



An Econometric Study on Education and Economic Growth in Bangladesh

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ABSTRACT

Education is a multidimensional process, one side it enhances the economic growth and another side, it reduces the poverty by increasing the productivity. This study examines the extent to which education affects economic growth in Bangladesh and show the impact of education on economic growth. In this study we utilize secondary time series data on GDP growth rate, adult literacy rate, gross enrolment in primary education, gross enrolment in secondary, gross enrolment in tertiary and government educational expenditure for the span of 2001-2015 in case of Bangladesh. The result of the t-test, F-test, the coefficient of correlation and coefficient of determination shows that education is positively and significantly related to the economic growth. For identifying the model specification, this study use multicollinearity test, Park test, Breusch-Godfrey (BG) test for heteroscedasticity, Durbin-Watson and Breusch-Pagan-Godfrey (BPG) test for autocorrelation. This test suggest that our data is free from Heteroscedasticity and autocorrelation but there is multicollinearity problem in this data, for removing this multicollinearity we use dropping variable method.

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1. Introduction

Education is one of the principal sources of increased economic growth, development and enhanced welfare of an individual and a household in the process of economic transformation. Increased labor productivity, effective use of land and other physical assets and improved socio-economic empowerment are three important routes through which education can contribute to economic development. Bangladesh has one of the lowest literacy rates in Asia, estimated at 66.5% for males and 63.1% for females in 2014. Recently the literacy rate of Bangladesh has improved as it stands at 71% as of 2015 due to the modernization of schools and education funds.

The importance of education in economic growth and their inter-relationship are increasing focus of public debate since the era of Plato. Education as an investment secures returns in the form of skilled manpower that gears the needs of development, both for accelerating economic development and for improving the quality of the society.

The main education system is divided into three levels: Primary Level (Class 1–8), Secondary Level (Class 9–12) and Tertiary Level. Investment in education can enhance growth and development by encouraging activities that can help catch up with foreign technological progress. Educational expenditures in Bangladesh have been increasing since the independence in 1971. In the following figure horizontal axis shows the year and vertical axis shows the GDP growth rate and government expenditure on education. From the figure we can see that when the government expenditure on education are increase the GDP growth will also be increased and both are fluctuating over the period.

From 2001 to 2015, there was a downward trend with some fluctuations in government educational expenditure. It picked at 18.15% in 2007 and got the lowest point in 2015 at 14.11%. From 2007 it began decreased very infrequently. Gross Domestic Product growth rate very much oscillated from 2001 to 2015 and it was 5.1%.

For political instability and natural disaster, GDP growth rate has decreased 4.7% in 2003 and then it was increased up to 2007. From 2013, the GDP growth rate began to increase and in 2015 it reaches 6.6%. It is evident that both GDP and educational expenditures have fluctuated over the years. It is worthwhile to mention two things. Most of the earlier studies involved in developed economy, while this study is in a developing economy that has seen a considerable and steady increase in expenditure on education. It is necessary to see whether the results of this study can differ from those obtained for the developing economies. Under these circumstances, education should be looked upon not as a mere item of consumption but as an investment in economic growth.

2. Literature Review

The inter-relation between education and economic growth has been discussed since ancient Greece. Adam Smith (1776) and the classical economists emphasized the importance of investment in human skills. Denison (1967) lays importance on investing in education for the first, which is thought to have an impact on growth and development. Investment in education can enhance growth and development by encouraging activities that can help catch up with foreign technological progress (Berthelemy and Varoudakis, 1996). Benhabib and Spiegel (1994) find that improved level of education positively affected growth in Chinese Taipei. Francis and Iyare (2006) find evidence of bidirectional causality for Jamaica and evidence of causation running from income to education for Barbados and Trinidad and Tobago. Barro (1997) focuses in human capital as a determinant of economic growth.

Although human capital includes education, health, and aspects of “social capital”- the main focus of the study is on education. Gylfason and Zoega (2003) show that education has been one of the key determinants of economic growth around the world since 1965.

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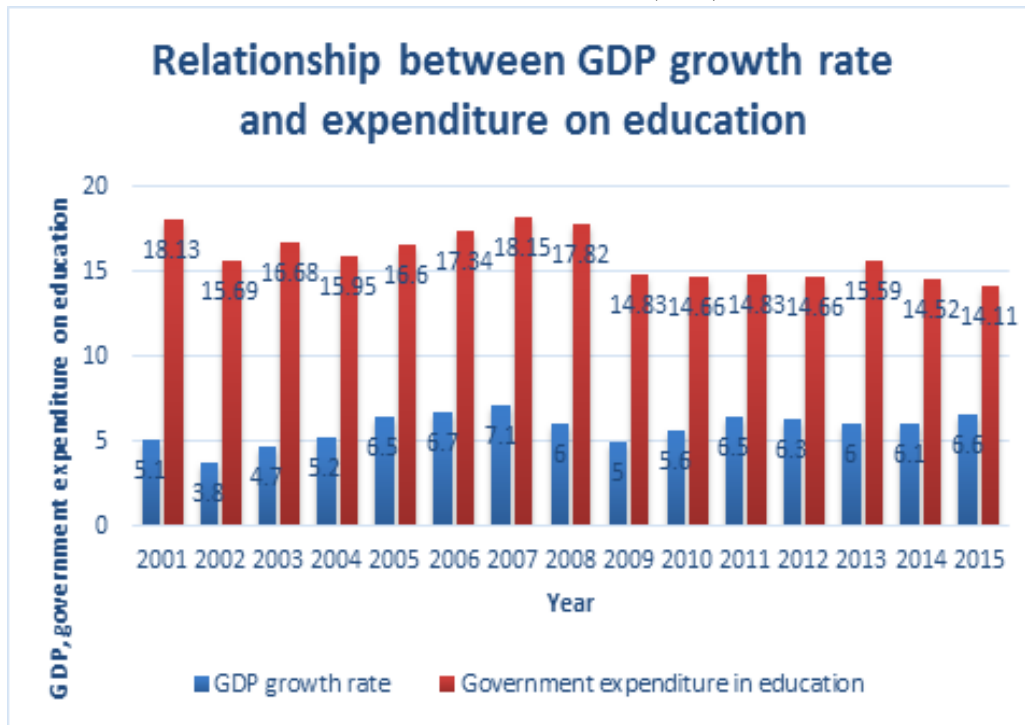


Figure 1. Relationship between GDP growth rate and expenditure on education

Stevens and Weale (2003) provide a survey work on the link between education and economic growth. Teles and Andrade (2004) show the main objective of their paper is to visualize the relationship between government spending on basic education and the human capital accumulation process, observing the impacts of this spending on individual investments in higher education and on economic growth. Loening (2005) investigates the impact of human capital on economic growth in Guatemala during 1951-2002 using an error-correction methodology. The results indicate a better-educated labor force having a positive and significant impact on economic growth. Babatunde (2005) investigated the long run relationship between education and economic growth in Nigeria between 1970 to 2003 through the application of Johansen Cointegration technique and Vector Error Correction Methodology in Nigeria. Khalifa (2008) examines the nature and direction of the relationship between education expenditure as a proxy for human capital and economic growth in the six GCC economies using time series data for the period 1977-2004. Pradhan (2009) specifically investigates the causality between education and economic growth in the Indian economy from 1951 to 2001. The empirical investigation has been carried out by Error Correction Modeling (ECM). The findings confirmed that there is uni-directional causality between education and economic growth in the Indian economy, and the direction of the causality is from economic growth to education but there is an absence of reverse causality. Ahmad (2003) studies on the basis of household data on the returns to education in developing countries generally indicate higher social benefits at primary level compared to secondary and tertiary levels, Islam, Wadud, and Islam (2007) use the multivariate causality analysis to examine the relationship between education and growth in Bangladesh using annual time series data from 1976 to 2003. Paul (2009) states that in a developing nation like Bangladesh, economic growth is instrumental in fighting poverty and ensuring development Azad (2010) examines whether the efficiency of education can any influences on economic growth of a country. Islam and Alam (2010) state

that if one has to show the reasons behind the economic success of the United States America in one word, that word will be “education”.

3. Methodology

This paper exploits annual secondary time series data on different components of education expenditures and GDP for the period 2001 to 2015 in order to assess to show the relationship between education and economic growth. This study is also based on review and analysis of secondary documents and literatures on budget and education. In this study we use two types of variables such as dependent variable and independent variable. Here dependent variable is GDP growth rate and independent variable is education. There are a lot of educational indicators, from which we select five most important indicators of education for our simplicity. They are gross adult literacy rate, gross enrolment in primary education, gross enrolment in secondary education, gross enrolment in tertiary education and government expenditure on education. It is assumed that time series data are stationary. In Hypotheses testing, we use null hypothesis that education and economic growth are positively related. For improving relationship between education and economic growth we use *t*-test, *F*-test, coefficient of correlation and coefficient of determination by OLS regression. For detecting multicollinearity, heteroscedasticity and autocorrelation we use OLS regression, Park test, Breusch-Godfrey test (*BG*), Durbin-Watson test and Breusch-Pagan-Godfrey (*BPG*) test. We use *SPSS* and *Stata* software for this study.

3.1. Data Source and Management

We use annual data for the GDP, adult literacy rate, enrolment education rate collected for the period 2001 to 2015, are sourced from the World Bank world development indicator. Our study covers on the basis of data availability.

3.2. Econometric Model

Model 1: For multiple regression analysis,

$$GDP = \beta_1 + \beta_2 ALR + \beta_3 GEPE + \beta_4 GESE + \beta_5 GETE + \beta_6 GEE + u$$

ALR = Adult Literacy Rate

GEPE = Gross Enrolment ratio in Primary Education

GESE = Gross enrolment ratio in Secondary Education

GETE = Gross enrolment ratio in Tertiary Education

GEE = Government Expenditure on Education

u = Stochastic Error terms

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5,$ and β_6 are parameter of the model.

Model 2:

To test **Heteroscedasticity**, we use the model,

Park test,

$$\ln \hat{u}^2 = \beta_1 + \beta_2 \ln ALR + \beta_3 \ln GEPE + \beta_4 \ln GESE + \beta_5 \ln GETE + \beta_6 \ln GEE + v_i$$

Breusch-Pagon-Godfrey test

Step 1:

$$Y = \beta_1 + \beta_2 ALR + \beta_3 GEPE + \beta_4 GESE + \beta_5 GETE + \beta_6 GEE + u_i$$

$$\text{Step 2: } \hat{\sigma}^2 = \frac{\sum \hat{u}_i^2}{n}$$

$$\text{Step 3: } p_i = \frac{\hat{u}_i^2}{\hat{\sigma}^2}$$

Step 4:

$$p_i = \alpha_1 + \alpha_2 ALR + \alpha_3 GEPE + \alpha_4 GESE + \alpha_5 GETE + \alpha_6 GEE$$

$$\text{Step 5: } \Theta = \frac{1}{2} (ESS)$$

Where,

$\ln \hat{u}^2$ = ln value of squared residual error

$\ln ALR$ = ln value of adult literacy rate

$\ln GEPE$ = ln value of gross enrolment in primary education (both sexes)

$\ln GESE$ = ln value of gross enrolment in Secondary education (both sexes)

$\ln GETE$ = ln value of gross enrolment in tertiary education (both sexes)

$\ln GEE$ = Government educational expenditure

v_i = Stochastic disturbance term

$\Theta = \chi^2$ = chi-square distribution with (m-1) degrees of freedom

ESS = Explained sum of square

$\hat{\sigma}^2$ = Maximum likelihood (ML) estimator of σ^2 (error variance)

Model 3:

The models are practiced to test the **Autocorrelation**:

Durbin-Watson Test

$$d = \frac{\sum_{t=2}^{t=n} (\hat{u}_t - \hat{u}_{t-1})^2}{\sum_{t=1}^{t=n} \hat{u}_t^2}$$

Breusch-Godfrey (BG) Test

$$\hat{u}_t = \alpha_1 + \alpha_2 ALR + \alpha_3 GEPE + \alpha_4 GESE + \alpha_5 GETE + \alpha_6 GEE + \hat{\rho}_1 \hat{u}_{t-1} + \varepsilon_t$$

Where,

d = Durbin-Watson d statistic

\hat{u}_t = residual error term in t time

\hat{u}_{t-1} = residual error term in $t-1$ time

$\hat{\rho}_1$ = coefficient of autocorrelation

ε_t = white noise error term

4. Empirical Results and Discussion

First we want to show an econometric relationship between GDP growth rate and the indicators of education such as adult literacy rate, gross enrolment ratio in primary education and government expenditure on education:

4.1. Relationship between education and economic growth

The econometric approach of this paper is based on OLS regression analysis by the **SPSS** and **Stata**. The chosen methodology is justified by the nature of analysis performed in this study.

Here, the value of **R** (Multiple correlation) is 0.897 (closer to 1) which suggest that there is a strong and linear relationship between the dependent and independent variable. The value of **R²** (i.e. the coefficient of determination) in the model represent that 80% of the variation in the dependent variable (**GDP**) is due to an independent variable included in the model which validates the model.

The result shows that, a positive impact of adult literacy rate (**ALR**) on the economic growth ($\beta_2=0.155$, sig=.044). 1 unit increase in adult literacy rate will lead to 0.155 times increase in **GDP**. The result also shows that, a positive impact of gross enrolment in primary education (**GEPE**) on the economic growth ($\beta_3=0.099$, sig=.051). Here a significant negative impact of gross enrollment ratio in secondary education (**GESE**) on the economic growth ($\beta_4=-0.104$, sig=.078). 1 unit increase in gross enrolment in secondary education will lead to 0.104 times decrease in **GDP**. Here an insignificant negative impact of gross enrollment ratio in tertiary education (**GETE**) on the economic growth ($\beta_5=-0.147$, sig=.273). 1 unit increase in gross enrolment ratio in tertiary education will lead to 0.147 times decrease in **GDP**. Here a very significant impact in Government expenditure on education on the economic growth ($\beta_6=0.368$, sig=2.502). 1 unit increase in government expenditure on education will lead to 0.368 times increase in **GDP**. **F**-test value (7.379, sig=0.005) is significant which suggest that the null hypothesis is rejected. So there is a positive relationship between education and economic growth.

The horizontal axis measures the year and vertical axis measures the adult literacy rate, gross enrolment in primary education, secondary education, tertiary education and government expenditure on education. From the following figure we can see that as the adult literacy rate, gross enrolment in primary education, gross enrolment in secondary, gross enrolment in tertiary and government expenditure on education increases the GDP growth rate will also be increased. It can be clear that over the period from 2001-2015 all the indicators are fluctuating.

4.2. Detection of multicollinearity

For detecting multicollinearity we use the detection way of multicollinearity compare to the following table:

Table 1. Ordinary Least Squares (OLS), taking GDP as Dependent variable (2001-2015).

Variables	Coefficient	Std. error	t ratio	Significance	R value	R ² value	F statistics	Sig.
C	-12.384	4.262	-2.905	.017	.897	.804	7.379(5,9)	0.005
ALR	0.155	.066	2.339	.044				
GEPE	0.099	.044	2.254	.051				
GESE	-.104	.053	-1.992	.078				
GETE	-.147	.126	-1.167	.273				
GEE	.368	.147	2.502	.034				

(The test is conducted by using Stata/SE 12.0)

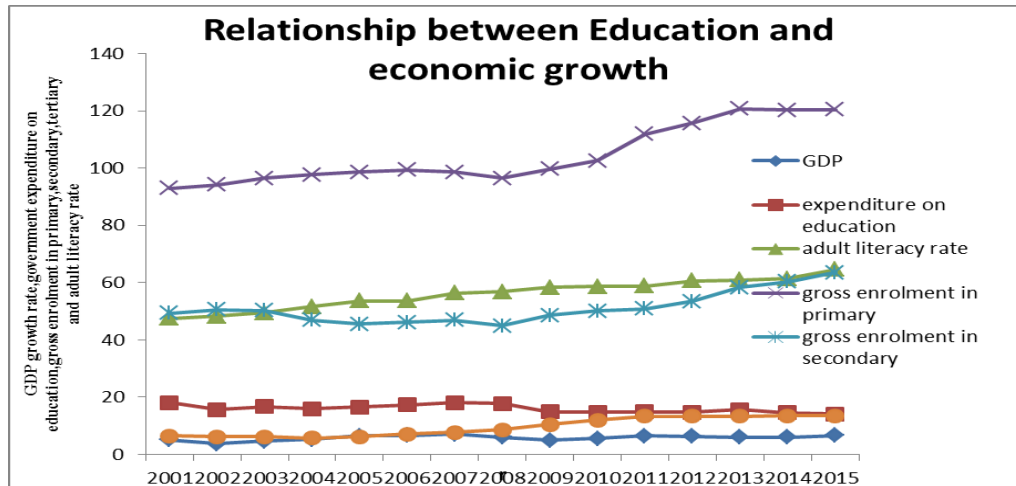


Figure 2. Relationship between education and economic growth

Table 2. Multicollinearity test.

Model	Unstandardized Coefficients		t	Sig.	Collinearity Statistics		Eigen value	Condition index
	B	Std. Error			Tolerance	VIF		
Constant	-12.384	4.262	-2.905	.017			5.908	1.000
ALR	.155	.066	2.339	.044	.148	6.764	.083	8.417
GESE	-.104	.052	-1.992	.078	.204	4.894	.006	32.312
GEE	.368	.147	2.502	.034	.414	2.418	.002	61.074
GETE	-.147	.126	-1.167	.273	.103	9.686	.001	93.156
GEPE	.099	.044	2.254	.051	.086	11.581	.001	104.431

(The test is conducted by using Stata/SE 12.0)

Here, *t*-test value of *GETE* variable is insignificant but other variable's *t*-test value is significant, *F*-test is significant and *R*² value is high. So there exist multi collinearity problem although it suggest that there is a positive relationship between education and economic growth. The result of tolerance suggests that there is collinearity problem, because the value is not closer to 1. The value of *VIF* of *GEPE* variable is exceed 10 but all other variables are not exceed 10 (*VIF*>10) indicate high multi collinearity). So we say there exist multi collinearity. The condition index suggests that there is high multi collinearity in this data as it exceeds 30.

4.2.1. Remedial Measure

We use dropping variable method for removing multi collinearity,

Table 3. Dropping Variable Method

GDP (Dependent variable)	Coefficients	Std. Err.	t	P> t
GEPE	.1451291	.030726	4.72	0.001
GESE	-.1477601	.0543467	-2.72	0.020
GEE	.3762989	.1536012	2.45	0.032
cons	7.806901	-4.283652	-1.82	0.096

(The test is conducted by using Stata/SE 12.0)

GETE and *ALR*, this two variables are dropped from the actual regression model based on the correlation matrix. From correlation matrix, *GETE* and *ALR* variable has greater collinearity with other independent variable. After removing this two variable the result of *t*-test value for other variables are significant, *F*-test is significant and *R*² value is high. So, in this model there is no multicollinearity problem but we have specification bias because *GETE* and *ALR* variable have some effect on *GDP*. After dropping *GETE* and *ALR* variables, the model will be:

$$GDP = \beta_1 + \beta_2 GEPE + \beta_3 GESE + \beta_4 GEE + u$$

4.3. Heteroscedasticity test

For testing heteroscedasticity we use Breusch-Pagon-Godfrey (*BPG*) test. The test result is given below:

From the test result, χ^2 value is insignificant because the probability for significance of χ^2 is 21.68%.

Here, null hypothesis will be accepted and there exist homoscedasticity in data. There is no heteroscedascity problem.

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity	
Ho: Constant variance	
Variables: fitted values of GDP	
chi (1) =	1.53
Prob> chi2 =	0.2168

(The test is conducted by using Stata/SE 12.0)

4.4. Autocorrelation test

For testing autocorrelation we use Durbin-Watson test and Breusch-Godfrey (*BG*) test.

Autocorrelation test (Durbin-Watson *d* test)

Durbin-Watson d-statistic (6, 15) =	1.634863
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(The test is conducted by using Stata/SE 12.0)

From the above table, the estimated *d* value can be shown to be 1.635, suggesting that there is no decision. From the Durbin-Watson tables, we find that for 15 observations and 5 explanatory variables, *d*_L= 0.562 and *d*_u=2.220 at 5percent level. The computed *d* value do not lies between *d*_L and *d*_u, so there is no decision. It is the limitation of Durbin-Watson test. For this reason we use Breusch-Godfrey (*BG*) test.

4.5. Breusch-Godfrey (*BG*) test

Breusch-Godfrey LM test for autocorrelation			

lags (p)	chi ²	df	Prob> chi ²
-----+-----			
1	0.314	1	0.5754

H0: no serial correlation			

(The test is conducted by using Stata/SE 12.0)

Here, probability of χ^2 value is insignificant. So null hypothesis is accepted and there is no serial correlation. Data is free from autocorrelation problem.

5. Impact of Education on GDP in Bangladesh

There are five basic types of education in Bangladesh, namely: general education, madrasah education, technical-vocational education, professional education and teacher's education. Of these types, the general education is taken by a majority of students (8.77million) followed by madrasah (1.77 million) and the lowest share of enrolment is reported for the teacher's education. Considering different levels of education, junior secondary level recorded the highest enrolment with 6.23 million (57.29%) followed by secondary level with 2.87 million (26.39%) while the masters level reported the lowest enrolment with 75275 students. This is understandable since the masters level of education is the highest level where the education is most expensive and the requirements are stiff for anybody seeking admission to the level. (BANBEIS, Final Report-2005).

In 2006, the number of primary schools (public and private) increase about two times compares to the number of such schools in 2001. It is also remarkable that the number of female teachers has been increased from 1990's and the participation of girls' students have been increased almost double in 2006, while it becomes only about 31% in 2001. The substantial progress has been made in improving the access of children to primary education.

In Bangladesh, the total number of educational institutions is 1,16,833 in 2008, out of them 82,218 (of the 38,000 public) are primary level schools, 18,756 are secondary schools, 3,116 are madrasah educational institutions, 3,277 are colleges and 82 are universities. Total number of teachers for primary schools is 3, 65,925, for secondary school is 2, 09,496, for madrasah is 1, 05,545, for colleges 87,715, and for universities is 12,585. The number of students for primary schools is 1,60,01,605, for secondary schools is 68,19,748, for madrasah is 18,96,111, for college education is 18,55,633 and for university education is 3,87,433. These are going to increase gradually day by day. Enrolment rate significantly varies by socio-economic groups as well. A sizeable number of children from very poor households were never enrolled in primary schools, and many of those enrolled dropped out before completing the full five years as their families depended on child labor for survival. Although there has been some reduction in dropout rate from 38 percent in 2002 percent to 35 percent in 2010, it still remains considerably high, and needless to mention that dropout rate is significantly higher amongst children from poorer households. The above description gives an idea about the growth of the number of schools, teachers, and students of different levels of educational institutions in Bangladesh. In view of this increasing trend, researchers are interested to see whether there exist any causal relationships between education expenditures and GDP growth or not.

6. Conclusion and Recommendation

This research work is primarily meant to find the relationship between Education and economic growth. For

this purpose, an application of OLS method using the dataset of adult literacy rate, gross enrolment in primary education (both sexes), gross enrolment in secondary education (both sexes), gross enrolment ratio in tertiary education (both sexes), government education expenditure and GDP growth rate for the period 2001 to 2015. The positive impact of the education and economic growth is because by learning education human being are efficient and this, in turn, increased labor productivity, effective use of land and other physical assets and improved socio-economic empowerment are three important routes through which education can contribute to economic development. Also, the investment in education leads to the formation of human capital, comparable to physical capital and social capital and that makes a significant contribution to economic growth. Thus there is a very close relationship between education and economic growth. The results of OLS regression and hypothesis testing it is clear that education is positively related to economic growth. By testing multicollinearity in the model, there has some multicollinearity effect. After dropping two variables, the model is free from multicollinearity. Park test and Breusch-Pagan-Godfrey (*BPG*) test suggest that the model is free from heteroscedasticity problem. Durbin-Watson test and Breusch-Godfrey (*BG*) test, both suggest that there is no autocorrelation problem. From our study, it is clear that the government should increase the expenditure on education for developing the economic growth.

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