International Journal of Social Science and Human Research

ISSN (print): 2644-0679, ISSN (online): 2644-0695

Volume 07 Issue 09 September 2024

DOI: 10.47191/ijsshr/v7-i09-09**,** Impact factor- 7.876

Page No: 6786-6796

Has Bangladesh's Economic Progress Impacted by Carbon Emissions and Human Capital in the Long Run? An Econometric Auto-Regressive Distributed Lag (ARDL) Approach

Roksana Akhter

Assistant Professor, Department of Economics Mawlana Bhashani Science and Technology University, Santosh, Tangail-1902,Dhaka, Bangladesh

ABSTRACT: The aim of this study is to investigate the outcome of human capital (proxied by government expenditure on education (GEE) and life expectancy (LE), carbon emission (CO_2), domestic credit growth (DCG), labor force participation rate (LFPR) and remittances (RMT) on Bangladesh's economic progress as indicated by GDP per person. From 1990 to 2018, data for the analysis were used from the world development indicator. ARDL (Auto -regressive distributed lag model is used for the analysis and the cointegration test(F-bound test) reveals that the value of F-statistics (32.83) is greater than I(1) bound(4.26) statistically 1 % significant level that confirms a sustained relationship throughout time between the variables being studied. Empirical results reveal that DCR, LE and RMT have significant and positive long-term effect on GDPPC. Conversely, carbon emission, GEE, LFPR and GCF have a long-term negative effects.

KEYWORDS: Human capital, Carbon emissions(CO_2), Gross Domestic Product per capita, Economic Development, Bangladesh.

INTRODUCTION

According to Bawono (2002), human capital is a non-physical asset or quality that includes things like education, training, intelligence, skills, health, and other traits that employers prize, such as loyalty and timeliness. And education is a crucial area to enhance in order to promote economic progress, particularly in emerging nations like Bangladesh where exceptional achievements have yet to be attained. An increase in the proportion of educated workers boosts the productivity of a country's economy because educated workers are better suited for jobs requiring critical thinking and reading comprehension (Bawono, 2021). By raising the standard of workers, education encourages technical innovation and so significantly increases economic growth. Because education contributes to enhancing the quality of human resources, it is essential for both technological and human capital development to succeed. Odusola (1998) defined "human capital development" as the intentional and ongoing process of acquiring and growing the population of people who possess the necessary information, education, skill, and experience that are crucial for a nation's economic prosperity. The economic advantages of human capital development result from raising labour productivity by improving people's health, diet, education, and other social indices through sensible and efficient spending (Dauda, 2010). According to Ghosh et al. (2014), achieving economic growth is one of the primary goals of the macroeconomic stabilization policy domain. According to Kuznets (1973), economic growth is the steady rise in a nation's ability to offer its people a greater variety of economic goods. Technology advances and the institutional and ideological changes needed to enable them both contribute to the development of this competence. Economic growth, according to Todaro and Smith (2011), is the gradual process through which the economy's productive capacity is raised over time to generate larger levels of national production and wealth.

Having the essential resources, such as energy and other natural resources, is necessary for an economic growth whereas sustainable economic development depends on availability of energy supply. Many of the world's most pressing economic, environmental, and developmental issues have their roots in the energy sector, which has profoundly impacted climate change through environmental carbon emissions. Higher levels of CO_2 emissions are caused by higher levels of energy consumption.

The main cause of global warming over the past century has been human activity, which includes utilization of fossil fuels, such as coal, oil, and gas as the primary source of electricity generation, manufacturing processes, transportation, and consumption of goods and services directly associated with economic growth (Alam, 2014). Bangladesh has had economic expansion in recent decades, and by the end of 2019 (World Bank, 2020), its gross domestic product had increased to 8.15%. This growth has been

mostly supported by the garment industry and other industries that produce greenhouse gas emissions, such as the production of CO2 (Carbon dioxide). It is well recognized that increased human activity stimulates the need for energy by which increasing economic growth (Chindo et al., 2015; Lu, 2017) as a result different by-products are released into the atmosphere in the form of gases and pollutants, changing the climate and posing difficulties to the environment on a worldwide scale (Afolayan, 2020). The main causes of the dominance of carbon dioxide have been recognized as excessive energy use, unsustainable economic expansion, and the use of fossil fuels (Ahmad et al. 2017). In order to manage the amount of carbon dioxide in the atmosphere, it has been necessary to reduce emissions globally (Lu, 2017) in order to guarantee sustainable economic development. This means that goals for decreasing CO2 may need to put a greater emphasis on long-term policy changes that allow for cleaner economic development trajectories. This implies that in order to meet CO2 reduction goals, there may be a need to prioritize sustainable policy changes that facilitate more sustainable paths for economic development (Lu, 2017).

Objective

1. To find out how human capital and carbon emission affects Bangladesh's economic development.
2. To investigate the relationship of gross capital formation, the labour force participation rate and remittances on economic development over the long term.

LITERATURE REVIEW

Many investigations have been carried out to ascertain the connection between economic advancement and carbon emissions from human capital. Muhammad, Abiodun, and Manzoor (2017) looked into links between human capital and economic growth. The empirical results, which are based on data collected over a 15-year period from 132 countries, show that human capital only contributes positively to per capita GDP development in the presence of more favorable regulatory frameworks and increased economic opportunities.

Obialor (2017) examines governmental investments in human capital and their impact on Ghana's economic development, Nigeria, and South Africa from 1980 to 2013 as well as the economic impact on healthcare, literacy, and educational attainment on the effectiveness of government. determinants for human capital investment. Using co-integration and VECM technique the results demonstrate that two of the education and healthcare are two human resources proxy variables, and only Nigeria has a considerable positive influence on growth, whereas literacy ratio is insignificantly favorable in all other nations (VECM). According to the VECM test results, the economies of SSA countries still have long-term growth potential.Jaiyeoba (2015) from 1982 until 2011, use time series data and empirically investigates the association between health and education in Nigeria. Trend analysis, the Ordinary least square technique, and Johansen co-integration are all used in this work. However, empirical research reveals An extensive connection exists between public education, healthcare, and economic expansion investments , spending on education and health , tertiary and secondary school attendance, and gross fixed capital creation are all statistically important indicators. A long-term relationship between economic growth and investments in education is suggested by Dauda's (2010) analysis of time series data from 1977 to 2007 using the Johansen co-integration approach and error correcting techniques. This analysis is important for economic development because it increases national income growth. Results also demonstrate that the creation of the gross fixed capital growth coefficient has a positive and significant economic impact. Adeyemi and Ogunsola (2016) examine annual time series data using the ARDL for the years 1980–2013 Co-integration approach in the estimate to determine whether the variables have long-run co-integration.. Enrollment in secondary schools and public funding for education, gross capital creation, life expectancy and expansion of the economy all has a small positive long-run association.

Three-quarters of the world's greenhouse gas (GHG) emissions are caused by carbon dioxide, which is connected to economic and other human activities (Huaman & Jun, 2014; IPCC, 2015). The relationship between income inequality and income levels, or the environmental Kuznets curve (EKC), which is analogous to the inverted U-shaped curve originally used by Kuznets to model in 1955, is the most widely used paradigm for analyzing how CO2 emissions and economic growth are related, whether in a single country or a group of countries.most of the empirical research on the connection between energy use and economic growth (Afolayan et al., 2020; Matthew et al., 2018; Narayan and Smyth, 2007; Alaali et al., 2015 have discovered a strong association between the two variables. Nevertheless, little research has been done to account for the impact of energy use's by-products, like CO2, on the environment and people's health in general while the economy has been growing. Rising GHG emissions are a serious threat to the economy and may reduce the production of the agriculture sector, according to studies by Jiang and Li (2017) as well as Behera and Dash (2017).Afolayan et al.'s (2020) findings that electric power consumption has a clear correlation with economic development in Nigeria do not statistically support the claim that GHE, completion rate, FFC, and CO2 emissions strongly explain economic progress (as measured by GDP per capita).Using the panel least squares method, Balan (2016) found that CO2 emissions from natural gas sources only have a statistically significant and negative impact on life expectancy, in contrast to emissions from other sources. Shuaibu and Oyinlola (2013) report that due to structural changes, CO2 emissions and energy consumption have no direct correlation to economic development. Zhang and Cheng (2009) found a similar long-term unidirectional association between GDP and energy usage and carbon dioxide emissions in their study for China, despite the fact that neither carbon dioxide emissions nor

energy consumption directly contribute to economic growth. Peters et al. (2007) used structural decomposition analysis (SDA) to arrive at the conclusion that CO2 emissions from China's urbanization process, household consumption in cities, and infrastructure construction have increased more than the savings from efficiency improvements. According to Ghosh et al. (2014), carbon emissions have a detrimental influence on economic growth whereas energy use has a favourable impact. This study is comparable to those of Gojayev et al. (2002), Zeshan and Ahmad (2013), and Bozkurt and Akan (2014). However, there isn't a statistically significant link between economic expansion and carbon dioxide emissions. Bangladesh can experience economic progress without compromising the quality of the environment. CO2 emissions from energy use are a common economic occurrence. Although, compared to many other industrialized countries, Bangladesh makes a negligible dent in the global climate change. Ghosh et al. (2014) state that the EKC does not appear to hold when income per capital and greenhouse gasses (GHG) are taken into account. The industrial and commercial sectors, which primarily rely on energy as an input, increase as a result of economic expansion. Mohammed et al. (2015) and Yazdi et al. (2014) found a correlation between carbon emissions, sulphur dioxide, and public health costs in Iran using the ARDL technique. The study's conclusion claims that public spending is still a crucial tool for minimising the consequences of polluting items on the economy. Health is regarded as being crucial for the growth of any economy since it improves the calibre of human capital and labour productivity. Carbon emissions and other gaseous pollutants have been observed to considerably rise with increased human economic activity, which leads to environmental deterioration and detrimental health effects. According to Afolayan et al. (2020), the study uses annual data series spanning 1980–2016 to integrate endogenous growth models and ecological economics technique to investigate the effects of carbon emissions (measured by CO2) and an indicator of health investments on economic development in Nigeria. The ARDL framework's limits testing technique is employed in the study, and co-integration between the model's variables is established. According to results from the long term estimation, Nigeria's poor and unpredictable electricity supply may have been the cause of its minimal impact on economic development. The results also demonstrate a positive correlation between GHE, FFC, and electric power consumption whereas a negative correlation exists between CO2 gross capital formation and graduation rate and per capita GDP. A few studies use fractional integration/co-integration approaches to analyse CO2 emissions. The EKC hypothesis, for example, received minimal support from Galeotti et al. (2009), who carried out similar investigations for 24 OECD (Organisation for Economic Cooperation and Development) nations. This methodology was used by Barassi et al. (2018) to study stochastic convergence of relative per capita CO2 emissions. In contrast to the BRICS countries (Brazil, Russia, India, China, and South Africa), the OECD countries have comparatively less evidence, according to their results. Using a long-memory approach with nonlinear trends and structural discontinuities, Gil-Alana et al. (2017) examine the stochastic behavior of CO2 emissions for the G7 and BRICS nations. The conclusion they reach is that shocks to CO2 emissions usually have long-lasting impacts, apart from the US, the UK, and Germany. Although this research only looks at China and ignores many other countries, it goes one step farther than theirs in examining potential long-term correlations between GDP growth rates and CO2 emissions through fractional cointegration tests.

METHODOLOGY

Variables and data source:

Both quantitative and qualitative method are used to adopt descriptive research design.In this analysis, secondary annual data from the World Development Indicator (WDI) 2021 of the World Bank are used from 1990 to 2018.The main focus of this research is that how seven independent variables impact on dependent variable on economic development (Proxies by GDPPC) in Bangladesh.

Methods of Data Analysis:

In order to determine if the selected variables are stationary or not, this study first applies the Augmented Dicky Fuller unit root test. Unreliable regression results can be avoided by using the Augmented Dicky Fuller test. To find the ideal lag for the cointegration test, the vector Autoregression (VAR) lag order selection criterion is then applied. Using the ARDL bound test technique to search for a long-term relationship and the error correction model to search for a short-term dynamics are the next steps taken. In conclusion, a few diagnostic tests are employed.

Model Specification:

Our main goal is to investigate the relationship between Bangladesh's economic development, CO_2 emissions, and human capital. Using a conventional Cobb Douglas functional form, the model for economic progress (as proxied by GDPPC) is as follows:

GDPPC=$AK^{\alpha}H^{\beta}CO2^{\delta}$ …….... (1)

Where,

GDPPC=Gross Domestic Product per capita (proxy for economic development)

A=Total factor productivity as defined by the level of technology

K=physical capital

H=Human capital variables

CO_2=Proxy for carbon emission in kiloton.

Here $\alpha, \beta \text{ and } \delta$ are output elasticity coefficients attributed to physical capital, human capital, and CO_2 in respective term.

Econometric model specification:

Some control variables, including domestic credit growth provided by the financial sector, labour force participation rate, and remittance, are introduced to the econometric model formulation in order to further analyse the influence of human capital and carbon emission on economic development in Bangladesh.

Now the functional form of the study can be written as

GDPPC=f (CO_2, DCR, GCF, GEE, LE, LFPR, RMT) …….... (2)

Gross Domestic Product per Capita(GDPPC)=current U.S. dollars

Carbon emissions(CO_2)=Kiloton

Domestic credit Growth to private sector(DCR)=% of GDP

Gross Capital Formation(GCF)=annual % growth

Government expenditure on education(GEE)=Total % of GDP

Life Expectancy at Birth(LE)=Total Years

Labor force participation rate for ages (15-24)(LFPR)=Total(%)

Personal remittances,received(RMT)=current U.S. dollars.

The econometric model of the aforementioned functional form can be stated as follows after the conversion of all variables to natural log for the basic elasticity interpretation and the addition of the stochastic error term:

$$\ln GDPPC_t = \alpha + \beta_1 \ln CO2_t + \beta_2 \ln DCR_t + \beta_3 \ln GCF_t + \beta_4 \ln GEE_t + \beta_5 \ln LE_t + \beta_6 \ln LFPR_t + \beta_7 \ln RMT_t + U_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Here, α is intercepts, β's is coefficient and U_t are stochastic error term.

Estimation Technique:

Unit Root Test:

Because most time series data are non-stationary or have a unit root, it is possible to produce erroneous findings by regressing a non-stationary time series to another non-stationary time series.The most widely used unit root tests, the Kwaitkowski-Phillips-Schmidt-Shin (KPSS), Phillips-Perron (PP), and Augmented Dickey-Fuller (ADF) tests, must therefore be used to determine the unit root of the variables before undertaking any estimating. Pesaran and Shin (1999) and Pesaran et al. (2001) methodology states that certain variables have no unit root or become stationary at levels or in the first or second differences.If the variables were stationary at level I(O), at the first difference I(1), or both, but not at the second difference I(2), we applied the auto-regressive distributive hypothesis (Mohammed Mafizur). To determine if the variables in this study are stationary, the ADF test is employed.H O: It is used with the null hypothesis. A substitute H1 is Every variable is stationary. This collection of variables is not stationary.A p-value of less than the significance level of 5% indicates the rejection of the null hypothesis.

ARDL Bound Testing Approach for co-integration:

Two variables are considered to be co-integrated in the context of economics if they have an equilibrium or long-run connection.For this reason, we employed the Pesaran et al. (2001) ARDL bound testing approach for co-integration testing in our study. As per Thao and Hua (2016), the OLS estimate of the conditional Unrestricted Error Correction Model (UECM) for cointegration analysis forms the basis of the ARDL bound test system. When compared to other traditional co-integration test methodologies, the ARDL technique has a number of advantages. First, regardless of whether the time series data are stationary or not, I(0), I(1), or mixed, the model technique can be applied.Second, using a straightforward linear transformation, UECM can be constructed from it, and this model combines short-run and long-run dynamics into a single equation.Last but not least, the methodology's empirical results show that even with a small sample size, they are superior and reliable.(Henry Kiptoo).

According with Rahman(2017),Shahbaz et.al(2013),Rahman and Kashem(2017) the empirical model for ARDL bound test for co-integration is specified as follows:

$$\Delta lnGDPPC_t = \alpha + \sum_{i=1}^{k} \beta i \, \Delta lnGDPPC_{t-i} + \sum_{i=0}^{l} \gamma i \, \Delta lnCO2_{t-i} + \sum_{i=0}^{m} \eta i \, \Delta lnDCR_{t-i} + \sum_{i=0}^{n} \nu i \, \Delta lnGCF_{t-i} + \sum_{i=0}^{o} \theta i \, \Delta lnGEE_{t-i} + \sum_{i=0}^{p} \Omega i \, \Delta lnEE_{t-i} + \sum_{i=0}^{q} \lambda i \, \Delta lnLFPR_{t-i} + \sum_{i=0}^{r} \psi i \, \Delta lnRMT_{t-i} + \delta_0 lnGDPPC_{t-1} + \delta_1 lnCO2_{t-1} + \delta_2 lnDCR_{t-1} + \delta_3 lnGCF_{t-1} + \delta_4 lnGEE_{t-1} + \delta_5 lnEE_{t-1} + \delta_6 lnLFPR_{t-1} + \delta_7 lnRMT_{t-1} + \varepsilon_{t1} \quad \ldots\ldots\ldots\ldots..(3)$$

The term "conditional error correction model" (ECM) refers to Equation 3, per Pesaran et al. (2001).Equation (3)'s first component, with the summing signs, represents the short-run dynamic model; the second part represents the long-run dynamic model.We will apply the Schwarz Information Criterion (SIC) to find the greatest delays for the variables k, l, m, n, o, p, q, and s.Ours AlternativeH1 for the HO null hypothesis It can be said that cointegration occurs or does not.If, after the t and F-statistics show the long-term

connection, When the ARDL bound test result is greater than the Upper bound I(1), the null hypothesis is disproved.Conversely, no cointegration occurs if the F-statistic value is smaller than the I(1) bound. Conversely, no cointegration occurs if the F-statistic value is smaller than the I(1) bound.Moreover, the outcome is meaningless if the F-statistics value falls between I(0) and I(1).

Error Correction Model:

The disequilibrium is corrected via the error correction mechanism (ECM), which was initially employed by Sargen and subsequently made popular by Engle and Granger.Granger representation theorem, an essential theorem, asserts that the relationship between two variables, Y and X, can be written as ECM(Gujratee) if the two cointegrated. From the error correction mechanism(ECM) the short-run parameters cab be estimated as under:

$$\Delta lnGDPPC_t = \alpha + \sum_{i=1}^{k} \beta i\, \Delta lnGDPPC_{t-i} + \sum_{i=0}^{l} \gamma i\, \Delta lnCO2_{t-i} + \sum_{i=0}^{m} \eta i\, \Delta lnDCR_{t-i} + \sum_{i=0}^{n} \nu i\, \Delta lnGCF_{t-i} + \sum_{i=0}^{o} \theta i\, \Delta lnGEE_{t-i} + \sum_{i=0}^{p} \Omega i\, \Delta lnEE_{t-i} + \sum_{i=0}^{q} \lambda i\, \Delta lnLFPR_{t-i} + \sum_{i=0}^{r} \psi i\, \Delta lnRMT_{t-i} + \varphi \mathrm{ECT}_{t-1} + \varepsilon_{2t}$$

……. (4)

The rate of short-run adjustment towards long-run equilibrium can be obtained from equation (4) using the error correction model (ECM).The significant negative value of the error correction term is found here.

Diagnostic test:

After finishing the ARDl estimation process, it is crucial to perform some diagnostic checks. In this case, recursive tests like the cumulative sum (CUSUM) and cumulative sum of Squares (CUSUM squares) for the stability test will be used, as well as the Jarque-Bera (JB) test for normality, the Breusch-Godfrey (BG) lagrange multiplier test for serial correlation, and the Breusch-Pagan-Godfrey (BPG) test for heteroskedasticity.

Descriptive Statistics:

Table:1

	GDPPC	CO2	DCR	GCF	GEE	LE	LFPR	RMT
Mean	656.7811	37006.90	29.80848	8.311536	1.888316	66.60679	45.80517	6.39E+09
Median	475.2919	30530.00	27.91340	8.586602	1.952470	67.33100	46.66000	3.58E+09
Maximum	1698.132	82760.00	47.58330	11.95168	2.202220	72.32000	50.29000	1.56E+10
Minimum	293.1604	10830.00	14.54554	2.459203	1.396060	58.21000	39.51000	7.69E+08
Std. Dev.	403.3901	22458.26	11.21017	2.140309	0.248221	4.303766	3.399046	5.59E+09
Skewness	1.248717	0.614740	0.214920	-0.820765	-0.632799	-0.459532	-0.365627	0.498745
Kurtosis	3.449246	2.107058	1.579323	3.528974	2.133526	2.024380	1.756101	1.553610
Jarque-Bera	7.780457	2.790001	2.662062	3.594106	2.842622	2.170789	2.515771	3.730163
Probability	0.020441	0.247833	0.264205	0.165787	0.241397	0.337768	0.284254	0.154884
Sum	19046.65	1073200.	864.4459	241.0345	54.76116	1931.597	1328.350	1.85E+11
Sum Sq. Dev.	4556259.	1.41E+10	3518.700	128.2658	1.725187	518.6272	323.4983	8.74E+20
Observations	29	29	29	29	29	29	29	29

Source: Author calculation using Eviews 10.0

Descriptive statistics disprove the characteristics of the variables included in the research: GDP per capita (GDPPC), carbon emissions (CO2), domestic credit growth (DCR), gross capital formation (GCF), government education expenditure (GEE), life expectancy at birth (LE), labor force participation rate (LFPR), and remittances. (RMT).The variables are summarized in Table 1.The results of this table demonstrate that the mean values are 656.781,37006.90,29.809,8.311,1.889,66.607,45,805and ,6.39E+09 as the average growth of Variables GDPPC,CO2,DCR, GCF,GEE,LE,LFPR,RMT respectively.This is also disclosed in their maximum values of 1698.132,82760.00,47.583,11.210,2,202,72,320,50.290,and 1,56E+10 with their respective minimum values of 293.160,10830.00,14.545,2.4692,1.396,58.210,39,510 and 7.69E+08.The value of standard deviation are 403.390,22458.26.11.210,2.1403,0.248,4.304,3.3999.5.59E+09.We know that Kurtosis and skewness assess the degree of the series' asymmetry and peakness or flatness of its distribution, respectively.Here, we can observe that GDPPC is leptokurtic (since 3.45>3) and has a lengthy right tail (positive skewness).On the other hand CO2,DCR and RMT has also a long right tail(positive skewness)

and all are Platikurtic(because <3).But GEE and LE are negatively skewed and Platykurtic.and also GCF is negatively skewed but leptokurtic(because 3.52>3).The Jarque-Bera result 7.780,2.790,2.662,3,529,2.842,2.170,2.516 and 3.3730 with the probabilities of 0.020,0.248.0.264,0.165,0.241,0.338.0.284 and 0.155 indicates a normal distribution for the variables except,GDPPC has a probability value of 0.020 which are <0.05(5%).

Unit Root test for Stationary:

Table 2: ADF Result at level

Variables	ADF test statistic	1%	5%	10%	Prob.*	Order of integration
LGDPPC	3.132900	-3.689194	-2.971853	-2.625121	1.0000	Non Stationary
LCO2	-0.084065	-3.689194	-2.971853	-2.625121	0.9420	Non Stationary
LDCR	-0.504105	-3.689194	-2.971853	-2.625121	0.8761	Non Stationary
LGCFF	-3.677311	-3.689194	-2.971853	-2.625121	0.0103	Stationary
LLE	-14.76252***	-3.711457	-2.981038	-2.629906	0.0000	Stationary
LGEE	-1.663857	-3.699871	-2.976263	-2.627420	0.4375	Non Stationary
LLFPR	-0.682686	-3.689194	-2.971853	2.625121	0.8353	Non Stationary
LRMT	-0.916775	-3.689194	-2.971853	2.625121	0.7677	Non Stationary

Source: Author calculation using Eviews 10.0

*MacKinnon (1996) one-sided p-values.

Table 3: ADF result at first difference

Variables	ADF test statistic	1%	5%	10%	Prob.*	Order of integration
LGDPPC	-3.322941**	-3.699871	-2.976263	-2.627420	0.0237	Stationary
LCO2	-7.560811***	-3.699871	-2.976263	-2.627420	0.0000	Stationary
LDCR	-5.955217***	-3.699871	-2.976263	-2.627420	0.0000	Stationary
LGCFF	-8.199890***	-3.699871	-2.976263	-2.627420	0.0000	Stationary
LLE	-2.435541	-3.724070	-2.986225	-2.632604	0.1427	Non Stationary
LGEE	-3.723287***	-3.699871	-2.976263	-2.627420	0.0095	Stationary
LLFPR	-4.400877***	-3.699871	-2.976263	-2.627420	0.0018	Stationary
LRMT	-3.855047***	-3.699871	-2.976263	-2.976263	0.0069	Stationary

Source: Author calculation using Eviews 10.0

*MacKinnon (1996) one-sided p-values.

Prior to calculating the ARDL Bound Test, we must first test the variables' stationary tests and ascertain the order in which they should be integrated.Because non-stationary variables result in regression that makes no sense (Granger, 1986).The obtained F-statistics, in accordance with Pesaran et al. (2001), are only valid when the variables are stationary and I(0) or I(1), not I(2).Here, we employ the most well-liked technique, the Augmented-Dicky Fuller test (ADF). From table 2 and table 3 we find that LGDPPC,LCO2,LDCR,LGEE,LLFPR and LRMT all variables are are non-stationary at level form but becomes stationary after first difference and it is statistically significant at 5% significance level,But LLE and LGCF is stationary at level form with a 1% significance level. So we get a mix result and is supports us for futher conducting the use of Autoregressive Distributed Lag(ARDL) approach to cointegration.

Table 4: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	277.5777	NA	2.94e-19	-19.96872	-19.58477	-19.85455
1	564.2617	382.2454	2.49e-26	-36.46383	-33.00827	-35.43631
2	735.1101	**126.5544***	**4.36e-29***	**-44.37853***	**-37.85135***	**-42.43766***
* indicates lag order selected by the criterion						

Source: Author calculation using Eviews 10.0

With the results of the unit root tests, we are now able to estimate the ARDL bound test to ascertain the cointegration between the variables.Lag order 2 has been identified by using the Unrestricted Vector Auto Regression (VAR) lag selection criterion.ARDL(2, 2, 1, 1, 2, 2, 2, 0) was the model we were able to select for our estimation by using the Scgwarz Information Criterion (SIC) and enforcing unconstrained constant and no trend (case-3).The results of the ARDL bounds test are shown in Table 5 for the model ARDL(2, 2, 1, 1, 2, 2, 2, 0).

Table 5: F-bound test and t-statistics for cointegration relationship

Null Hypothesis: No levels relationship				
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	32.82522	10%	2.03	3.13
K	7	5%	2.32	3.5
		2.5%	2.6	3.84
		1%	2.96	4.26

Null Hypothesis: No levels relationship				
Test Statistic	Value	Signif.	I(0)	I(1)
t-statistic	-6.846039	10%	-2.57	-4.23
		5%	-2.86	-4.57
		2.5%	-3.13	-4.85
		1%	-3.43	-5.19

Source: Author calculation using Eviews 10.0

Here we see that the calculated F-statistics value (32.82522)is greater than I(1) bound(4,26) at 1 % significant level and also the absolute value of t-statistics (-6.846039) is above the value from I(1) bound at 1 % significant level.This shows that there exist long-run cointegration among our studied variable.

Long run and short run model estimation:

The results of the long run model is shown in table 6 below:

Table 6: Results of long run model

Dependent variable : lnGDPPC				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LCO2	-0.223336	0.201002	-1.111115	0.3032
LDCR	0.000516	0.122688	0.004203	0.9968
LGCFF	-0.121886	0.028854	-4.224294	0.0039
LGEE	-0.499703	0.098609	-5.067509	0.0015
LLE	4.639158	1.667522	2.782066	0.0272
LLFPR	-5.752148	0.577100	-9.967335	0.0000
LRMT	0.063000	0.026890	2.342859	0.0516

Source: Author calculations

Table 6 shows that the domestic credit growth coefficient is positive but not statistically significant, meaning that a 1% rise in DCR will boost GDPPC by 0.00051% with all other factors being constant.At a 5% level of significance, there is a positive correlation between life expectancy and gross domestic output.GDPPC will increase by 4.64%, ceteris paribus, with every 1% increase in life

expectancy. Remittances, on the other hand, show a favourable and significant link with economic development (as measured by GDPPC).In other words, a 1% rise in RMT causes a long-term increase in GDPC of 0.063%.

Conversely, carbon emission(CO2),Gross capital formation(GCF) and Government Education expenditure (GEE) ,Labor force participation rate(LFPPR)are all observed negative impact on GDPPC. A 1% rise in atmospheric CO2 will just barely (by 0.22%) slow down economic growth. Equally, Economic development will be reduced by 0.12%, ceteris paribus, for every 1% increase in capital investment (GCF), which is statistically significant at the 1% level of significance. On the other hand, a 1% increase in government spending will result in a 0.50 percent, ceteris paribus, and considerable reduction in GDPPC. In the same way, a 1% increase in LFPR will decrease by 5.75%, ceteris paribus, and will be very significant at a 1% level of significance.

Because of its buildup in the atmosphere and its harmful impact on Bangladesh's economic growth, there are concerns for the health of the population. Oguntoke and Adeyemi (2017), The use of dangerous and filthy energy sources has led to a high concentration of CO2 and other pollutants in the atmosphere, which can have serious health impacts, including breathing difficulties, lung cancer, eye problems, and impairments. Matthew et al. (2018) and Matthew et al. (2019) confirm this. This may have a detrimental effect on labor productivity and impede economic growth in addition to lowering average life expectancy and increasing mortality. Health is a vital factor in determining the caliber of human capital, as it is a precondition for economic development and progress. Accordingly, the adage "health is wealth and a healthy nation is one that is wealthy" is not merely a slogan but rather true (Matthew et al., 2019). Government spending on education has a negative correlation with GDPPC; this may be due to the fact that in some countries, attendance at school and the accumulation of diplomas are given more weight than competence, skill development, and innovative talents. The quality of schooling could be hampered by this.2019 (Matthew et al.).

A functional education should help to improve economic development, however research indicates that Bangladesh does not have this. The level of education in Bangladesh is insufficient to have a beneficial effect on GDPPC (i.e., economic progress).This supports a study's finding that the problem of unemployment is made worse by increased education spending (Afolayan et al., 2019; Oladeji's (1989a; 2014; Matthew et al., 2019).

Table 7: Results of short run model (From ECM)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	15.50064	0.675687	22.94057	0.0000
D(LGDPPC(-1))	0.597004	0.035104	17.00668	0.0000
D(LCO2)	-0.035022	0.064701	-0.541289	0.6051
D(LCO2(-1))	0.190736	0.038743	4.923128	0.0017
D(LDCR)	-0.266420	0.040327	-6.606501	0.0003
D(LGCFF)	-0.083210	0.006599	-12.60992	0.0000
D(LGEE)	-0.050691	0.038093	-1.330735	0.2250
D(LGEE(-1))	0.405146	0.043308	9.354939	0.0000
D(LLE)	-100.6980	6.835968	-14.73061	0.0000
D(LLE(-1))	154.3564	8.818025	17.50465	0.0000
D(LLFPR)	0.557355	0.121411	4.590658	0.0025
D(LLFPR(-1))	8.524110	0.409195	20.83141	0.0000
CointEq(-1)*	-1.539692	0.067185	-22.91732	0.0000
R-squared	0.987424	F-statistic	91.60036	
Adjusted R-squared	0.976644	Prob(F-statistic)	0.000000	
F-statistic	91.60036	Durbin-Watson stat	3.085512	

Source: Author calculations

The error term produces dampening oscillations in the regression when the lagged error correction term coefficient is between -1 and -2.This suggests that the error correction mechanism does not uniformly converge to the equilibrium level but rather varies around the long-run value in a dampening approach. Following completion of this procedure, convergence to the equilibrium path occurs more quickly (Narayan and Smyth, 2006), Henrt 2021.

This table 7 shows that the adjustment coefficient's sign is negative and that it is statistically significant at the 1% level, which is consistent with the findings of Musyoka (2009) and Henry et al. (2002).In the next era, the economic development's deviations from long-term equilibrium are corrected by 154%.It will take roughly 6 months (or 1/1.54=) for this economic development equilibrium to oscillate fully to its equilibrium. Shorter adjustment periods are anticipated as a result of a greater adjustment coefficient.

The corrected R-squared value is 97.67%, indicating that all of the variation in the dependent variable is explained by the independent factors.

Diagnostic test:

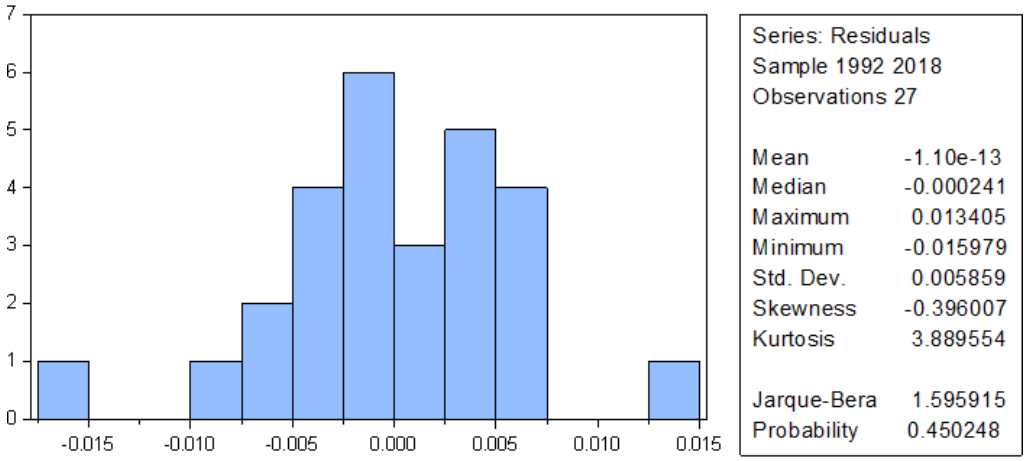
Table 8: Diagnostic test result

Test	F- statistic	P-value	Null hypothesis
Breusch-Godfrey Serial Correlation LM Test:	3.121935	0.1319	No serial correlation
Heteroskedasticity Test: Breusch-Pagan-Godfrey	0.402131	0.9483	Constant Variance
Ramsey-Reset Test(Omitted Variables):	0.031401	0.8652	No omitted variable

Source: Author calculations

According to the table's results, our model does not exhibit heteroskedasticity, as demonstrated by the high p-value (.9483) of the Breusch-Pagan-Godfrey test. This high p-value indicates that the null hypothesis of "Constant Variance" should be accepted. The high p-value of.01319 from the Breusch-Godfrey Serial Correlation LM Test, however, indicates that there is no serial correlation in the estimated model's residuals. The null hypothesis "No serial correlation" is thus accepted. The results of the Ramsey-Reset test further demonstrate the accuracy of the estimated model's definition. The high p-value of 0.8652, which indicates that no factors were eliminated, demonstrates this.

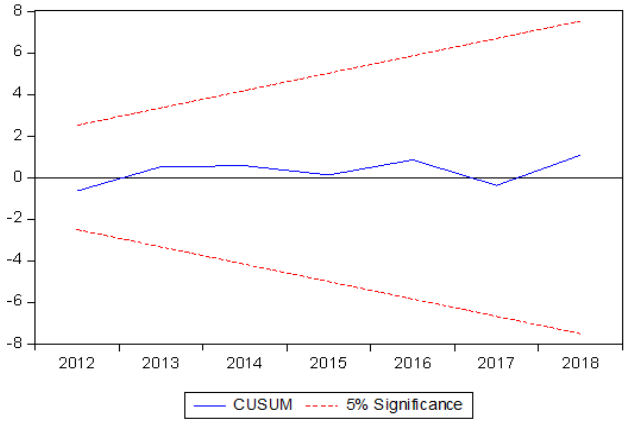
Normality Test: This figure demonstrates that the model's residual is normally distributed as indicated by the high p-value (0.450248).



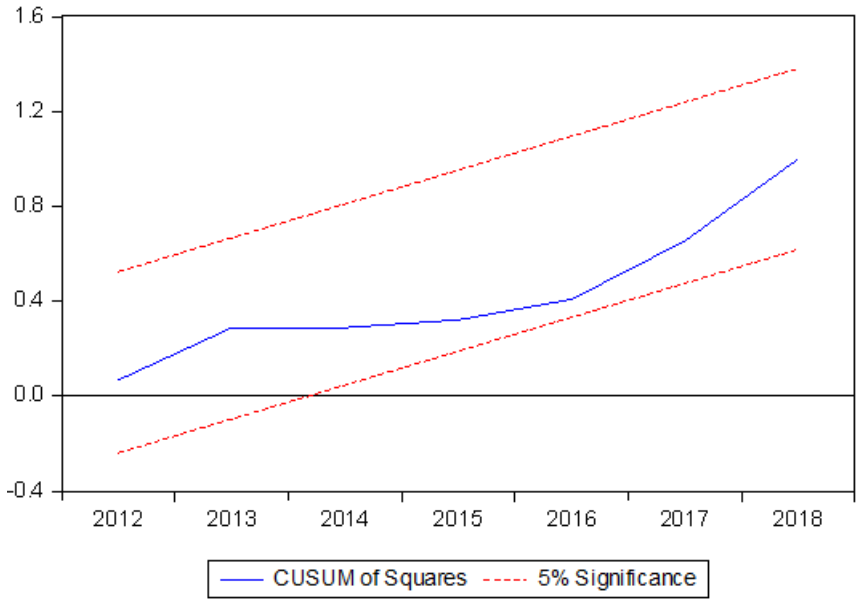
Source: Author calculations

Stability test:

We can see from figures 1 and 2 that the 5% critical limit is not exceeded by either the cumulative sum of recursive residuals (CUSUM) or the cumulative sum of recursive residuals of squares (CUSUMSQ).Therefore, the model's structural integrity is unbroken.



Source: Author calculations



Source: Author calculations

CONCLUSION

Bangladesh's economy is among the fastest-growing in the world. Bangladesh's economy ranks 25th in terms of purchasing power parity and 33rd in nominal terms, according to Wikipedia. Following the worldwide pandemic, macroeconomic stability, infrastructural upgrades, a burgeoning digital economy, and expanding trade flows contributed to Bangladesh's strong GDP growth rate of 7.2% in the fiscal year 2021–2022.With tax receipts making up just 7.7% of GDP, tax collection is still extremely low. Numerous non-performing loans and loan defaults in Bangladesh's banking sector have raised several worries. Bangladesh's current human capital investment scenario is inadequate when it comes to public spending on healthcare, education, labour force participation, foreign direct investment, and other critical elements. The people of this country are its most precious resource. To supply the needs of such a big population, both now and in the future, other forms of natural resources are limited and insufficient. Strategic problem solving involves more than just turning a lot of people into human capital. Governmental and non-governmental awareness has contributed to the development of a skilled man. Health and education spending has increased both in absolute terms and in terms of the percentage distribution of public spending. This growth in spending supports the labour force and helps our nation move towards sustainable development.

REFERENCES

1) Adeyemi, P. A., & Ogunsola, A. J. (2016). The Impact of Human Capital Developme nt on Economic Growth in Nigeria: ARDL Approach. IOSR Journal of Humanities and Social Science (IOSR JHSS), 21(3), 01-07.
2) Afolayan, O.T., Okodua, H., Oaikhenan, H., Matthew, O. (2020). Carbon emissions, human capital investment and economic development in Nigeria. 670216917.
3) Ahmad N, Du L, Lu J, Wang J, Li H-Z, Hashmi MZ (2017) Modeling the CO2 emissions and economic growth in Croatia: is there an environmental Kuznets curve? Energy 123:164–172. https://doi.org/10. 1016/j.energy.2016.12.106.
4) Alaali, F., Roberts, J., Taylor, K. (2015), The Effects of Energy Consumption and Human Capital on Economic Growth: An Exploration of Oil Exporting and Developed Countries. Sheffield Economic Research Paper Series, No. 2015015. England: The University of Sheffield.
5) Alam, J. (2014). On the relationship between economic growth and CO2 emissions: The Bangladesh experience. IOSR Journal of Economics and Finance (IOSR-JEF), 5(6), 36-41.
6) Balan, F. (2016), Environmental quality and its human health effects: A causal analysis for the EU-25. International Journal of Applied Economics, 13(1), 57-71.
7) Bawono, S. (2021). Human capital, technology, and economic growth: A case study of Indonesia. Journal of Asian Finance, Economics and Business.
8) Behera, S.R., Dash, D.P. (2017), The effect of urbanization, energy consumption, and foreign direct investment on the carbon dioxide emission in the SSEA (South and Southeast Asian) region. Renewable and Sustainable Energy Reviews, 70, 96-106.
9) Bozkurt, C. and Akan, Y., "Economic Growth, CO2 Emissions and Energy Consumption: The Turkish Case", International Journal of Energy Economics and Policy, Vol.4, No.3, pp. 484-494, 2014.

10) Chindo, S., Abdulrahim, A., Waziri, S.I., Huong, W.M., Ahmad, A.A. (2015), Energy consumption, CO2 emissions and GDP in Nigeria. GeoJournal, 80(3), 315-322.
11) Dauda, R.O. (2010). Role of Human Capital in Economic Development: An Empirical Study of Nigeria Case, Selected Papers for 2010. UK: Oxford Business and Economic Conference Program.
12) Ghosh, B. C., Alam, K. J., & Osmani, M. A. G. (2014). Economic growth, CO2 emissions and energy consumption: The case of Bangladesh. International Journal of Business and Economics Research, 3(6), 220-227.
13) Gojayev, Z., Sarmidi, T., Salleh, N.H., Jafari, Y., "Economic Growth, Energy Consumption and Environmental Pollutants: The Case of Turkey", Prosiding Perkem, 7(2), 1047-1057, 2012.
14) Gujarati, D.N. (1995). Basic Econometrics. McGraw-Hill, London.
15) Huaman, R. N. E., & Jun, T. X. (2014). Energy related CO2 emissions and the progress on CCS projects: A review. Renewable and Sustainable Energy Reviews, 31, 368–385.
16) IPCC. (2015). Climate change 2014, synthesis report, 978–92-9169-143-2. IPCC.
17) Jaiyeoba, S. V. (2015). Human capital investment and economic growth in Nigeria. African Research Review, 9(1), 30-46.
18) Jiang, X.T., Li, R. (2017), Decoupling and decomposition analysis of carbon emissions from electric output in the United States. Sustainability, 9(6), 1-13.
19) Kuznets, S. (1955). Economic growth and income inequality. American Economic Review, 45, 1–28.
20) Kuznets, Simon, "Modern Economic Growth: Findings and Reflections', (Nobel address), American Economic Review, 63, 247-58, 1973.
21) Lu, W.C. (2017), Greenhouse gas emissions, energy consumption and economic growth: A panel co-integration analysis for 16 Asian countries. International Journal of Environmental Research and Public Health, 14(11), 1436.
22) Matthew, O., Osabohien, R., Fagbeminiyi, F., Fasina A. (2018), Greenhouse gas emissions and health outcomes in Nigeria: Empirical insights from ARDL technique. International Journal of Energy Economics and Policy, 8(3), 43-50.
23) Mohammed, A.M., Nassor, S.N., Omar, B.H. (2015), The relationship between energy consumption, CO2 emissions and economic growth in Tanzania. International Journal of Energy Sector Management, 9(3), 361-375.
24) Narayan, P.K., Smyth, R. (2007), Energy consumption and real GDP in G7 countries: New evidence from panel co-integration with structural breaks. Energy Economics, 30(5), 2331-2341.
25) Obialor, M. C. (2017). Effect of government human capital investment on economic growth in Sub-Saharan Africa: Evidence from Nigeria, South Africa and Ghana (1980-2013). International Journal of Asian Social Science, 7(4), 328-339.
26) Odusola, A.F. (1998). Human Capital Investment and the Empirics of Economic Growth in Nigeria, In Rekindling Investment for Economic Development in Nigeria Selected Papers for 1998 NES Annual Conferences, Ibadan: Nigerian Economic Society. pp. 257-272.
27) Peters, G. P., Weber, C. L., Guan, D., & Hubacek, K. (2007). China's growing CO2 emissions a race between increasing con- sumption and efciency gains. Environmental Science & Technology, 41, 5939–5944.
28) Shuaibu, M.I., Oyinlola, M.A. (2013), Energy Consumption, CO2 Emissions and Economic Growth in Nigeria. Lagos, Nigeria: Paper Presented at the 2013 NAEE International Conference.
29) Todaro, M. P.; Smith, S. C., Economic development, eleventh edition. Pearson Education limited: England. 865 p, 2011.
30) World Bank. (2020). The world development indicators, https://databank.worldbank.org/source/worlddevelopment-indicators#
31) Yazdi, S.K., Zahra, T., Nikos, M. (2014), Public healthcare expenditure and environmental quality in Iran. Recent Advances in Applied Economics, 1, 126-134.
32) Zeshan, M., Ahmed, V., "Energy, environment and growth nexus in South Asia", Environment, Development and Sustainability,15(6), 1465-1475, 2013.
33) Zhang, X.P., Cheng, X.M. (2009), Energy consumption, carbon emissions and economic growth in China. Ecological Economics, 68, 2706-2712.