by incorporating other relevant variables in an augmented production function.

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