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# Impact of Human Capital and Human Security on the Economic Growth of Bangladesh: An Empirical Study

**Shyamal C N Talukder**[1]

**Abstract**

*This research attempted to examine the effect of human capital and human security on the economic growth of Bangladesh employing annual timeseries over the years 1981-2019. The paper also attempted to look into the connection between government spending on health, investment, and economic growth. An econometric framework for non-stationary timeseries was used in the research. The Johansen test showed that there was cointegration between the variables, but neither the VECM nor the ARDL model could establish any meaningful long-term causality. In the VECM model's short-run dynamics, lag-3 human security was identified as being significantly positively related to economic growth, whereas in the ARDL model, lag-3 investment was identified as having a significantly positive effect on economic growth and lag-1 human capital as having a significantly negative impact. According to the Granger causality test, lagged investment and lagged human security have an effect on economic growth, but lagged government health expenditure and lagged human capital do not. The OLS test identified human capital, and investment as having a substantial impact on Bangladesh's economic growth. The research recommends increasing funding for capacity building and human resource development, modernizing agriculture, and ensuring human security.*

**Keywords:** Human capital, human security, government expenditure on education and health, economic growth of Bangladesh

## 1. Introduction

Dusche (2012) defined development as the "expansion of the people's freedom, political liberties, economic chances, social opportunities, transparency guarantees, and protective security". Human liberty is the ultimate end goal as well as the major means of development, which mostly depends on human development. Sustainable human development is growth that empowers people instead of marginalizing them, regenerates the environment instead of destroying it, and distributes the benefits of economic progress fairly. Human development is possible through the development

[1] Additional Director, Infrastructure Investment Facilitation Company (IIFC), Dhaka-1215, Bangladesh. Email: shyamalcnt77@hotmail.com

The author is currently an MPhil Student at Centre for Higher Studies and Research, Bangladesh University of Professionals (BUP), Dhaka-1216, Bangladesh.

of human capital – increasing years of schooling by education, training, work experience, etc. and the development of human security – economic, health, food, environment, political security, etc. (Klingebiel & Hildebrand, 1994).

Human capital development is the process of making and growing a group of people skilled, knowledgeable, and experienced in a specific field required for economic progress (Adelakun, 2011). Earnings of better-educated people are usually always higher than average, and they are significantly higher in less developed countries (Caire & Becker, 1967). People empowered by education not only strengthen nations and fosters growth but also help change demographic habits, which are directly or indirectly connected to the nutrition, physical and mental well-being of the people, especially life expectancy, reproductive health, and child mortality (Islam, 2020). So, education is critical to encouraging growth, particularly in industrialized countries (Annabi et al., 2011). Besides, human security supported it's seven dimensions is also an important issue for human development. Whether increased government expenditure fosters economic progress is a crucial subject in the classical theory of growth and literature (Alshahrani & Alsadiq, 2014). There are a number of literature on the effects of government spending on health and education on Bangladesh's economic growth. The goal of this research is to add something new which is avoided in the existing research.

Considering the importance of human security (HS), and human capital (HC) development, governments of the developing world design their expenditure strategy on education, health and nutrition, social safety, and other related sectors, so that the scarce resources are properly utilized to enhance the economic growth. Bangladesh, as a developing nation, also needs to explore such strategy that will ensure the appropriate allocation of public resources. So, it is necessary for the government to reveal whether the development indicators such as human capital and human security have short-run and/or long-run impacts on Bangladesh's economic growth.

According to some recent research, Bangladesh has made significant progress in human development during the past three decades. A few measures of social and economic advancement have mirrored the development of these sectors. In Bangladesh, per capita GDP increased to Tk. 177,843 in 2020-2021 from Tk. 34,502 in 2005-06. Gross fixed capital formation was 14.44 percent of GDP in 1980, and has increased to 30.47 percent in 2020. The growth rate of the population declined from 2.17 per cent in 1991 to 1 per cent in 2020, and the labour force participation rate decreased from 59.04 percent in 1990 to 58.34 percent in 2019. Bangladesh's Human Development Index (HDI) for 2020 shows an improvement in life expectancy at birth to 72.6 years, mean years of education to 6.2 years, and HDI value to 0.632 in 2019, compared to 58.2 years, 2.8 years, and 0.394 in 1990. This upward tendency is expected to continue if the government allocates resources in strategic ways.

Following the empirical evidence, investment in health and education fosters economic prosperity. According to Lucas (1988), public education investment creates "human capital", which quickens the pace of long-term economic progress.

Romer (1990) takes a similar approach, arguing that spending on research and development boosts a country's long-term economic growth. Romer (1989) and Bauchet and Rostow (1961) indicate in econometric literature that education has spillover effects, improves entrepreneurs' ability to adapt to disequilibrium, and increases research output. However, empirical studies frequently fall short of demonstrating such a connection between 'human capital' and 'economic growth', especially in developing nations. According to Levine and Renelt (1992), economic growth is not statistically significantly impacted by schooling. According to Dessus et al. (2001), educational investment in poor nations does not result in faster growth.

This study examined how human security and human capital affected Bangladesh's economic development. This has attempted to address the following questions: Does there exist a causal relationship between human security, human capital, and economic progress over the long and/or short terms? Do these factors have impacts on the growth of Bangladesh? The findings of these research questions will aid us in realizing the dynamic relationship of economic progress with human security, and human capital. This will also assist policymakers in determining which areas they should focus on or where strategic changes in funding are required in the long and near term.

Following the introduction, the remainder of the paper is divided into the following sections: section two discusses the literature review; section three discusses the methodology; section four discusses the results; and section five discusses the conclusion and recommendations.

## 2. Literature Review

In developing countries like Bangladesh, there is an abundance of population, most of which live in villages and semi-urban areas where the scope of education is limited to the urban centres. It is a densely populated country with limited natural resources, which will be depleted unless alternative sources are discovered. The strength of the country is vested in its large population (World Bank, 2002) and the development of human resources is the main factor of growth and development. Sustainable development also requires the workforce to be free from want and free from fear. Freedom from want is possible by ensuring "economic security, food security, health security and environmental security", while freedom from fear can be ensured by providing "personal, community security, and political security" (Klingebiel & Hildebrand, 1994). In this study, human security, and human capital, considered as the two components of human development that are assumed to affect Bangladesh's economic progress.

There exist a lot of studies regarding the influence of HC and HS on economic development in the literature of economic research, although a handful of them on Bangladesh's perspective. Mankiw Gregory et al. (1992) extended the "Solow Growth Model" incorporating the HC along with physical capital in a view to examine the cross-country variation of a standard of living. The extended model was effectively fitted for describing the cross-country data. Rao et al. (2010) using time

series data suggested further extension of the growth model of the neo-classical framework in the context of Guatemala. Bashar and Khan (2012) using the data over the period 1974-2007 of physical, and human capital revealed positive economic growth. As a proxy for HC, he used secondary enrolment rates, while the investment-GDP ratio served as a proxy for physical capital.

Some researchers found favourable effects of health and education expenditure, HC on the growth trajectory. Investigating the effect of public education expenditure and gross investment on the growth of Azerbaijan during 1995-2018, Mukhtarov et al. (2020) found a statistically significant positive relationship on long-run growth. Musila and Belassi (2004) found a positive association between public education spending and economic progress in the short-run as well as in the long-run in Uganda employing time series during the period 1965-1999. Using probit model, Megawati (2020) found a statistically significant positive effect of public education spending on school enrollment, and positive causality between government education expenditure and a greater likelihood of enrollment in school for underprivileged kids in Indonesia. Conducting the Johansen test for cointegration and bi-directional causality test of Engle and Granger on growth, public expenditure on education, labour, and capital of France during 1970-2012, Ozatac et al. (2018) found the variables as the determinants of GDP for France, and unidirectional causalities to GDP from education spending and labour, and to capital from labour. Yahya et al. (2012) found positive cointegration of GDP with fixed investment, participation of labour-force, and public education expenditure, and bidirectional short-term Granger cause for education expenditure and economic progress by applying VAR and "Granger Causality" test using the timeseries over the period 1970 to 2010 in Malaysia. Boussalem et al. (2014) by employing the time series of public health spending on growth in Algeria over the period 1974-2014 and applying cointegration and causality tests in an error correction framework found only long-term causality from public spending on health to growth. Erçelik (2018), by employing the ARDL model on health spending (both public and private) and growth in Turkey employing the timeseries from 1980 to 2015, found the existence of cointegration between the variables. Examining macroeconomic factors of growth, Chirwa and Odhiambo (2017) found a positive association between HC and growth in the short-run and long-run in Zambia. Another researcher Kurt (2015) using the Feder–Ram model in Turkey and analyzing data set between January 2006 and October 2013 period considering monthly data revealed direct effect of public health spending on growth significantly positive, while that of indirect effect significantly negative.

Some researchers conducted their studies using cross-country data and found diverse results. Employing the panel cointegration test and FMOLS test to compare the effect of public education expenditure on gross domestic products in developed and developing countries, Idrees (2013) revealed less impact on developed countries than developing countries. Frank (2018) found empirically inconclusive evidence of education expenditure's effect on growth by studying 179 countries during 1970-

2014. The research revealed an overall positive effect of education spending on growth, but found the opposite in developing countries and an insignificant impact in OECD countries. Mallick (2016) found education expenditure being among the crucial growth factors in fourteen countries of the Asian region using panel data over the period 1973-2012 and applying the cointegration test, FMOLS, panel VECM, and Granger causality test. Baum and Lin (1993), by analyzing the differential effects of different public expenditures of 58 countries, found a significantly positive effect of education spending on growth, while welfare expenditure has a negative impact and defense expenditure showed significant growth in a subset of the sample countries, which has data for a longer period. Siddiqui and Rehman (2017) studied the causal effect between economic growth and education across two Asian regions and found a positive association between growth and public education expenditure. The study also showed that the disparities in educational advancement between East and South Asia are related to the growth rates in the two regions. Devlin and Hansen (2001) examined the causality between GDP and expenditure on health for 20 OECD countries. The result of the study reveals that for a sub-set of the 20 OECD members, health expenses Granger-cause GDP and the reverse is true for others. Another researcher Heshmati (2001), conducting a research on OECD members employing a dataset over 1970-1992, found that health care expenditure positively impacts GDP growth. Maitra and Mukhopadhyay (2013) found long-term causality between government education and health expenditure, and health and GDP applying cointegration test. The study also found a positive effect of health and education expenditure on GDP. Muneer and Islam (2018) conducted a comparative analysis of economic growth and human development between Pakistan and Bangladesh and revealed that Bangladesh, which has more limited resources than Pakistan, spends a good amount more of its GDP on health to improve the health of its population than that of Pakistan, but public spending on education in both nations has remained more or less same.

According to several studies, there is little connection between spending on education and economic progress. Specifically, Benhabib and Spiegel (1994) using cross-country data, found an insignificant effect of HC on growth rates per capita. Likewise, Islam (1995) and Pritchett (2001) using a panel data set failed to obtain significant evidence of the association between human capital and per capita output. Tamang (2011) found a lesser impact of labour expenditure on economic growth compared to capital using the time series during 1980-2008 in the Indian economy. Al-Yousif (2008) found mixed results using time series during 1977-2004 by employing the Granger causality test on education spending and growth trajectory in the six "Gulf Cooperation Council" countries. Harry and Onyinyechika (2021) did not find any significant positive results due to the increase in government education spending, health, and HDI on economic growth in Nigeria from 1980 to 2019 employing the Johansen test for Co-integration and VECM method. Okuneye et al. (2008) found no impact of the short-run government expenditure on economic growth, and revealed an association between public expenditure and growth in

Nigeria in the long-term using the Cobb-Douglas production function-based extended Solow model, cointegration and VEC models.

In Bangladesh, most of the research found a positive association between public health spending, public education spending, human capital, and economic growth. Islam and Alam (2022), employing the ARDL model and Toda-Yamamato Granger causality test on the time series for the year 1990-2019 of the HC (outlay of education and health expenditure of the government) and GDP growth of Bangladesh revealed the positive influence of health expenditure on the whole but negative influence in short-run while health expenditure impacted positively in short-run and negatively in the long-run. The research found unidirectional causality to growth from education and health expenditure. Ahmed et al. (2020), using the time series of material resources, financial progress, and HC for the years 1985–2019 in Bangladesh and applying the ARDL model and Granger causality test revealed that physical infrastructure, HC, and financial progress had positive and negative effects on growth respectively. Pomi et al. (2021) found a favourable effect of the independent variables on growth employing dataset during 2000-2019 in Bangladesh and the VAR model on HC, physical capital, and growth. Ahmad and French (2011), utilizing VEC, VAR, and Granger causality tests, discovered a positive association between Bangladesh's GDP and HC between 1973 and 2004. Maitra (2018), by applying the Johansen test revealed a long-term association between income and investments in capital, health, and education. By applying the Granger causality test, VECM model, and Johansen test for cointegration, it was also discovered that there was a positive relationship in the lag period to increase income in Bangladesh between 1980 and 2016. The study discovered a high positive correlation between life expectancy, income, and health care spending, but found negative correlation between life expectancy and education spending. The government's spending on education and Bangladesh's economic growth for the years 1973 to 2009 were examined by Arif et al. (2015) using the Johansen test for Cointegration, the VEC Model, and the Granger Causality Test. These analyses revealed a long-term relationship between the variables and a single-direction causality running from education spending to GDP, suggesting that Bangladesh's economic growth is influenced by investments in education. Sharif (2013) taking into account the endogenous growth models –Lucas (1988) and Romer (1990), and applying the ADF test and Granger causality test on a hypothetical model of growth revealed a positive association between HRD activities and growth in Bangladesh in which investment on education showed significant role in economic growth. Sen et al. (2018) revealed a significant positive correlation between education and growth following the coefficient of determination, correlation coefficient, t-test, and F- test using the time series from 2001 to 2015 in Bangladesh. Islam and Khan (2019) found a positive association between government health spending and economic growth and no impact on current expenditure using timeseries during 1998-2017 in Bangladesh and employing the Granger causality test and the Johansen test of cointegration. The researcher also found that GDP growth Granger cause government education

expenditure but not current expenditure. Islam (2020), examining the association of health and education expenditure, food security and economic growth in Bangladesh based on the time series from 1998 to 2017 (World Bank Data) applying the descriptive statistics and the Engle-Granger cointegration test found a positive association between education spending and growth in short as well as in the long-run. Rahman (2011) found that spending on health and education increases the significance of the HC and physical capital coefficient of the growth equation. The Granger causality test revealed only one-way causation between health spending and GDP and two-way causality between education spending and GDP by using timeseries data from 1990 to 2009 in Bangladesh and employing the Engle and Granger (1987) test of cointegration, ECM model, and "Granger causality test". Mamun and Arfanuzzaman (2020) discovered that HC and social characteristics have a strong illustrative capacity to explain the household's monthly income using the cross-section data set of 9943 samples from the HIES and applying OLS.

### *2.1 Research Gap*

Studying the above literature, it is found that different researchers applied different methods for analyzing the data and found diverse outcomes based on the differentiated variables. Researchers used country-specific time series or cross-sectional data and cross-country data based on their research objectives. Researchers, who focus on the impact of government education and health spending on the growth trajectory of Bangladesh used the timeseries ranging from 1998 to 2017. Besides, some studies used human capital and government healthcare expenditure as explanatory variables to reveal the effects on growth. But none of the research in the literature in Bangladesh has used the human security index as a proxy of human security to examine its effects on growth. So, this research has attempted to examine the causality between HC, government health spending, human security, investment, and the GDP per labour and examine their effects on economic growth employing techniques for a non-stationary time series dataset. The variable 'Human Security' is the Human Security Index (HIS), constructed based on the procedure of "UNDP Human Development Index" (HDI) using the time series of GNI per capita PPP and "Life Expectancy at birth (LE)" over the period 1981-2019, which is yet to be done by any researcher in the context of Bangladesh.

## 3. Data and Methodology

### *3.1 Specification of Variables and Data Sources*

The basic model consists of five variables – real GDP per person engaged (GDPL), human capital (HC), government health expenditure (HEX), human security (HS), and investment (INV). The variable real GDP per person engaged, i.e., the productivity of labor is the proxy of "economic growth", "human capital index" is the proxy of "human capital", "human security index" is the proxy of "human security", and "gross fixed capital formation" (GFCF) is the proxy of investment. The study analyzed the data of the above variables over the year 1981-2019. Data on real GDP per person engaged have been constituted by dividing the real GDP, which

was extracted from the World Bank WDI, by the number of employed persons in the respective years, data of which was extracted from Penn World Table (PWT 10). Data on government health expenditure was collected from Bangladesh Economic Review (for the period 1995-2019) and that for the period 1981-1985 from the report "Public Expenditure and Social Development in Bangladesh (Chowdhury & Sen, 1998). Data on GFCF was extracted from the World Bank WDI. Data on the human capital index was collected from PWT 10, which has been constructed by normalizing the data based on the attainment of the schooling years. Data on the human security index has been constructed by the author by normalizing the data on GNI per capita PPP and life expectancy at birth and then by calculating the geometric means of the normalized data based on the procedure of calculating the UNDP Human Development Index. In the basic regression model, Economic Growth (GDPL) is the dependent variable, and HC, HEX, HS and INV are the independent variables.

### *3.2 Empirical Methodology*

In this study, econometric approaches of the non-stationary timeseries framework have been applied to assess the causality between variables and ordinary least squared (OLS) regression of the first differenced of the series to examine the effects of independent variables on the dependent variable. To check the stationarity of the data set, unit root tests were performed, because ignoring nonstationary data results in a spurious link between the variables (Granger & Newbold, 1974). Then cointegration test was followed by the "error correction model", "autoregressive distributed lag model", the "Granger causality test", and finally the OLS regression was performed.

"The characteristic roots of the autoregressive or moving average polynomial of an Autoregressive Moving Average (ARMA) model sits on or near the unit circle" is a definition of a unit root in a time series. The time series with unit roots have unstable means and variable variances, which increases overtime resulting spurious regression (Granger & Newbold, 1974)- this is because the series contains effects of shocks permanently perpetuating in a long-run period. The "Augmented Dicky-Fuller (ADF)" test, the "Phillips Perron (PP) test," and the Dickey-Fuller Generalized Least Square (DF-GLS) tests" have all been employed in this study to check for the presence of unit roots in the data. The hypotheses for unit root tests are:

$H_0$: $Variable\ is\ non-stationary\ or\ have\ unit\ root$

$H_a$: $Variable\ is\ stationary\ or\ does\ not\ have\ unit\ root$)

After getting confirmation of stationarity, the first difference of the non-stationary variables was performed to make it stationary, and then conducted the test of cointegration between the non-stationary variables.

Generally, to be cointegrated, variables must be stationary at first differenced and nonstationary at a level. In this study, Johansen test for cointegration (Søren Johansen, 1988, 1991) has been employed using Stata. Johansen test of cointegration

is conducted to reveal whether variables under study are cointegrated or not. If variables are cointegrated, then the VECM model is employed, but if not, then the unrestricted VAR model is used. If variables are of I (1) and have cointegration among the series then the VECM model, which estimates both the long-term and short-term causality between timeseries, is used. It determines the speed of adjustment towards long-run equilibrium.

When the regressors include current and lagged values of one or more explanatory variables along with lagged values of the dependent variables, an ARDL relation is present. If the variables under investigation fall within both I (1) and I (0), the ARDL model is used to explore both the short- and long-term causal relationships between the variables. The "Bounds Test" have been carried out to estimate every coefficient of the ARDL model or its error correction representations and test whether there is long-term causality between the variables.

To determine the combined impact of the lag variables on the dependent variable, the Granger causality test is utilized. To perform the Granger causality test, data should be stationary either at level or at first/second difference. No seasonal component should be considered in this test. If $x_t$ and $y_t$ are two stationary series at level/first differenced/second differenced, which affect each other with distributed lags then the VAR model is applied at the first step and the augmented auto regression of the model is estimated. The hypotheses of the Granger causality test are:

Null Hypothesis, $H_0$: No Granger causality.

Alternative Hypothesis, $H_a$: $x_t$ Granger causes $y_t$ or $y_t$ Granger causes $x_t$ or both.

### *3.3 Specification of the Models*

The mathematical model was designed to establish a link between the human capital index as a proxy of human capital (HC), human security index as a proxy of human security (HS), government health expenditure (HEX), gross fixed capital formation as a proxy of investment (INV) and real GDP per person engaged, i.e., the productivity of labour as a proxy of economic growth. The following is the mathematical model for the above relationship:

$$GDPL = f(HC, HEX, HS, INV) \quad (1)$$

Where, GDPL is the real GDP growth per person engaged, HC is the human capital, HEX is the government health expenditure, HS is the human security, and INV is the investment. In the econometric form, equation (1) can be written as:

$$GDPL_t = \alpha + \beta_1 HC_t + \beta_2 HEX_t + \beta_3 HS_t + \beta_4 INV_t + u_t \quad (2)$$

Where, $\alpha$ is the constant term, $\beta_i$ are the coefficients of the respective variables, and $u_t$ is the error term.

If the co-integration of the variables is established, we can further specify the model for error correction as:

$$\Delta GDPL_t = \alpha + \beta_1 \Delta HC_{t-k} + \beta_2 \Delta HEX_{t-k} + \beta_3 \Delta HS_{t-k} + \beta_4 \Delta INV_{t-k} + \beta_5 ECT_{t-1} + \varepsilon_t \quad (3)$$

Where, $\beta_5$ is the coefficient of the error correction term. It is the residuals' lagged value produced from the variables' co-integrating regression and reflects how quickly the system adjusts to the long-term equilibrium path.

## 4. Results and Discussion

It is first necessary to determine if the series has a unit root or not to examine the link between the non-stationary timeseries and disclose the effect of the independent variable on the dependent variable. The ADF test, PP test, and DF-GLS test are the three-unit root test methodologies have been employed in this work. According to the experiments by ADF tests and PP tests, all variable series are stationary at the first difference and nonstationary at the level. But the test statistics of the human capital variable in ADF and PP tests (without trend) were found less than the critical value in the first differenced, and in the PP test (without trend) test statistic is greater than the critical value at level, implying the stationarity of the variable at the level. Besides, in DF-GLS tests, test statistics of all the variables at the level are smaller than critical values while that are greater than that in the first differenced, i.e., variables are I (1) variables. The nonstationary components are removed by the series' first differencing, and the null hypothesis of non-stationarity has been decisively rejected at the different significance, indicating that all the variables are integrated of order one, i.e., I (1). The unit root test outputs have been shown in Table 1.

**Table 1: Results of unit root tests**

| | **Test Statistics at Level** | | | | | |
|---|---|---|---|---|---|---|
| | **ADF Test** | | **PP Test** | | **DF-GLS** | |
| Variables | Constant | Constant and Trend | Constant | Constant and Trend | Tau Stat | k |
| GDPL | 1.43 | -1.78 | 1.505 | -1.848 | -1.167 | 1 |
| HC | 2.841 | -0.178 | 9.946 | 0.466 | -0.802 | 1 |
| HEX | -1.631 | -1.119 | -1.589 | -1.221 | -1.241 | 1 |
| HS | 1.885 | -1.773 | 2.21 | -1.124 | -0.849 | 1 |
| INV | 1.856 | -0.881 | 1.413 | -1.342 | -0.872 | 1 |
| | **Test Statistics at First Differenced** | | | | | |
| Variables | Constant | Constant and Trend | Constant | Constant and Trend | Tau Stat | k |
| GDPL | -4.88*** | -5.63*** | -5.64*** | -6.12*** | -4.794 | 1 |
| HC | -1.26 | -3.73* | -1.25 | -3.39* | -3.771 | 1 |
| HEX | -4.44*** | -4.77*** | -6.5*** | -6.63*** | -3.789 | 1 |
| HS | -4.03** | -4.59** | -4.57*** | -5.32*** | -3.746 | 1 |
| INV | -3.52** | -3.96** | -7.13*** | -7.79*** | -3.404 | 1 |

*Source: Author's calculation*

*Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, which denotes the rejection of the null hypothesis of non-stationarity. Critical values of the ADF and PP tests are -2.96, and -3.54 for the first, and second models respectively. In the DF-GLS test, 5% critical value is -3.336, 10% critical value is -3.020.*

To further proceed to the analysis, of whether there exists short and long-run association among the series, it is necessary to examine whether they are cointegrated or not. As all the series are I (1), both the Johansen method and ARDL model have been employed in the research. Mentionable that as per guidelines, for the Johansen test, the series must be non-stationary at level but stationary at first differenced, i.e., the variable must be I (1), and for the ARDL model, mixed of I (0) and I (1) variables can be used. So, we have run both the Johansen cointegration model and the ARDL model for cointegration analysis.

### *4.1 Johansen Test for Cointegration*

Before employing the Johansen test, a test for lag order selection criteria has been employed. As per the criteria of AIC, HQIC, FPE, and LR, lag order four was selected to run the Johansen test. The Søren Johansen (1988) maximum likelihood method has been used to estimate and test for the existence of cointegrating vectors., the output of which is displayed in Table 2.

**Table 2: Results of Johansen test of cointegration**

| Trend: | Constant | | Number of observation = 35 | | |
|---|---|---|---|---|---|
| Sample: | 1982-2019 | | Lags | = 4 | |
| maximum rank | parms | LL | eigenvalue | trace statistic | 5% critical value |
| 0 | 80 | 636.56977 | . | 106.354 | 68.52 |
| 1 | 89 | 659.17262 | 0.72517 | 61.1483 | 47.21 |
| 2 | 96 | 673.68193 | 0.56356 | 32.1297 | 29.68 |
| 3 | 101 | 682.91107 | 0.40985 | 13.6714* | 15.41 |
| 4 | 104 | 687.61054 | 0.23551 | 4.2725 | 3.76 |
| 5 | 105 | 680.74677 | 0.11491 | | |

*Source: Author's calculation*

In the Johansen method, the long-term relationship of HC, government health spending, human security, and investment with economic growth have been examined. The results displayed in Table 2 show that both the trace statistic and maximum eigenvalue statistic have rejected the null hypotheses of having no cointegrating relation and one cointegrating relations. Then the trace statistic also rejected the null of having two cointegrating relation, but the max eigenvalue statistic failed to reject the same. So, it has been decisively concluded that there exist two cointegrating equations in the model. The Johansen test of cointegration reveals that the variables of economic growth, human capital, government health expenditure, human security, and investment in Bangladesh can move together in the long run. To confirm the results, whether there exist long-run as well as short-run causality among the variables, the vector error correction model has been employed.

### *4.2 Vector Error Correction Model*

As the Johansen test of cointegration has exhibited the presence of a cointegrating relation between the variables, the VECM model was employed to confirm whether there exists long-term causality among the series, and also to examine short-term causality running from human capital, government health

expenditure, human security, and investment to economic growth. The model was run using lag year four recommended by the criteria of AIC, HQIC, FPE, and LR. Table 3 (a) represents the outcomes of the VECM model.

**Table 3: Results of VECM and ARDL models**

| a) Results of VECM Model | | b) Results of ARDL Model | |
|---|---|---|---|
| D_GDPL | | | D.GDPL |
| L._ce1 | -0.00307 | ADJ | |
| | (0.173) | | |
| L._ce2 | -0.00607 | L.GDPL | -0.0987 |
| | (0.00733) | | (0.121) |
| LD.GDPL | 0.331 | LR | |
| | (0.674) | | |
| L2D.GDPL | -0.556 | HC | 0.135 |
| | (0.583) | | (0.158) |
| L3D.GDPL | 1.213 | HEX | -0.0107 |
| | (0.695) | | (0.0105) |
| LD.HC | 0.0187 | HS | -0.147 |
| | (0.0421) | | (0.189) |
| L2D.HC | 0.00837 | INV | -0.00200 |
| | (0.0558) | | (0.00251) |
| L3D.HC | 0.0293 | SR | |
| | (0.0460) | | |
| LD.HEX | 0.000165 | LD.GDPL | -0.109 |
| | (0.00135) | | (0.264) |
| L2D.HEX | 0.0000493 | L2D.GDPL | -0.450 |
| | (0.00165) | | (0.251) |
| L3D.HEX | -0.00203 | L3D.GDPL | 0.377 |
| | (0.00179) | | (0.250) |
| LD.HS | -0.0000728 | D.HC | -0.00594 |
| | (0.0153) | | (0.0147) |
| L2D.HS | 0.0197 | LD.HC | -0.0452* |
| | (0.0165) | | (0.0174) |
| L3D.HS | 0.0283* | L2D.HC | -0.0122 |
| | (0.0120) | | (0.0171) |
| LD.INV | 0.0000576 | D.HEX | 0.000255 |
| | (0.000187) | | (0.000511) |
| L2D.INV | -0.000140 | D.HS | 0.00731 |
| | (0.000199) | | (0.00715) |
| L3D.INV | 0.000356 | D.INV | -0.0000901 |
| | (0.000199) | | (0.0000770) |
| _cons | -0.0000368 | LD.INV | 0.0000134 |
| | (0.000470) | | (0.0000741) |
| | | L2D.INV | 0.0000495 |
| | | | (0.0000793) |
| *Standard errors in parentheses* | | L3D.INV | 0.000269** |
| ** p < 0.05, ** p < 0.01, *** p < 0.001* | | | (0.0000699) |
| | | _cons | -0.00667** |
| | | | (0.00199) |

*Source: Author's calculation*

In Table 3 (a), the parameters of the prior period error correction mechanism and the short-run dynamics are computed, together with their standard errors and confidence intervals. The error correction terms, ce1 (0.00307), and ce2 (0.00607) have a negative sign, but they are not statistically significant implying that HC, government health expenditure, human security, and investment do not have any significant effect on economic growth to make a long-run equilibrium relationship in Bangladesh. On the other hand, the VECM dynamics show the presence of short-term causality running from the lag-3 human security to growth. To check the robustness of the VECM model, the ARDL model has been employed.

Diagnostic checking was conducted for the error correction model. The LM test failed to reject the null hypotheses that there is no serial correlation, and Jarque-Bera test has failed to reject the null hypothesis of the residuals' normality. This implies that the residuals of the model are not autocorrelated and they are also normally distributed, i.e., the model is statistically fit.

### *4.3 Autoregressive Distributed Lag Model*

As was previously mentioned, the sequence of the series must match the Johansen test of cointegration, i.e., I (1). But the ARDL model is more liberal, i.e., it should not necessarily be of the same order. It can be employed if variables are a combination of I (0) and I (1). The PP (constant) test indicated the human capital variable as stationary at level, despite the DF-GLS test's recommendation that all series be non-stationary at the level and stationary at first difference. So, by employing the ARDL model in the analysis more robust and authentic results can be possible. The ARDL (4 3 1 1 4) model was run using the lag year recommended by the criteria of AIC, HQIC, and FPE. The outputs of the model are to determine whether there exist cointegrating relations running from human capital, government health expenditure, human security, and investment to growth and long-term, and short-term causality. The results of the ARDL (4 3 1 1 4) model are displayed in Table 3 (b).

Table 3 (b)'s findings show that although the probability value for the ARDL error correction term (.098701), which has a negative sign, is more than 5%, there is no long-term link between variables. To check the robustness of the output and whether growth is cointegrated with HC, government health expenditure, human security, and investment in the long term, the ARDL "Bounds" test was run. The null of no cointegrating link between variables has failed to be rejected in the test, as the value of 'F statistic' is less than the critical value for I (1) regressors and the value of 't statistic' is greater than the critical value for I (1) variables. This implies that the economic growth of Bangladesh has no statistically significant long-run causality with human capital, government health expenditure, human security, and investment.

In the short-term, lag-1 HC, lag-3 investment, and the intercept have statistically significant association-ship with growth. To check the joint impact of lagged variables in the short-run, the Granger causality Wald Test has been conducted, which is explained in the next section.

Diagnostic checking of the ARDL model was also done. The null hypothesis that there is no autocorrelation in the model was not rejected by the Breusch-Godfrey LM test. Similarly, the model was found to be a good model when the Cameron and Trivedi's decomposition of the IM test failed to reject the null hypothesis that there was no heteroscedasticity in the model.

### *4.4 Granger Causality Test*

The "Granger Causality" test exhibits the joint effects of lagged variables on the other variables. The test was run using the optimum lag order four recommended by lag selection criteria of AIC, HQIC, FPE, and LR. From the results displayed in Table 4, it has been observed that lagged human capital does not cause growth and lagged growth also does not cause human capital, lagged health expenditure does not cause growth but lagged economic growth can cause health expenditure, lagged human security can cause economic growth and the reversed is also true, lagged investment does cause economic growth and reverse is also true. Human capital and health expenditure has bi-directional causality, lagged human security does not cause

**Table 4: Results of Granger causality Wald tests**

| Equation | Excluded | chi2 | df | Prob > chi2 |
|---|---|---|---|---|
| GDPL | HC | 3.9527 | 4 | 0.412 |
| GDPL | HEX | 4.1606 | 4 | 0.385 |
| GDPL | HS | 18.831 | 4 | 0.001 |
| GDPL | INV | 24.862 | 4 | 0.000 |
| GDPL | ALL | 75.709 | 16 | 0.000 |
| HC | GDPL | 3.0159 | 4 | 0.555 |
| HC | HEX | 12.411 | 4 | 0.015 |
| HC | HS | 2.956 | 4 | 0.565 |
| HC | INV | 15.745 | 4 | 0.003 |
| HC | ALL | 36.944 | 16 | 0.002 |
| HEX | GDPL | 24.752 | 4 | 0.000 |
| HEX | HC | 25.442 | 4 | 0.000 |
| HEX | HS | 5.3936 | 4 | 0.249 |
| HEX | INV | 3.0983 | 4 | 0.542 |
| HEX | ALL | 66.004 | 16 | 0.000 |
| HS | GDPL | 11.29 | 4 | 0.023 |
| HS | HC | 12.11 | 4 | 0.017 |
| HS | HEX | 4.2592 | 4 | 0.372 |
| HS | INV | 7.9117 | 4 | 0.095 |
| HS | ALL | 59.887 | 16 | 0.000 |
| INV | GDPL | 15.867 | 4 | 0.003 |
| INV | HC | 10.845 | 4 | 0.028 |
| INV | HEX | 4.8549 | 4 | 0.303 |
| INV | HS | 34.129 | 4 | 0.000 |
| INV | ALL | 91.896 | 16 | 0.000 |

*Source: Author's calculation*

human capital but lagged human capital can cause human security, investment and human capital has bi-directional causality, human security and health expenditure do not have any causal relationship, investment does not cause human security but

human security can cause investment. In the short-run, the dependent variable may be caused by all of the lagged independent factors taken together. The Null Hypotheses of the Granger causality test are:

Null: Each of the other endogenous variables does not have a causal effect on the dependent variable.

From Table 4, it reveals that human capital does not Granger-cause economic growth implying that human capital is exogenous in the time series framework or is not linearly informative about the future economic growth of Bangladesh, the reverse is also true as economic growth does not Granger-cause human capital. Similarly, government health expenditure does not Granger-cause growth implying that health expenditure of the previous year is not able to predict future economic growth but lagged economic growth can predict future expenditure on health meaning that present growth performance can be able to predict future expenditure on health. Lagged human security can cause economic growth implying that the past value of human security can predict economic growth and the reverse is also true. Lagged human security does not Granger-cause human capital and government health expenditure means it cannot predict the future human capital and government health expenditure. Similarly, health expenditure cannot predict future human security, but human capital can predict future human security implying that if human capital is more skilled it can ensure future human security. Investment can predict future economic growth and human capital, but cannot predict health expenditure and human security.

### *4.5 OLS Regression Model*

The Johansen test of cointegration found the variables cointegrated and there exist two cointegration equations in the system. However, the VECM model and the ARDL model have shown that the past period error-correcting mechanism and short-run dynamics are unable to advance towards long-run equilibrium. In the short-run, only the lag-3 human security in the VECM model, and lag-1 human capital, lag-3 investment and the intercept in the ARDL model are statistically significant to individually predict future economic growth. But most of the lagged variables of each series can predict the dependent variable, which has been examined in "Granger causality" test.

In the above tests, causal relationships between the variables have been examined. To check the statistical relationship between human capital, government health expenditure, human security, and investment on economic growth, the ordinary least square technique has been applied. In the OLS, the first differenced of the variables have been used in the model because the variables are serially correlated at the level. The results of the OLS regression are displayed in Table 5.

The explanatory factors may account for a change in the dependent variable of 71.9 percent with an R-square of 0.719. The HC has a statistically significant positive effect on growth implying that growth will increase (decrease) by 0.038

units due to one-unit increase (decrease) in HC. The investment has a statistically significant negative relationship with economic growth meaning that it will decrease

**Table 5: Results of the OLS test**

| | **D_GDPL** |
|---|---|
| D_HC | 0.0380*** |
| | (0.00852) |
| D_HEX | 0.00128 |
| | (0.000699) |
| D_HS | 0.00370 |
| | (0.00620) |
| D_INV | -0.000263*** |
| | (0.0000308) |
| _cons | -0.000428* |
| | (0.000172) |
| $R^2$ | 0.719 |

*Source: Author's calculation*

*Notes: Standard errors in parentheses.* $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$

(increase) by 0.00026 units due to one-unit increase (decrease) in investment. The negative relationship between economic growth and investment may seem unusual, but this may happen when the preparedness of the labour force is not as per the requirement of new investment and the latest technology, which can be adjusted through training and capacity building of the workforce. The short-run dynamics of the ARDL model indicate this adjustment in its results – investment in the current year showed negative causality but its lag-3 showed positive causality on economic growth. Human security and government health expenditure do not have a statistically significant contemporaneous effect on growth.

## 5. Conclusion and Suggestions

This paper has attempted to see the impact of human capital, human security, government health expenditure, and investment on the economic growth in Bangladesh over the period 1981-2019.

The Johansen test of cointegration indicated the presence of cointegrating relations among the variables. But the short-run dynamics, which was performed through the VECM model reject the presence of long-term causality between variables. The ARDL "Bounds" test also supports the same result. ECM dynamics of economic growth show that lag-3 human security has a statistically significant influence on growth. ECM dynamics of the ARDL model show that lag-1 human capital, lag-3 investment, and the intercept have a significant effect on growth.

From the Granger causality test, it has been found that lagged human capital, and lagged government expenditure on health cannot Granger-cause growth, while human security, and investment can Granger-cause economic growth. This is due to the fact that if HC recorded in the previous year is not properly utilized in the current then it will not contribute to economic growth, this is also true for government health expenditure. As a whole, lagged human capital, lagged health expenditure, lagged

human security, and lagged investment jointly can Granger-cause economic growth implying that if all the lagged variables are included in the system, they can jointly predict the economic growth of Bangladesh.

Results of the ordinary least square test reveal that human capital has a statistically significant positive effect on growth, while investment has a statistically significant negative effect. But the short-run dynamics of the ARDL model shows that lag-3 investment can positively influence economic growth. This is because when a new investment is occurred through a new establishment or expansion of the existing establishment or new technology, work force required for this additional investment is not prepared in the current year of investment - it takes some time to adjust to the new investment through skills development and capacity building of the work force. In the OLS, test human security does not have a statistically significant effect on growth, but short-term dynamics of VECM show that lag-3 human security has a significantly positive effect on economic growth implying that the impact of human security cannot influence the economic growth in the current year, it takes some times to influence the growth.

There are some policy implications in the paper. As Bangladesh is on the way to graduating to a developing country, it needs more investment particularly in the industry sector. To meet the requirement of the additional investment, a more skilled work force will be required. So, the government should allocate more funds to the national budget for education and human resources development. Besides, increasing demand in the industry and service sectors is inducing agricultural labourers to change their job. In this situation, the government should also concentrate to modernize, and mechanize the agricultural system. Finally, the government should concentrate on human security as it is a vital factor in the economic development of Bangladesh.

The study has also some suggestions for further research. The variable 'human capital' in the study has been constructed by combining the data of GNI per capita PPP and life expectancy at birth of Bangladesh. Data on other dimensions of human security like environmental security, political security, etc. can also be combined with the human security, constructed for this study and examine its impact on growth. As the human capital and human security have impacts on the growth, these variables can improve the quality of labour, which will in turn improve its productivity. So, these variables combined with the employed population can be used to determine the output per unit of labour in the growth accounting of Bangladesh.

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**Annex**

**Table A1: Results of ARDL bounds test:**

```
Pesaran/Shin/Smith (2001) ARDL Bounds Test
H0: no levels relationship            F =  3.346
                                      t = -0.815

Critical Values (0.1-0.01), F-statistic, Case 3

      | [I_0]   [I_1]  | [I_0]   [I_1]  | [I_0]   [I_1]  | [I_0]   [I_1]
      |    L_1     L_1 |   L_05    L_05 |  L_025   L_025 |   L_01    L_01
------+----------------+----------------+----------------+---------------
  k_4 |   2.45    3.52 |   2.86    4.01 |   3.25    4.49 |   3.74    5.06
accept if F < critical value for I(0) regressors
reject if F > critical value for I(1) regressors

Critical Values (0.1-0.01), t-statistic, Case 3

      | [I_0]   [I_1]  | [I_0]   [I_1]  | [I_0]   [I_1]  | [I_0]   [I_1]
      |    L_1     L_1 |   L_05    L_05 |  L_025   L_025 |   L_01    L_01
------+----------------+----------------+----------------+---------------
  k_4 |  -2.57   -3.66 |  -2.86   -3.99 |  -3.13   -4.26 |  -3.43   -4.60
accept if t > critical value for I(0) regressors
reject if t < critical value for I(1) regressors

k: # of non-deterministic regressors in long-run relationship

Critical values from Pesaran/Shin/Smith (2001)
```

**Table A2: Results of the LM test for residual autocorrelation in VECM model:**

```
LM Test for Residual Autocorrelation:

 Lagrange-multiplier test
  +--------------------------------------+
  | lag  |      chi2    df   Prob > chi2 |
  |------+-------------------------------|
  |   1  |   36.0662    25     0.07060   |
  |   2  |   13.3344    25     0.97213   |
  |   3  |   14.1992    25     0.95815   |
  |   4  |   10.8969    25     0.99343   |
  +--------------------------------------+
   H0: no autocorrelation at lag order
```

**Table A3: Jarque-Bera test for the normality of residual in VECM model**

Jarque-Bera test

| Equation | chi2 | df | Prob > chi2 |
|---|---|---|---|
| D_GDPL | 2.661 | 2 | 0.26437 |
| D_HC | 3.167 | 2 | 0.20528 |
| D_HEX | 2.663 | 2 | 0.26410 |
| D_HS | 0.346 | 2 | 0.84118 |
| D_INV | 0.418 | 2 | 0.81122 |
| ALL | 9.255 | 10 | 0.50811 |

**Table A4: Breusch-Godfrey LM test for residual autocorrelation in ARDL model:**

Breusch-Godfrey LM test for autocorrelation

| lags(p) | chi2 | df | Prob > chi2 |
|---|---|---|---|
| 1 | 0.144 | 1 | 0.7045 |
| 1 | 0.144 | 1 | 0.7045 |
| 3 | 5.654 | 3 | 0.1297 |
| 4 | 8.243 | 4 | 0.0831 |
| 4 | 8.243 | 4 | 0.0831 |

H0: no serial correlation

**Table A5: IM test for heteroscedasticity in the ARDL model**

Cameron & Trivedi's decomposition of IM-test

| Source | chi2 | df | p |
|---|---|---|---|
| Heteroskedasticity | 35.00 | 34 | 0.4204 |
| Skewness | 12.40 | 17 | 0.7755 |
| Kurtosis | 0.77 | 1 | 0.3808 |
| Total | 48.17 | 52 | 0.6255 |