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Does Public Education Expenditure Cause Economic Growth? Comparison of Developed and Developing Countries

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Abstract

The purpose of this paper is to examine the long-run relationship between public education expenditures and economic growth. The social benefits of education exceed its private benefits. Therefore, education is considered a merit good; if not supplied by the public sector, private production is undersupplied. The study has employed heterogeneous panel data analysis. Panel unit root tests are applied for checking stationarity. The single-equation approach of panel cointegration (Kao, 1999); Pedroni's Residual-Based Panel Cointegration Test (1997; 1999) is applied to determine the existence of long-run relationship between public education expenditures and gross domestic production. Lastly, panel fully modified ordinary least square results indicate that the impact of public education expenditures on economic growth is greater in the case of developing countries as compare to the developed countries, which verified the "catching-up effect" in developing countries.

Keywords: Economic growth, education expenditure, fully modified ordinary least square, human capital.

1. Introduction

Economic backwardness is highly linked with low labor productivity and slow growth in knowledge. The developed nations are far ahead of the developing nations due to their high levels of education. Education is a merit good and is considered as a driver of individual and the society's well being. Education not only facilitates the adoption of new technology but also helps to develop innovative capacity which results into economic growth. But there are great variations across countries in education investment and the education outcomes. In terms of the education spending as percentage of GDP, the developing countries lag far behind the developed ones. Education expenditures are very crucial for human capital formation and hence economic growth. It not only raises the demand for education by lowering the costs of education attainment but also plays an

important role in raising its quality. Thus, human capital formation is an important determinant of growth.

Generally, education provides skills to the individuals; to bring them out of poverty and also helps a country to prosper. It also improves the health status of a country by making people aware of the diseases and helping them use health services in the most effective manner. Education contributes to the national income by increasing the earnings of the individuals. In many poor countries, the wages increase by 10 percent with each additional year of schooling. Education not only raises the personal income but also increases the national income of a country.

Greater investment in education leads to human capital formation, which raises the productivity of labor. Increased productivity minimizes the wastage of resources and increases the output levels. Some part of the output is consumed while the other is saved which is then reinvested in the education sector due to increased demand for the high skilled labor. In addition to human capital formation, education generates many positive externalities to the society. These are the social benefits, through knowledge creation, that adds to the well being of the whole society. Higher level of skills and education attainment increases the productivity of an individual and the chances of getting a high paid job. However, besides the increase in private returns, the social benefits are also accrued which are far greater than the private returns to an individual. There is absence of diminishing social returns to human capital investment because education generates positive externalities in the society. The creation of new knowledge leads to technological advancement, more efficient workers, and reduced cost of production by minimizing wastage of resources; easy adoption of new technologies; and creating a healthy interaction among the workers thereby raising the productivity of other workers. As a result of these positive externalities, the social benefits of education exceed the private benefits of education.

The positive externalities to education lead to the under-production of human capital than the amount that is socially desirable. So this market failure necessitates some sort of government intervention to bring the private and social benefits in line with each other to produce an optimal level of a social good. Thus, market failure in an economy provides a rational for government intervention and government takes the role of paternalism and compels the society to consume a good that it views to be in the best interest of the individuals and the society. This is the reason why education is called a merit good. To get to the socially optimum level of education, the private costs of education needs to be lowered and this can be done through increased government expenditures on education. The increased level of public expenditure on education gives incentive to its citizens to attain high level of education through subsidizing the cost of education. It also plays an important role in raising the education quality if the resources are allocated efficiently.

2. Literature Review

Education is a merit good. It not only facilitates the adoption of new technology but also helps to develop innovative capacity. According to Griliches (1970), one third of the Solow residual can be attributed to the educational levels of the labor force. Wozniak (1987) analyses the role of education, experience and information acquisition on the decision of technology adoption. According to the study, the differences in how quickly a country adapts to changing technology can be explained by differences in human capital

and knowledge about new technology. The study concludes that human capital and knowledge increases the probability of profitable innovation, thereby raising the chances of early adoption of technology but old knowledge has to be continuously replaced with the new one. However, this study gives way to further analysis in net returns to education from early adoption of new technology which has been ignored in the study. Lucas (1990) evaluated the contribution of human capital in economic growth by presenting an additional role of human capital as a driving force to attract other factors of production. The study suggested that developing countries need to invest in higher education; to produce technicians, professionals and administrative workers. Lucas (1990) gives more importance to tertiary education but it failed to show the impact of primary and secondary education which is a prerequisite for tertiary education. So the initial levels of education cannot be ignored. Murphy *et al.* (1991) further takes on this work by dividing the tertiary education into engineering and law students to study its impact on economic growth. However, basic education could not be ignored which is a prerequisite for higher level of education. Krueger and Lindahl (2001) examined the role of education in economic growth by first analyzing the micro economic framework and then extending it to the macro level. The study uses the techniques of ordinary least square and instrumental variable to study the impact of schooling on economic growth through cross country regression analysis. The study differs from others (Lucas, 1990; Murphy *et al.*, 1991; Kumar, 2003; Izushi and Higgins, 2004; Zeira, 2009) as it attempts to reconcile the micro and macro literature on education. Technological progress can be a byproduct of education which leads to economic growth. Yamauchi and Godo (2001) studied the bidirectional relationship between education and economic growth; by focusing on the complementarities between education and technologies. The study uses causality analysis on time series data of Japanese economy to examine the role of education on economic growth. Relationship between education and economic growth is very complex and education does not automatically find its way into its productive use. Rogers (2002) examined the cross country variations in the impact of schooling on economic growth. The data on corruption, black market premium and brain drain to US is used as proxies for economy's productive use of schooling according to which the developing countries are divided into sub-samples. Similarly Musila and Belassi (2004) also give importance to institutional framework for productive use of schooling. However, the study by Rogers (2000) differs from others as it highlights the issues through which the resources on education might end up unproductively. Enrollment in higher education is a key determinant of economic growth. Aghion *et al.* (2006) examines the relationship between technological change and educational policies by using data of OECD countries and 50 US States. The study concluded that tertiary education is the main cause of economic divergence. But, it is not only the years of schooling that matters but quality of education is equally important for economic growth. Advance level of education gives rise to more researchers who not only innovate but also facilitate technology adoption. Azomahou *et al.* (2009) makes use of generalized additive models and shows that countries which are near the technology frontier have to invest in higher education while those far away from the frontier can enhance their technology level by investing in primary and secondary schooling. The study differs from others as it shows the need of complementarities between education and R & D expenditures that is essential for economic growth. The study takes enrollment ratio to measure education which may not be a very good indicator as it fails to capture the dropout rates or passing ratio.

3. The Model

The classical production function represents output growth as a function of capital and labor:

$$Y = f(K, L) \quad (1)$$

Where Y= Total Output, K= Capital, L= Labor

To incorporate the effects of education, the factor productivity is generated from within the economy through increased public expenditures on education. The study has used the following endogenous growth production function:

$$Y = f(EDU) \quad (2)$$

Where Y represents the total output and EDU refers to public expenditures on education and indicates human capital formation i.e. the skilled labour force. It will enhance the productivity of physical and human capital which results in economic growth. Based on equation (2), the study estimates the following econometric model:

$$GDP_{it} = \beta_0 + \beta_1 EDUit + \mu_{it} \quad (3)$$

Where

GDP_{it} = Gross Domestic Product
EDU_{it} = Total Public Expenditure in Education Sector
μ_{it} = Error term

The variables have i and t subscripts for i = 1, 2, … , N cross sections and t = 1, 2, … , t time periods. The parameter β_0 is the intercept term; and β_1 is the slope coefficients with the expected positive signs i.e.

$$\beta_1 > 0$$

This indicates that GDP of a country is positively related to education undertaken by the public sector. The study has emphasized on public sector because of the non-excludable nature of knowledge which is created through education. Private sector is rent seeking and profit maximizing agency and tries to restrict its domain to reap maximum returns on its investment. Whereas, public sector works for the welfare of the masses and tries to capture the positive externalities.

4. Methodology

The study used panel data consisting of 14 cross sections and each cross section covers a time period of 17 years from 1990 to 2006. The cross sections include seven developed countries which include the G-7 (UK, US, Canada, Germany, France, Italy and Japan) and seven developing countries which include Pakistan, India, China, Turkey, Poland, Russia and South Africa. The unit of measurement for all the variables is US dollars in billions. The data is collected from secondary sources that include various publications by International Agencies.

The cointegration tests are applied to determine the existence of long-run relationship among the variables. The Engle-Granger (1987) method is a single-equation approach and it only determines the presence of long run relationship (the causality). Another property of cointegration is that the variables should be integrated of the same order. For this purpose the panel unit root test are applied on the series under consideration to check the order of integration. The panel unit root tests differ from the standard (DF and ADF

approach) time series unit root tests as i) The panel data allows for different degree of heterogeneity between the cross sections; ii) In panel data unit root analysis, one cannot be sure of the validity of rejecting a unit root. The formulation of null hypothesis differs under different panel unit root testl; iii) The power of panel unit root test increases with the increase in panel series; iv) The additional component of cross-sections in panel data provides better information as compared to the standard ADF in time series. The study has employed LL (1992; 2002) and IPS (1997) panel unit root tests. The causality between public education expenditures and economic growth is verified through Kao (1999) and Pedroni's Residual-Based Panel Cointegration Test (1997; 1999).

After employing the panel unit root and panel cointegration tests, the panel group Fully Modified Ordinary Least Square (FMOLS) regression is applied to Equation (3), to obtain asymptotically efficient consistent estimates in the panel series. FMOLS (Pedroni, 2000) is used to tackle the problem of non-exogeneity and serial correlation problems in the heterogeneous cointegrated panels with the time trends. In addition, it allows consistent and efficient estimation of the cointegration vectors, addresses the problem of non-stationary regressors and solves the issue of simultaneity biases as the OLS estimation yields biased results because the regressors are endogenously determined in the $I(1)$ case and resulting into nuisance parameters.

5. Empirical Results

Since most of the series of economic variables are non-stationary. The first step is to determine the order of integration among the panel series. For series to be cointegrated they have to be of the same integrated order. Table 1 summarizes the unit roots tests for the panel series and shows that the panel is non-stationary at level i.e. the acceptance of the null hypothesis of unit root.

Table 1: Panel Unit Root Tests on Panel Series at levels (With Individual Trend and Intercept)

Variable Name	Test Name	Null Hypothesis	Calculated Statistic	Prob.
GDP	Levin and Lin (LL) test	Unit Root	t-statistic (0.01)	0.5
	Im, Pesaran and Shin (IPS) test	Unit Root	IPS-statistic (0.87)	0.8
EDU	Levin and Lin (LL) test	Unit Root	t-statistic (-0.38)	0.35
	Im, Pesaran and Shin (IPS) test	Unit Root	IPS-statistic (1.3)	0.90

To test the order of integration, the panel unit root tests are then applied at first difference. The results showed that the panel series are stationary at first difference, as the test-statistics have greater negative values as compare to the critical value. So it can

be concluded that the panel series are I(1) i.e. all the series can be made stationary by taking the first difference. The results are provided in Table 2.

Table 2: Panel Unit Root Tests on Panel Series at First Difference (With Individual Trend and Intercept)

Variable Name	Test Name	Null Hypothesis	Calculated Statistic	Prob.
GDP	Levin and Lin (LL) test	Unit Root	t-statistic (-4.54)*	0.000 **
	Im, Pesaran and Shin (IPS) test	Unit Root	IPS-statistic (-3.25)*	0.0006 **
EDU	Levin and Lin (LL) test	Unit Root	t-statistic (-7.06)*	0.00 **
	Im, Pesaran and Shin (IPS) test	Unit Root	IPS-statistic (-4.96)*	0.00 **

The Schwartz criterion is used for automatic selection of lags. * and ** indicates the rejection of null hypotheses at 0.01 level of significance.

Since the panel series are integrated of the same order, the cointegration tests can be applied. Table 3 provides results for the Kao (1999) panel cointegration test. The calculated value of t-statistic is greater than the critical value that indicates the rejection of null hypothesis of no cointegration. Thus, it can be concluded that the long-run relationship exists between public education expenditure and economic growth.

Table 3: Kao's Residual Panel Cointegration Test (ADF)

Null Hypothesis	t-Statistic	Prob.
No Cointegration	-5.637*	0.0000

* indicates the rejection of null hypothesis at 0.01 level of significance

Table 4 shows Pedroni's Residual-Based Panel Cointegration Test (1997; 1999).

Table 4: Pedroni's Residual-Based Panel Cointegration Test

Panel Cointegration Statistics (Within-Dimension)	
Test Statistics	Statistical Values
Panel v-statistic	4.217* (0.0000)
Panel ρ-statistic	-1.372 (0.085)
Panel PP-statistic	-1.196 (0.115)
Panel ADF-statistic	-3.506* (0.0002)
Group Mean Panel Cointegration Statistics (Between-Dimension)	
Test Statistics	Statistical Values
Group ρ –statistic	0.950 (0.8908)
Group PP-statistic	-1.748** (0.0402)
Group ADF-statistic	-2.929* (0.0017)

The values in parentheses ( ) give the probabilities values, the SIC is used for the automatic lag selection, H_0 = no cointegration; * and ** indicate the rejection of null hypothesis at 0.01 and 0.05 significance level.

Out of the total seven statistics, four statistics that include Panel v-statistics, Panel ADF-statistic, Group PP and Group ADF statistics have probability values closer to zero which indicate the rejection of null hypothesis of no cointegration. The value of Panel v-statistic is 4.217, which is greater than the critical value of 1.64 and this indicates the rejection of null hypothesis of no cointegration. Similarly, the calculated values of Panel ADF-statistic, Group ADF and Group PP-statistics have greater negative values as compare to the critical value of –1.64. So, it can be suggested that long-run relationship exists between public education expenditure and economic growth. However, the results do not suggest the number of cointegrating vectors.

Since cointegration exists between public education expenditures and economic growth, equation (3) is estimated through Fully Modified Ordinary Least Square (FMOLS) method. The estimates are provided in the Tables 5.

Table 5: Panel FMOLS Results

Dependent Variable: GDP		
Panel Group	Intercept	EDU
		Slope Coefficients
Whole Panel	88.47 (1.02) {0.305}	20.85 (36.09)* {0.0000}
Developed Countries	-47.50 (-0.17) {0.857}	21.85 (17.35)* {0.0000}
Developing Countries	-5.08 (-0.17) {0.86}	27.29 (21.89)* {0.0000}

The parentheses ( ) and { } indicate t-statistics and probability values, respectively. The null hypothesis for the *t*-ratio is $H_0=\beta_i=0$; * indicate the rejection of null hypothesis at 0.01 level of significance.

The results indicate the rejection of null hypothesis at 0.01 level of confidence. Generally, 1 dollar increase in public education expenditures brings 20.85 dollars increase in GDP. Similarly, in the case of developed countries, 1 dollar increase in education expenditures brings an increase of 21.85 dollars in the GDP. On the other hand, in developing countries, 1 dollar increase in public education expenditures increases the GDP value by 27.29 dollars. This shows that the impact of public education expenditures on economic growth is greater in the case of developing countries as compare to the developed countries. This might suggest the presence of "catching-up effect" in developing countries. This also verifies the "inverted-V hypothesis" or the "flying geese theory". Developing countries replicate the production methods and technologies currently employed by the developed nations in the most cost effective way by undertaking research and development activities at the domestic level that best suits their local economic conditions and factor prices.

6. Conclusion and Policy Recommendations

The study examines the impact of public education expenditures on economic growth. The panel unit root tests are applied which shows that the variables are non-stationary at levels and stationary at first difference. The Kao (1999) and Pedroni's Residual-Based Panel Cointegration Test (1997; 1999) suggest the existence of long-run relationship between the variables. Lastly, the education parameters are calculated by applying Fully Modified Ordinary Least Squares (FMOLS) method in order to determine the impact of public education expenditures on economic growth. The study concludes that public financing of education is an important determinant of economic growth. The result of panel FMOLS implies that, in general, 1 dollar increase in education expenditures brings about 20.85 dollars increase in the Gross Domestic Product. Public education expenditures is an investment in labor raising the productivity of labor, which results in economic growth by increasing the output levels. Thus, education is an important ingredient to economic growth.

Another important finding of the study is the empirical evidence of the "catching-up effect" among the developing countries. The FMOLS method is applied separately on the sub-samples in which the country sample is segregated into two panel groups i.e. developed and developing countries. The findings suggest that convergence is taking place in the developing countries. The impact of public education expenditures on economic growth is greater in the developing countries as compared to the developed nations. This is because developing countries have greater marginal productivity in human capital formation even though developed countries invest heavily in human capital are at the advance stages of development with high skilled manpower. The study reveals that, in case of developed countries, 1 dollar increase in public education expenditures brings 21.85 dollars increase in GDP. Whereas, in developing nations, 1 dollar increase in public expenditures in education brings an increase of 27.29 dollars in GDP. Thus, it can be suggested that developing countries are catching-up the developed nations through increased investment in human capital. This verifies the "inverted-V hypothesis" or the "flying geese theory". Developing countries replicate the teaching courses and methodologies currently employed by the developed nations in the most cost effective way.

Thus, investment in education is a key to economic progress. It not only builds up human capital but also help in the implementation of new technologies by lowering its adoption costs. So, a country's policy for economic development has to focus on educational institutions. Countries should strive to achieve high quality education along with ensuring education for all. This could be done through increased public expenditures in the education sector. The quality of education be improved by building up an effective and modern education system that could meet the challenges of modern society and the high demand for innovative products. Education should be made affordable for all i.e. subsidizing education that would increase the government cost of providing education but would lower the cost of education attainment; thereby raising the demand for education and this in turn would increase the stock of human capital.

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