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Public educational expenditure and economic growth in Bangladesh- an empirical analysis

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ABSTRACT

This paper aims to investigate the short and long-term dynamic relationship between public educational expenditure and economic growth in Bangladesh using annual time series data from 1991 to 2021. Time series analysis has been performed with a quantitative methodology using the Ordinary Least Square (OLS) model, and Auto Regressive Distributive Lag (ARDL) cointegration model. The study specified a multiple regression model where per capita GDP (as a proxy of economic growth) is used as a dependent variable, and public educational expenditure (share of GDP) and public educational expenditure (share of total government expenditure) are used as independent variables. The estimated results indicate that public educational expenditure (share of GDP) has a positive significant impact on per capita GDP. In contrast, public educational spending (Share of total government expenditure) negatively affects per capita GDP in Bangladesh. Econometric Software EViews Student Version 12 has been used to estimate the empirical analysis. The Error Correction Model (ECM) has been used to capture the short-run adjustment. The Granger causality test shows that there is a unidirectional relationship exists between per capita GDP and public educational expenditure (Share of total government expenditure). The study suggests some policy recommendations to increase public educational expenditure and concludes that more education funding from the government can improve the education system, teacher quality, and accessibility for all which can help create a more skilled workforce, and economic growth in Bangladesh.

Contribution/ Originality: This study contributes to the existing literature on the relationship between Public educational expenditure and economic growth. As far as we know, this is one of the very few studies that has used a quantitative methodology to examine the relationship between public educational expenditure and GDP per capita in Bangladesh.

1. INTRODUCTION

A country's economy can benefit from investing in human capital, which includes education. Education contributes to economic development, based on the relationship between economic growth and education (Ejim, 2022).

Education is considered a crucial aspect of enhancing social welfare and a key factor in developing a country's economy. Public expenditure, which refers to the costs incurred by the government for the upkeep of society, the economy, and itself, has been steadily increasing over time (Edame, 2014). Researchers and economists have emphasized the importance of public spending on economic development and education in public finance. According to the current economic growth hypothesis, education plays a vital role in receiving financial support. During the

budget release process, the government raises education spending as part of its economic policy to match the long-term growth rate.

Education plays a crucial role in social development, and for developing countries, public spending on education is a major priority. In Bangladesh, investing more in education has been linked to a faster recovery of the labor market and increased agricultural productivity (Asadullah, 2005). If education contributes to a nation's GDP, then more funding should be allocated to this area. However, since education is a long-term approach, it is crucial to identify long-term relationships between these two variables. While there have been a few studies on the direct relationship between government spending on education and economic growth in several countries, empirical research on Bangladesh is still insufficient.

This study focuses on the long-term relationship between Bangladesh's economic growth and public expenditures on education. In terms of GDP share for education in 2021, Bangladesh has the lowest public spending (2.12 percent). The statistics are much higher than the average for least-developed countries (LDCs), lower-middle-income countries, upper-middle-income countries, and high-income nations. For LDCs, the average is above three percent, below four percent, and five percent. Bangladesh has the second-lowest public spending on education relative to its GDP (Raihan, 2022).

The estimated budget for the fiscal year (2022–2023) includes Tk81,449 crore for the education sector. Of the total budget, the basic and mass education ministry received Tk31,761 crore, the secondary and higher education division received Tk39,961 crore, and the technical and madrasa education division received Tk9,727 crore. The allocation, at 1.83 percent of the nation's GDP overall, is significantly less than that recommended by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) (TBS Report, 2022).

The amount set allocated for education in the fiscal year (2021–2022) is Tk 72,000 crore or 11.9 percent; this is less than the 12.3 percent specified in the fiscal year (2020–2021) modified budget. According to UNESCO, 20 percent of the national budget and (4–6) percent of GDP should be set aside to meet the educational needs of developing countries. According to Ahmed (2021) Bangladesh has the lowest public spending on education overall (as a share of GDP) in South Asia.

In 2019, it was predicted that Bangladesh's overall government spending on education would account for 1.3263 percent of GDP. Between 1979 and 2019, Bangladesh's growth rate averaged 1.68 percent, with a low of 0.94 percent in 1980 and a high of 2.2 percent in 2007. In Bangladesh, public spending on education ranged from 5.26 percent in 1980 to 20.49 percent in 2000, with a 12-year average of 12.95 percent.

The elementary and mass education ministry received funds in the amount of Tk 24,937 crores in the fiscal year (2020–2021), the secondary and higher education division received Tk 33,118 crores, and the technical and madrasa education division received Tk 8,345 crores. The budget's allocation for education was Tk 66,400 crores in total. While the amount allocated accounts for 11.69 percent of the total expenditure, it only contributes 2.09 percent to the GDP (Alamgir, 2020).

The recent fiscal year (2021–22) budget allocated Tk 71,951 crores to the education sector. Of this amount, Tk 26,311 crores will go to the basic and public education ministry, Tk 36,486 crores to the secondary and higher education division, and Tk 9,154 crores to the technical and madrasa education division. The budget accounts for either 2.08 percent of the GDP or 11.9 percent of the total federal budget.

Improved access to education can lead to better learning conditions, higher-quality instruction, and increased funding for education. A more educated and skilled workforce can enhance human capital, leading to increased productivity and innovation, which can contribute to economic growth. A well-funded educational system can promote technological advancement and innovation, leading to the establishment of new markets and groundbreaking products. Higher levels of education also increase a population's propensity to engage in research and development, ultimately contributing to economic growth.

It is widely believed that education plays a crucial role in driving a country's economic growth. Without investing in education, no nation can achieve economic prosperity. People who receive education tend to be more productive as they are capable of fulfilling their goals. Moreover, education fosters innovation, entrepreneurship, and technical advancement, ultimately leading to an improved standard of living. As one's level of education increases, so does their compensation. This increase in individual income is essential to boost economic growth and outcomes. Researchers have explored the link between education and economic development.

To estimate the outcomes, the study used the Ordinary Least Square (OLS) model and Auto Regressive Distributive Lag (ARDL) Cointegration model. The analysis shows that expenditure on public education (as a share of GDP) positively and significantly affects GDP per capita and economic growth. However, when expressed as a share of government spending, it significantly hinders Bangladesh's economic expansion. The government should prioritize devoting a bigger share of the national budget to education to carry out the study's policy recommendations, which call for increased budget allocation.

The study also recommends focused expenditure, transparent and responsible spending, curriculum creation, teacher training and professional development, infrastructure enhancement, and research and innovation. The improvement of Bangladesh's educational system would need time, careful planning, cooperation among diverse stakeholders, and a long-term commitment.

The remainder of the article is organized as follows. Section 2 employs the theoretical framework; Section 3 describes the Review of Literature. Section 4 discusses the results of the empirical methodology. Section 5 lists a few policy recommendations and Section 6 is Concluding Remarks.

2. FRAMEWORK FOR THEORY

The term "human capital" was first used by Schultz (1960) to refer to the value of human potential. However, it was popularized by Becker (1962). Smith (1776) compared costly equipment to educated individuals, highlighting the value of investing in people. According to Marshall (1930) knowledge is the most effective and valuable form of capital that can be used to invest in people.

2.1. Samuelson's Pure Theory of Public Expenditure

Education is a public good, as it's neither exclusive nor competitive. Samuelson (1954) defined public goods as "collective consumption goods." Regulating community consumption with a decentralized pricing system is impossible. Thus, the government must spend public funds to ensure education is available to everyone.

2.2. Endogenous Growth Model

Romer (1986) and Lucas (1988) endogenous growth models suggest that education is a key factor in economic growth. According to this theory, economies that continuously invest in human capital as a productive input can converge, while those that don't, can diverge. However, the benefits of capital can only be realized once human capital reaches a specific threshold. Lucas (1993) pointed out that South Korea's GDP per capita increased by 6.2 percent annually between 1960 and 1988, doubling the standard of living every 11 years. He attributed the rapid economic progress to the increase in human capital.

2.3. Rostow-Musgrave Model

Musgrave (1969) and Rostow (1971) argued that increased public spending is necessary for economic growth, and the government must provide basic infrastructure facilities to support economic development. They concluded that the pace of growth of public expenditure will be very high in the early stages of economic development. The government must invest in infrastructure such as roads, power, water supply, healthcare, and other necessities to help the economy go from the start-up stage to the take-off stage of economic development.

3. REVIEW OF THE EMPIRICAL LITERATURE

Several studies have explored the connection between education spending and economic growth. According to Breton (2013) education has a significant impact on how a country's economy develops, both directly and indirectly. Lauder, Brown, and Cheung (2018) suggest that education contributes directly to people's knowledge, assumptions, and abilities. Therefore, it cannot be reduced to just employment skills, and it is challenging for education to provide economic support. However, Karaçor, Burcu, Esra, and Sevilay (2017) argue that education also creates individuals who can generate and redirect growth. Education can be used to improve human capital, which indirectly benefits the economy. Credible individuals can influence economic recovery.

Chang and Shi (2016) investigate the most effective ways to deploy human capital in China to promote economic growth using data from 30 provinces and autonomous regions. However, it has been challenging to create human capital. Han and Lee (2020) show that although human capital is still essential for encouraging economic success in Korea, the share of senior or female workers has increased and is now a significant driving factor behind the advancement of public policy.

Blankenau, Simpson, and Tomljanovich (2007) investigated the relationship between public education spending and economic growth using the endogenous growth model. Their research indicates that the growth response to education spending may be non-monotonic, depending on the level of coverage. They also found that this relationship is influenced by factors such as the level of government spending, the tax structure, and the characteristics of industrial technology.

Chakraborty (2005) suggests that most research studies focus on endogenously generated economic growth and emphasize the growth of human capital. It is widely agreed that investments in education have a positive impact on both the micro- and macro-levels of society and can have a direct and indirect effect on economic growth (Dahlin, 2005).

By upholding law and order, supplying economic infrastructure, boosting labor productivity through health and education, and developing export industries, the policymakers contended that social sector spending is essential to a nation's economic development (Al-Yousif, 2008). Barro (2001) examined nearly 100 countries using panel data from 1965 to 1995 and discovered a strong correlation between growth and the average years that adult males began secondary and tertiary education.

Jariwala (2017) examines the short- and long-term dynamic link between educational investment, as defined by educational spending, and economic growth in the Indian context using annual data sets from 1951 to 2015. The results suggest that GDP and education have a long-term, stable equilibrium connection.

Lucas (1988) suggests that employee motivation leads to increased innovation and productivity, benefiting everyone. Additionally, higher levels of education have been shown to increase productivity among those with whom they interact, indicating a positive externality. Pradhan (2009) found evidence of a unidirectional causal relationship between education and economic growth in India, validating both short- and long-term links between the two variables. In a separate empirical study, Mallick and Dash (2015) found that educational spending has a positive long-term relationship with economic growth in India over the period 1951-2012.

According to Bhatia and Dash (2011) most developed nations that have already achieved the goal of education spend a significantly higher proportion of their GDP on education. Underdeveloped and developing countries need to increase and improve resource allocation for this sector. Musai, Mehrara, and Fakhr (2011) conducted a study on the link between education and economic development in 79 different nations. Their study shows that increasing labor force expenditures and education spending promote economic growth. While education spending ideally should have a substantial effect on economic growth, it's not a must for advancement.

The institutional structure of the country, for example, affects whether investments in the education sector will have a significant impact on growth or not (Ghosh, Mohan, & Chatterji, 2013). Mallick, Das, and Pradhan (2016) investigated the connection between economic growth and education spending in 14 important Asian countries.

Using panel cointegration tests, the study discovered that there is a long-term relationship between educational investment and economic growth in each of the selected nations.

3.1. Bangladesh's Past Empirics

According to Aminuzzaman (2011) research, conducted in Bangladesh, a causal relationship exists between economic growth and consumption spending. Similarly, Islam, Wadud, and Qamarullah (2007) found a connection between Bangladesh's development and education after examining the causal relationship between GDP growth and education. Al-Mukit (2012) investigated the effect of education investment on Bangladesh's economic growth from 1995 to 2009 in a different study. The data were analyzed for the study using the cointegration test, unit root test, and Ordinary Least Square (OLS) method. The empirical findings demonstrated that sustained support for public education has a major and positive impact on education and, in turn, on the growth of the nation's economy.

3.2. GDP and Public Education Spending Relationship

Investing in education leads to long-term economic growth. In Bangladesh, spending on education peaked at 0.94 percent of GDP in 1980 and reduced to 1.1 percent in 1975. In 1999, education spending increased by 2.42 percent, resulting in a GDP increase of Tk. 2370.9 billion. In 2001, education spending increased to 2.46 percent of GDP, which was $2732.0 billion. Despite GDP growth, educational expenditure as a percentage of GDP has not increased in Bangladesh.

Bangladesh has made substantial improvements to its educational system since achieving gender parity at both the primary and secondary levels and a primary enrollment rate of over 92 percent. The question of whether there is a direct causal relationship between Bangladesh's educational spending and both long- and short-term economic growth must now be answered.

Figure 1. GDP per capita growth rate, public education spending as a share of GDP (EXE), and public education spending as a share of total government spending (EXETGE) (1991-2021).
Source: World bank data (1991-2021).

Figure 1 displays, over the period from 1991 to 2021, the growth rates of GDP per capita, public educational expenditure (share of GDP), and public educational expenditure (share of total government spending). In 1991, the

GDP per capita growth rate was 1.5 percent; by 2021, it will be 5.7 percent. However, the rate significantly decreased in 2020. Public educational expenditure (share of GDP) has varied during the last 30 years from (1.2 to 2.2). From 11.06 percent in 1991 to 10.22 percent in 2021, public educational expenditure (share of overall government spending) decreased.

A scatterplot of the public educational expenditure (share of GDP) and per-capita GDP between 1991 and 2021 is shown in Figure 2. The graph demonstrates that the two variables have a favorable association ship with one another. The computed regression equation demonstrates that a rise in EXE of one percentage point results in a gain in GDP per capita of 718.55 percentage points, and vice versa. The correlation coefficient is 0.374.

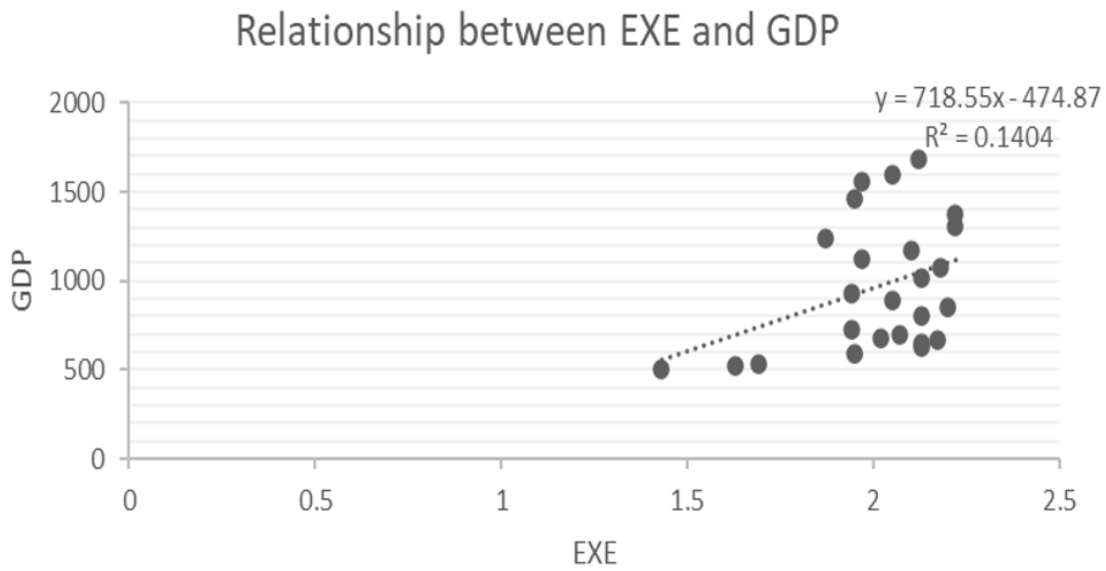

Figure 2. Scatterplot of EXE and GDP (1991-2021).

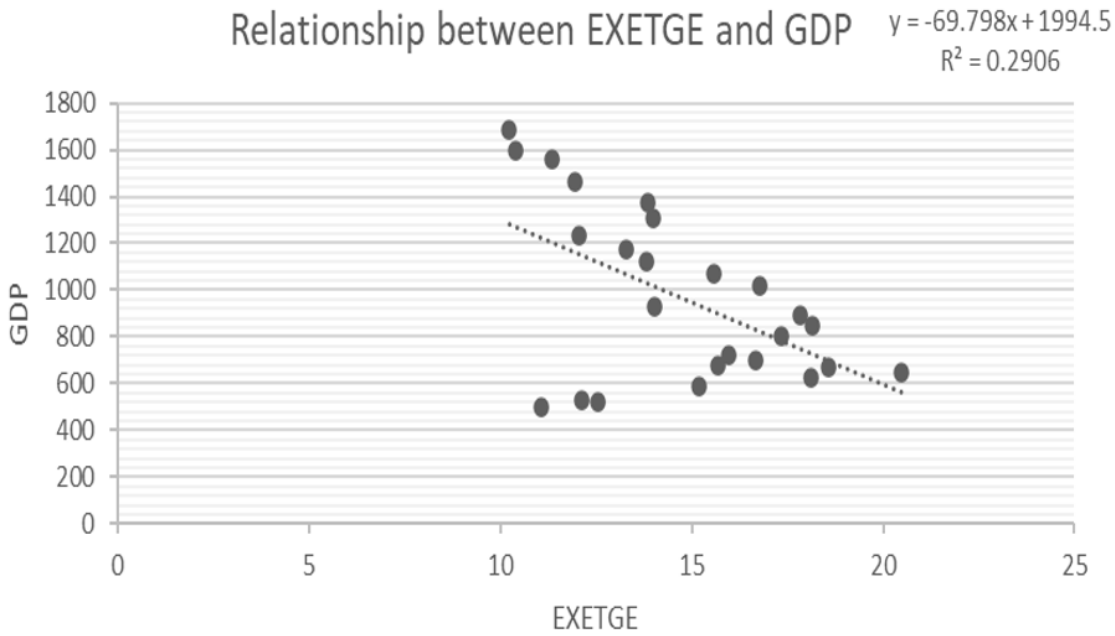

Figure 3. Scatterplot of EXETGE and GDP (1991-2021).

Figure 3 displays the scatterplot of public education spending from 1991 to 2021 (share of total government spending) versus GDP per capita. The graph demonstrates that the two variables have a negative association ship with one another. The computed regression equation demonstrates that a one percentage point rise in EXETGE causes a 69.79 percentage point decrease in GDP per capita, and vice versa. The correlation coefficient is 0.539.

Table 1. Public education spending (South Asian country comparison).

Country	Total public expenditure on education			
	As a share of the GDP	Year	As a share of total public expenditure	Year
Afghanistan	2.9	2020	10.9	2021
Bangladesh	2.12	2021	11.9	2022
Bhutan	7	2021	19.7	2022
India	4.5	2020	16.5	2020
Maldives	5.8	2020	11.9	2021
Nepal	4.2	2020	12.4	2022
Pakistan	2.4	2021	10.2	2021
Sri Lanka	1.9	2019	9.9	2019

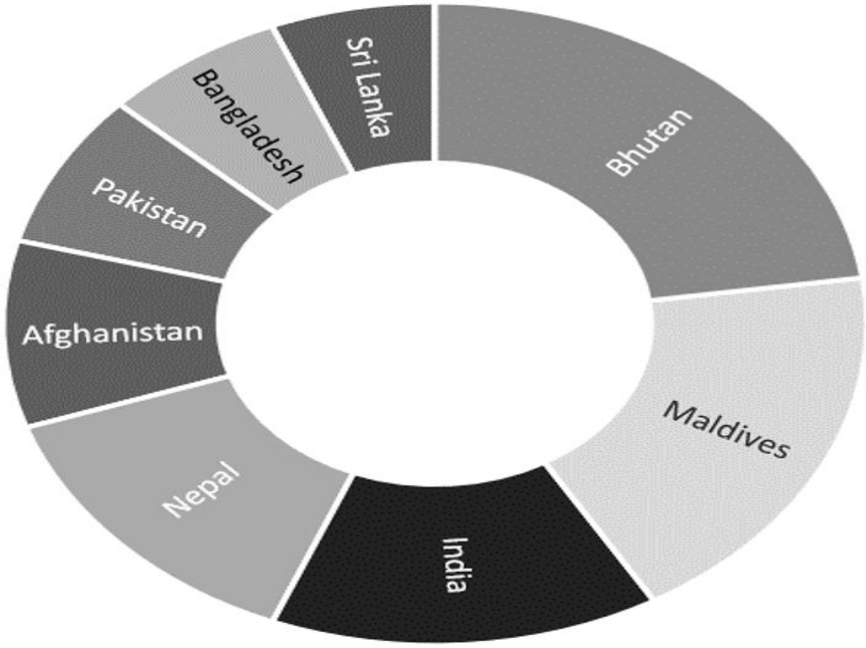

Figure 4. Public expenditure on education (South Asian country comparison).

3.3. Public Education Spending (South Asian Country Comparison)

The lowest of all areas, South Asian countries spend only 4 percent of their average GDP on education, which is still less than the world average of 4.8 percent. Bhutan (7 percent), Nepal (4.2 percent), India (4.5 percent), and the Maldives (5.8 percent) are the four of the eight countries that outperform the global average. In Afghanistan, Pakistan, Sri Lanka, and Bangladesh, government spending on education accounts for less than 4 percent of GDP, as seen in Table 1 and Figure 4. Figure 4 demonstrates that Bangladesh is in the second-worst position in terms of public expenditure on education when compared to the other seven nations.

4. DATA SOURCE AND METHODOLOGY

The long-term causal relationship between education and economic growth is examined using secondary time series data on various education expenditures and GDP per capita from 1991 to 2021. To overcome non-stationary data and explain the relationship between education and economic growth, this study will illustrate recently developed econometric models. The relationship is estimated using the following methods: the Granger Causality test for a long-term causal link; the cointegration test for a long-term relationship; the Error correction model for both short- and long-term dynamic adjustments; and the Augmented Dickey-Fuller test for a unit root test.

To estimate the causal relationship over a 25-year sample period from 1991 to 2021(Availability of data), three variables—GDP per capita, EXE (Public education spending as a share of GDP), and EXETGE (Public education

spending as a share of total government spending) are employed. The entire yearly public education budget (current and capital), stated as a percentage of GDP is known as public expenditure on education. The term "public expenditure on education as a share of total government expenditure" refers to the entire amount spent on public education (both capital and current) divided by the total amount of government spending across all sectors in a given fiscal year. The time-series data for GDP per capita, EXE, and EXETGE were provided by the World Bank.

The standard linear model can be generated as below:

$$GDPt = f(EXE, EXETGE) \quad (1)$$

After the transformation of Log values, the log-log model will be as follows:

$$Ln\ GDP_t = \beta_1 + \beta_2\ Ln\ EXE_t + \beta_3\ LnEXETGE_t + U_t \quad (2)$$

Where,

Ln GDP = Natural Log of Per Capita Gross Domestic Product (GDP).

Ln EXE = Natural Log of Public Educational Expenditure (share of GDP).

Ln EXETGE = Natural Log of Public Educational Expenditure (share of total government expenditure).

U = Error term.

4.1. The Model Specification

Time series data covering the years 1991 through 2021 were utilized to create this multiple regression model. 25 observations in total have been made according to the data availability. The model is recreated as follows:

$$Ln\ GDP_t = \beta_1 + \beta_2\ Ln\ EXE_t + \beta_3\ LnEXETGE_t + U_t$$

Using the econometric software EViews (Student Version 12), the estimated findings were produced. An overview of correlation analysis, the unit root test, the cointegration connection, and the Granger Causality test are some of these. To confirm the estimation method, several diagnostic tests have also been carried out, including the Multicollinearity test, Serial correlation Lagrange Multiplier (LM) test, Heteroskedasticity test, Normality test, CUSUM test, and CUSUM SQ test.

4.2. Empirical Validity

The planned regression estimation is regarded to be worthless if the value of R-squared exceeds the Durbin-Watson Statistic, according to a general rule of thumb first proposed by Yule (1926) and Granger and Newbold (1974).

Table 2. OLS regression results estimation.

Dependent variable: Ln GDP				
Variables	**Coefficients**	**Std. error**	**t-values**	**P-values**
Constant	9.153	0.452	20.268	0.000
Ln EXE	3.352	0.367	9.138	0.000
Ln EXETGE	-1.750	0.194	-9.005	0.000
R^2 = 0.833 Adjusted R^2 = 0.818 F-statistic =55.028 Durbin Watson test = 1.207				

The following integration equation results from the equation's estimate using direct Ordinary Least Square (OLS) Model (Table 2):

$$Ln\ GDP = 9.153 + 3.352\ Ln\ EXE - 1.750\ Ln\ EXETGE \quad (3)$$

Table 2 demonstrates that the R-squared value is less than the Durbin-Watson statistic, indicating that there are no spurious regressions in the OLS estimation. Additionally, the EXE has a positive significance coefficient with the

GDP per capita, whereas the EXETGE has a negative significance coefficient. Therefore, the predicted coefficients are eligible for the study's next phase.

4.3. Empirical Results

Table 2 shows that EXE's coefficient is statistically significant at the 5 percent level and that EXE and GDP possess a positive relationship. Relative to GDP per capita in Bangladesh, an increase of one percent in total spending on public education seems to translate into a 3.35 percent rise in GDP. It is very statistically significant that this coefficient has a t-value of 9.14. If total government spending on education (EXETGE) increases by one percent, the GDP per capita falls by 1.75 percent. It is statistically significant, yet the t-value for this coefficient is -9.00, which is negative.

F = 55.02804 demonstrates that the regression model significantly fits the data. The R-squared result suggests that overall changes in the independent variable may be responsible for 83 percent of the variation in GDP per capita.

Table 3. Correlation matrix of the variables.

Variables	Ln GDP	Ln EXE	Ln EXETGE
Ln GDP	1	0.468	-0.448
Ln EXE	0.468	1	0.496
Ln EXETGE	-0.448	0.496	1

4.4. Correlation Analysis

The correlation coefficient measures the strength of the relationship between two variables. Table 3 displays the correlation coefficients for the study's variables. The correlation coefficient between the explanatory variables has an average value. and they do not go above 0.5. However, the R2 value for this model is high (0.833404), higher than the adjusted R2 (0.818259). The F-test is highly significant since the coefficients are not simultaneously equal to zero. Once more, the t-ratios demonstrated statistical significance. This makes it easy to first assert that the model has no significant multicollinearity problems.

4.5. Unit Root Tests Results

Testing the stationary property of each variable utilized in the model for time series analysis is crucial. Here, the unit root tests of Phillips-Perron (PP) and Augmented Dickey-Fuller (ADF) have been used to examine the stationarity of the variables. Table 4 presents the findings from these tests.

4.5.1. Unit Root Test (Augmented Dickey-Fuller (ADF) and Phillips Perron (PP)Test Results

Table 4. Results of the ADF and PP tests.

Variables	ADF test		PP test		Order of integration
	Level	First difference	Level	First difference	
Ln GDP	-3.505 (0.017)	-7.396 (0.000)	-3.497 (0.017)	-9.715 (0.000)	I (0)
Ln EXE	-5.289 (0.000)	-3.773 (0.011)	-10.954 (0.000)	-6.073 (0.000)	I (0)
Ln EXETGE	-1.364 (0.583)	-4.645 (0.001)	-1.458 (0.537)	-4.645 (0.001)	I (1)

The ADF and the PP test statistic used to investigate the null hypothesis that a unit root exists in the GDP per capita and public education spending data is shown in Table 4. Table 4 suggests that the Ln GDP of both tests are integrated of order 0 or I (0) and are stationary at levels at the 5 percent level of significance. As a result of having an ADF and PP test statistic below the crucial values, Ln EXE values are stationary in level and are therefore assumed

to be integrated of order 0 or I (0). Ln EXETGE of both tests are stationary in the first difference, indicating that the values are integrated with I (1). We infer that all variables are integrated of order 0 and 1, or I (0) and I (1), based on the results of the ADF and PP tests.

4.6. Selection of Optimum Lag Length

The ideal lag lengths determined by various information requirements are listed in Table 5.

Table 5. Optimum lag selection criteria.

Lag	Log L	LR	FPE	AIC	SIC	HQ
0	54.659	NA	1.47e-06	-4.919	-4.771	-4.888
1	123.548	111.534*	4.95e-09*	-10.624	-10.027*	-10.494*
2	127.725	5.569	8.37e-09	-10.164	-9.119	-9.938
3	138.953	11.763	8.04e-09	-10.377	-8.884	-10.053
4	152.574	10.378	7.53e-09	-10.817*	-8.877	-10.396

Note: * indicates lag order selected by the criterion:
LR: Sequential modified LR test statistic (Each test at 5% level).
FPE: Final prediction error.
AIC: Akaike information criterion.
SIC: Schwarz information criterion.
HQ: Hannan-Quinn information criterion.

According to the Akaike information criteria (Table 5), four lags are determined to be the best for this investigation.

4.7. Cointegration Test

Since the variables are evaluated as I (1) or I (0), the cointegration approach can be utilized to identify the long-term relationship between variables. The Autoregressive Distributed Lag (ARDL) bounds testing approach was used to assess cointegration (Pesaran, Shin, & Smith, 2001). Given that the study's data set has 25 annual observations, this technique is more suitable in this situation.

4.7.1. ARDL-Bound Test Approach

To determine whether there is a long-term relationship between the variables, the ARDL bound testing approach is employed in this study. To establish if cointegration between the variables exists or not, the estimated F-statistic after the null hypothesis of no cointegration must be compared with critical bounds such as the lower critical bound (LCB) and upper critical bound (UCB).

Table 6. ARDL bounds test results.

F-statistic	Significance level	Critical values	
		Lower bounds I (0)	Upper bounds I (1)
9.0612722	1%	3.41	4.68
	5%	2.62	3.79
	10%	2.26	3.35

The outcomes of the ARDL-bound testing strategy are explained in Table 6. The sample period for this study's 25 observations runs from 1991 to 2021. The calculated F-statistics, which are 9.0612722 according to the data, are higher than the upper critical bound (UCB). We cannot accept the null hypothesis that cointegration does not exist. Thus, in the instance of Bangladesh from 1991 to 2021, the ARDL limits tests point to the existence of cointegration or long-run relationships among the variables such as GDP per capita, Public educational expenditure (share of GDP), and Public educational expenditure (share of total government expenditure).

4.8. ARDL Long-Run and ECM Short-Run Coefficient Estimation

4.8.1. ARDL Long-Run Coefficient Estimation

The next stage is to conduct an estimation of the long-run relationship among the variables. Table 7 presents the econometric findings for the long-run model.

Table 7. ARDL long run coefficient results.

Dependent variable: Ln GDP				
Variables	**Coefficients**	**Std. error**	**t-values**	**P-values**
Constant	8.179	0.413	19.795	0.000
Ln EXE	4.025	0.465	8.653	0.000
Ln EXETGE	-1.733	0.131	-13.276	0.000

$$Ln\ GDP = 8.179 + 4.025\ Ln\ EXE - 1.733\ Ln\ EXETGE$$

The Error Correction Term (ECT) which is obtained from the long-run equilibrium is given as

$$\omega LnGDPECT_{t-1} = Ln\ GDP - 8.179 - 4.025\ Ln\ EXE + 1.733\ Ln\ EXETGE$$

In Table 7, it is evident that over the long term, the Public Expenditure on Education (share of GDP) has a favorable and statistically significant impact on GDP per capita. The results suggest that at a significance level of 5 percent, public expenditure on education (share of total government expenditure) has a negative significant impact on GDP per capita.

4.8.2. ARDL Short Run Coefficient Estimation (ECM Estimation)

The Error Correction Model (ECM) is generated to assess the robustness of the short-run dynamics from the ARDL model, and the findings are shown in Table 8.

Table 8. ARDL short run coefficient results.

Dependent variable: Ln GDP				
Variables	**Coefficients**	**Std. error**	**t-values**	**P-values**
D (Ln GDP (-1))	-0.373	0.199	-1.873	0.091
D (Ln GDP (-2))	-0.802	0.195	-4.119	0.002
D (Ln EXE)	-0.287	0.087	-3.308	0.008
D (Ln EXE (-1))	0.426	0.088	4.851	0.001
D (Ln EXE (-2))	0.151	0.067	2.251	0.048
D (Ln EXETGE)	0.271	0.054	4.985	0.027
D (Ln EXETGE (-1))	-0.113	0.044	-2.581	0.027
D (Ln EXETGE (-2))	0.059	0.042	1.386	0.196
CointEq(-1)	0.242	0.035	6.864	0.000
$R^2 = 0.795$ Adjusted $R^2 = 0.669$ F-statistic =69.993 Durbin Watson test = 1.949				

According to Table 8, the coefficient of CoinEq(-1) exists in the range of (-1 to 0), and at a 5 percent level of significance, it is highly significant. This indicates that there is cointegration between the three variables and that there is a long-term relationship between them.

Following a short-term shock, the coefficient of CoinEq(-1) depicts how quickly the long-run equilibrium is restored. The estimated CoinEq(-1) coefficient is 0.242093, and at a 5 percent level of significance, it is statistically significant. This finding implies that, over a long period, an annual adjustment of about 24 percent is made to the GDP per capita deviation caused by a specific shock. Another indication that the series has a reliable long-term link is CoinEq(-1)'s statistical significance. The short-term effects of the explanatory variables included are represented by other coefficients. Some explanatory variables significantly affect GDP per capita in the short run, while others

have negligible effects. The regression fits very well, even though the error correction specification retains many unimportant coefficients. The short-run model is not fictitious, according to the Durbin-Watson statistic, which is higher than the R-squared value.

4.9. Results of Diagnostic Tests

Several diagnostic tests, including the Serial Correlation LM Test, the Heteroskedasticity Test, and the Normality Test, have been carried out to assess the dependability of the estimated model. Table 9 describes all diagnostic test's probability outcomes.

Table 9. Results of different diagnostic tests.

Test name	P-value
Serial correlation LM test	0.411
Heteroskedasticity test	0.610
Normality test (JB test)	0.281
Ramsey RESET test	0.605

Table 9 shows that this study has found a probability value of 0.411, 0.610, 0.281, and 0.605 which are more than 0.05. Therefore, the null hypothesis of these tests cannot be rejected, implying that there is no serial correlation, no heteroskedasticity, the residuals are normally distributed, and the model is stable. So, the regression model is highly valid.

4.9.1. Results of the Stability Test

To verify the stability of the calculated model, we check the plot of the Cumulative sum of recursive residuals (CUSUM) test and the Cumulative sum of recursive squares (CUSUM SQ) for this purpose. Figures 5 and 6 show the outcomes of the CUSUM and CUSUM SQ tests.

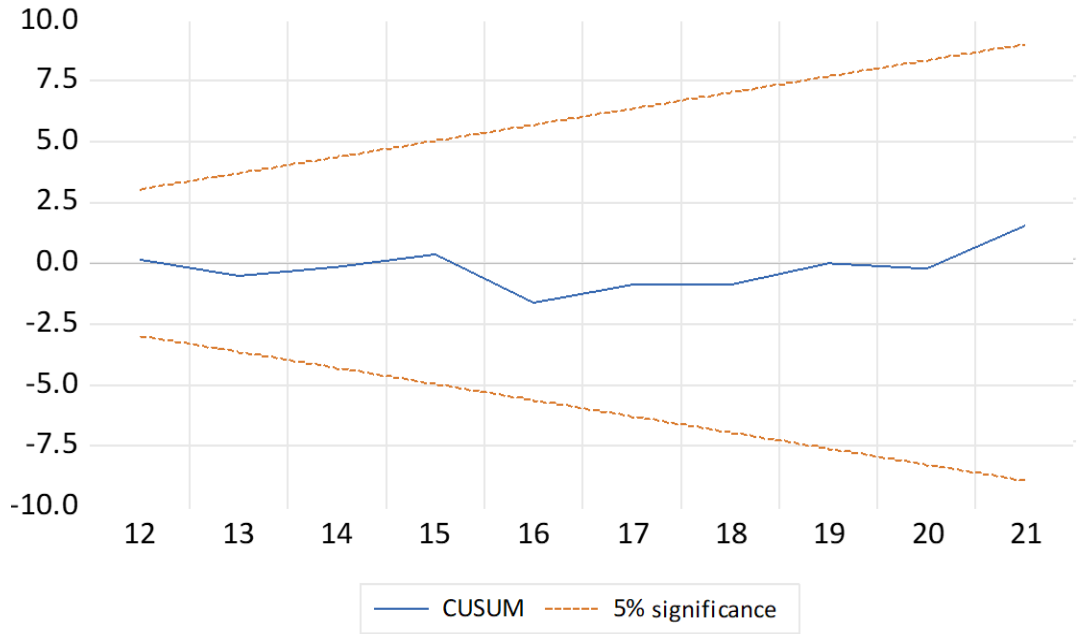

Figure 5. Results of cumulative sum of recursive residuals (CUSUM).

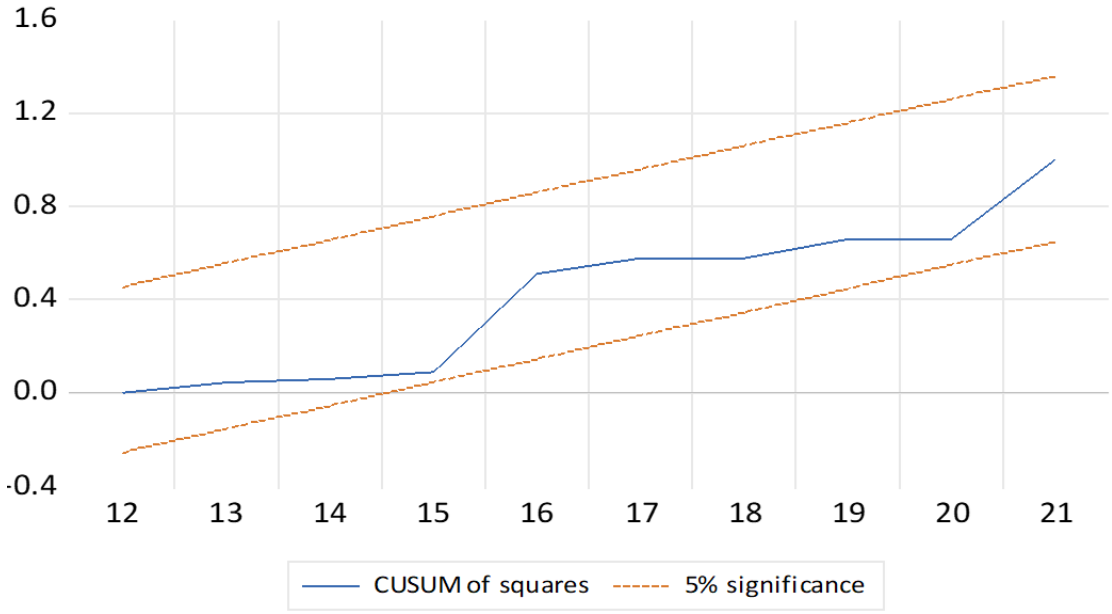

Figure 6. Result of cumulative sum of squares of recursive residuals (CUSUM SQ).

The CUSUM and CUSUM of Square tests have proven that all coefficients in the error-correction model are stable, as seen in Figures 5, and 6. This is because both test plots at a 5 percent level of significance are within the crucial range. As a result, the ARDL model chosen for this investigation is reliable and consistent.

4.9.2. Results of Granger Causality Test

Pairwise To further examine the causal connections between the chosen macroeconomic variables, Granger causality tests are used. The direction of the causality is specified by this test, which is helpful. Table 10 illustrates the test's outcomes.

Table 10. Granger causality test results.

Null hypothesis	F-statistic		Probability	Decision	Direction of causality
Ln EXE does not Granger cause Ln GDP	0.590		0.676	Accept	No causality
Ln GDP does not Granger cause Ln EXE	0.262		0.896	Accept	
Ln EXETGE does not Granger cause Ln GDP	1.137		0.385	Accept	Unidirectional causality Ln GDP→ Ln EXETGE
Ln GDP does not Granger cause Ln EXETGE	5.492		0.009	Reject	
Ln EXETGE does not Granger cause Ln EXE	1.793		0.195	Accept	Unidirectional causality Ln EXE → Ln EXETGE
Ln EXE does not Granger cause Ln EXETGE	4.962		0.013	Reject	

Table 10 demonstrates that there is no direct relationship between economic growth and public educational expenditure (share of GDP). However, there is a unidirectional causality established between economic growth and public spending on education as a share of total expenditure. According to the model, the hypothesis that GDP per capita does not contribute to the share of total government spending on public expenditures has been rejected at the five percent significance level. According to these results, public spending on education (as a share of total government expenditure) was the primary driver of GDP growth in Bangladesh during the study period. Due to the unidirectional

causality between public expenditure on education (share of GDP) and public expenditure on education (share of total government expenditure), which implies that EXE Granger causes EXETGE, the model has rejected the hypothesis that public expenditure on education (share of GDP) does not Granger cause public expenditure (share of total government expenditure) at the five percent significance level.

5. POLICY RECOMMENDATIONS AND FURTHER RESEARCH

Bangladesh can improve education by increasing public spending. The government should allocate more funds to improve the curriculum, teacher preparation programs, and infrastructure. Establish clear methods for budget allocation and spending to ensure accountability. Prioritize spending on early childhood education, teacher preparation, and enhancing school infrastructure for maximum impact. Future studies should consider the teacher investment program to increase the quality of teaching in Bangladesh which can deliver an effective outcome of economic growth that can be enhanced shortly.

Invest in education's fundamentals for long-term gains. Fund teacher preparation programs, provide up-to-date curricular materials, and maintain educational facilities. A qualified teaching staff, relevant curricula, and a positive learning environment can improve academic results.

Increase funding for initiatives that improve access to education for underprivileged populations, including girls, rural children, and children with impairments. Provide scholarships, transportation assistance, and support services. Invest in technology for classrooms and community involvement projects to engage parents, local authorities, and stakeholders.

6. CONCLUSION

Being the fundamental foundation of a nation, education also serves as the main engine for its economic growth. The regression analysis shows that total public educational expenditure (share of GDP) has a positive significance and public educational expenditure (share of total government spending) has a negative significance on the economic growth of Bangladesh. More education funding from the government can improve the education system, teacher quality, and accessibility for all. This can help create a more skilled workforce, which is important for productivity and economic growth.

Public education spending can boost economic growth, but its effectiveness depends on governance, spending efficiency, and policy implementation. To maximize the benefits of investing in education in Bangladesh, a comprehensive approach to economic development is necessary, which includes infrastructure, healthcare, and policies that support business growth. The government needs to allocate more resources and increase the education budget to accelerate Bangladesh's economic development.

The relationship between GDP per capita and public spending on education in Bangladesh's economy is discussed in this article using time-series data for the period 1991 to 2021. Public educational expenditure (share of total governmental spending) and GDP per capita have a unidirectional causal relationship, but GDP per capita is also greatly impacted by public spending on education. Education expenditure is a useful tool for countercyclical economic policy, as it is influenced by factors such as GDP per capita. Its benefits are long-lasting and the effectiveness of public education investment can be assessed on a disaggregated level. Increasing public spending on education is crucial for the economic development of Bangladesh.

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