Integrated Analysis of Human and Physical Capital: Driving Forces of Economic Expansion in N11 Countries

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Abstract

The aim of this study is to investigate the effect of human capital and physical capital on economic growth in N11 countries (Bangladesh, Egypt, Indonesia, Iran, Mexico, Pakistan, Philippines, Turkey, Korea, and Vietnam) from 1995 to 2022. We analyzed the effect of life expectancy, literacy rate, and gross fixed capital formation on real GDP. First, the unit root is used to check the unit root properties of variables. The long-run relationship between variables is examined through Pedroni cointegration test. For panel causality, this paper used Dumitrescu Panel causality test. Finally, the fully modified ordinary least square (FMOLS) and dynamic ordinary least square (DOLS) are applied to get the long run estimates. The results revealed the presence of cointegration in the model. The results showed that adult literacy rate and life expectancy at birth have a positive impact on real GDP per capita in long run. Gross fixed capital formation also has a favorable impact on economic growth in the sample region. This research will provide number of useful suggestions for policymaking. Based on the findings of research, it is suggested that N11 countries should improve their human and physical capital to improve economic growth of the economy.

Keywords: Human capital, Physical capital, Economic growth, FMOLS, N11 countries.

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1.   Introduction

According to the OECD, (2001), human capital is the knowledge, abilities, and characteristics that people possess and which help to create economic, social, and personal well-being. The development of health and education is necessary for the creation of human capital. It is said that education gives people more financial power and promotes economic expansion. Numerous demographic habits are closely correlated with education, which also contributes significantly to economic growth and enhances population life expectancy and reproductive health.

Throughout the world, education is considered as one of the essential human rights. It increases labor force productivity, which directly affects per capita income. The education can open doors to both social and economic advancement. Thus, the level of literacy is essential for both short- and long-term economic progress. Even when the direct and indirect expenditures of education are taken into account, research indicates that education significantly increases one's income. Higher educated people almost always make far more money than the average, and even in less developed nations, gains are typically greater (Mincer 1974; Becker 1975). Similar to this, a country's lifespan and labor force health are significant factors in determining its economic prosperity, with a healthy populace being necessary for both economic growth and a productive labor force. There is a reciprocal relationship between health and economic growth. Poor human capital restricts economic growth, and a person's lifetime earnings may be lowered as a result of their health. Thus, the body of research on economic growth indicates that not only is the development of human capital a vital goal, but it also has a significant impact on economic growth. In general, nations that have seen exceptional economic growth have grasped the importance of education and health, and as a result, their populations have better health and greater literacy rates.

Vietnam is a development success story that has had substantial growth over the years, with its GDP per capita expected to reach over US$3,700 by 2022. With GDP growth rates that potentially challenge those of the most developed nations, the N11 countries are classified as emerging markets with the potential to rank among the greatest economies in the world. Vietnam's health results have improved; between 1990 and 2020, the country's life expectancy increased dramatically and newborn mortality rates decreased. Life expectancy is rising in the N11 countries, which is a reflection of advances in healthcare and living standards. The general pattern of economic growth and development in these countries shows a beneficial impact on education and literacy levels, even though the sources do not have particular statistics on literacy rates in the N11 countries. Education and literacy rates are probably improving in these nations as a result of economic reforms and development plans, but a more thorough picture would come from knowing the precise literacy rates for each of the N11 countries (Education, 2015).

In order to support economic growth, capital formation with human capital is equally crucial. The majority of rapidly developing nations invest a sizeable portion of their GDP. Conversely, nations that do not invest experience a slow rate of growth (Sial et al., 2010). Capital formation is the process by which things are produced in order to produce other goods, according to economists. It is a fact that economists have come to a consensus regarding the

beneficial impact of investment on economic growth. However, there is no agreement on whether private or governmental investment has a greater effect on economic growth.

However, empirical evidence from all over the world proves that private investment has a more fruitful impact on economic growth than public investment (Aschauer, 1989). A sizable fraction of people live below the national poverty threshold in an impoverished nation like Pakistan. It is a widely held belief that poverty and unemployment may be reduced via economic growth, although things are not the same in Pakistan. Pakistan's poverty cannot be eradicated by economic progress alone; rather, all aspects of the nation must be improved. Consequently, it is believed that investing in people helps them overcome poverty and accelerates their personal growth. This calls for some income securities in addition to health and education securities.

It is believed that whereas capital and natural resources contribute slowly to economic progress, human capital is an active component of production. Both the social structure and economic progress can be strengthened by human capital. Economists generally agree that nations possessing greater natural resources have a tendency to develop more rapidly than nations with fewer resources. Nevertheless, the existence of these resources does not imply economic expansion. It is obvious that improving our human capital through literacy, skill development, and quality enhancement is necessary if we wish to use other resources effectively, reduce poverty and unemployment, and boost economic growth. The term "human capital" typically refers to an individual's health, education, skill development, and other attributes that might increase their efficiency and production (Todaro, 2020). It is generally believed that investing in people results in greater economic growth (Smith, 1776).

One of the key prerequisites for economic progress is the development of human resources (Harbinson and Myers, 1964). Human capital is defined as the mental and physical capacities that people have developed from education, skill-building, healthcare, training, and participation in social practices such as yoga (Singh, 1999).

The development of society depends heavily on human capital, particularly in the N11 countries, where low levels of primary enrollment, infant mortality, and birthrate persist despite rapid economic progress. Problems like unemployment, poverty, and illiteracy have resulted from the emphasis on physical capital rather than human capital. Empirical studies reveal that enhancements in human capital can have notable effects on economic growth by means of variations in educational standards and innovative mechanisms (Baily, Senior Fellow Emeritus - Economic Studies, & Barry P. Bosworth, 2021). Research indicates that allocating resources towards human capital can result in heightened efficiency, inventiveness, and financial gain, which in turn propels economic expansion and enhances quality of life. Therefore, in order to promote sustainable development and successfully solve socioeconomic difficulties, it is imperative that the human capital inadequacies in the N11 countries be addressed.

Adam Smith and J.B Say reviewed the investment process of capital circulation in its various forms, introduce the foundation for the study of reprocessing proportions and the role of investment in this process (Bouzekri, 2015). Pakistan ranks 154th among 189 countries on the UN's Human Development Index (HDI) 2020. On account of

inequality, Pakistan did not perform well as suffered a loss of 3.1% due to inequality in the distribution of HDI dimension indices. Capital formation and human development are the chief inputs for all sectors of the economy. However, government inefficiency to invest and spend in human development results in lower economic growth. Therefore, the issue that keeps coming up is how to measure variables and what the nature of the causes, consequences, and relationships between them are. The two proxies of human capital used in this study to characterize the relationship between GDP and human capital are the literacy rate and life expectancy at birth. Consequently, the study aims to find out the core association between real GDP per capita and human and physical capital in N11 countries for the period of 1998-2022.

Organization of the Study

The distribution of the study is as follows: section 2 describes the substantial contribution of previous literature in the field of capital formation and human capital. Data and econometrics methodology are described in section 3. Empirical outcomes and the explanation are represented in section 4. Finally, the conclusion policy recommendation of the study are described in section 5.

2. Literature Review

Human capital is thought to be an important factor in industrialization and progress. Research suggests that human capital is crucial for long-term revenue growth (Mankiw et al., 1992; Lucas, 1988). A country with a high degree of education can increase productivity by easing technology adoption and creating a demand for skilled workers. Human capital is a key factor for economic progress, according to several ideas. The human capital hypothesis emphasizes investing in a skilled and educated workforce to drive economic progress. According to this idea, labor force productivity is linked to formal education, implying that higher literacy rates lead to higher output (Schultz, 1961; Psacharopoulos and Woodhall, 1993; Sakamoto and Powers, 1995).

There are many other growth theories, which highlight the role of both internal and external forces in driving economic growth. Endogenous growth theory suggests investing in health and education to support human capital and create a skilled workforce, leading to increased productivity. Endogenous technological innovation will eventually contribute to economic growth (Maitra and Mukhopadhyay, 2012). Human capital, notably education, must be developed publicly through income tax finance, with an appropriate tax rate of 6-10% (Ni and Wang, 1994).

Khatoon et al., (2021) investigated the effect of human capital on GDP. They used the education level as an indicator for human capital. They conducted this study regarding Pakistan. They applied Johnson cointegration and the results showed that there is a relationship between GDP and human capital. The education sector should boost to increase human capital and ultimately economic growth. Haldar and Malik, (2010) examined the effect of human capital on economic growth. They used time-series data from the period of 1960-2006 in India. By applying the techniques they found that capital investment does not affect GDP neither short-run nor long-run. But human capital

has a positive effect on economic growth. They indicated human capital as primary education and openness. This research helps India to model its policy and taking into consideration the relevance of economic growth. Afridi, (2016) investigated the correlation between economic growth and human capital in Pakistan. This paper used infant mortality rate, primary enrolments, and birth rate as a proxy to human capital. The fund that high percentage of GDP can be obtained by spending more in these sectors.

Ali et al., (2012) have investigated the function of human capital in economic growth. They used secondary data over the time of 1972-73 and 2010-11 in Pakistan. They used education enrolment as an indicator of human capital and said that health, primary education, and capital are necessary to boost GDP. After estimation, they found that the Gini coefficient, primary education, and capital formation have a positive effect on GDP while infant mortality rate, consumer inflation, headcount ratio, and investment have a negative impact on economic growth. Shehzad, (2015) has examined the impact of human capital on economic growth. He used secondary data from the time of 1990 to 2013 in Pakistan. By applying least squares multiple regression in E-views, he found showed that primary education which is a proxy of human investment and capital formation has a significant impact on GDP, While investment has also effect positively to economic growth. Moreover, infant mortality rate has a negative effect on economic growth. These results showed that the education sector and health should give high priority to boost the economic growth of the country.

Nikoloski, (2015) investigated the role of capital in economic growth. They said capital is one of the crucial factors in boosting the economic growth of a country. They used developing countries as an example of this study. They found that capital use depends on many factors like; economic infrastructure, social norms, institutional efficiency, orientation for development, and the quality of worker's education. Channi et al., (2012) have examined the relationship between capital formation and economic growth. They used time-series data from 1972-2009 in Pakistan. They used the gross domestic product as a dependent variable and investment in physical capital, human capital, and labor force as an independent variable. By applying ARDL and Granger Causality, they found long-term and short-term effects respectively. They discovered a long-term association between GDP and human capital. Granger causality shows the bi-directional relationship between human capital and economic growth.

Sial et al., (2010) focused to found the role of investment in economic growth regarding Pakistan. They applied the Vector Error Correction (VER) technique and found that both public and private investment have a positive and significant impact on economic growth but the growth is largely affected by private investment as compared to public investment. In the short run, there is a positive impact of private investment on economic growth but public investment has a negative impact on economic growth. They found a positive association between economic uncertainty (which is a proxy for inflation) and economic growth in the short run. Bouzekri, (2015) has shown that there is a close relationship between human capital and economic growth. Human capital is directly and indirectly affected by education, which plays a major part in boosting human capital and then increases economic growth. Adedeji and Campbell, (2013) have investigated the role of higher education in human capital. They focused on

Nigeria and said that over the earlier decades human capital is always the main determinant in economic growth and human capital is directly and indirectly affected by the education, which is a vital function of human capital. This paper introduces the public-private partnerships in Higher Education (HE) to improve the performance of the educational structure.

The literature study emphasizes the importance of human capital in accelerating industrialization and economic growth. Several theories, like the human capital hypothesis and the endogenous growth theory, emphasize the necessity of investing in education and health to boost human capital, resulting in higher productivity and economic growth. The research provided emphasize the positive influence of human capital on GDP, with an emphasis on aspects such as education, primary enrollment, and health outcomes. There is abundance of studies demonstrating a favorable association between human capital and GDP. There is a significant study gap in the literature regarding the specific processes by which human capital directly promotes economic growth, particularly in N11 countries. Thus, current study aims at investigating the effect of human capital literacy rate, and gross fixed capital formation on GDP per capita in N11 nations from 1995 to 2022.

3. Data and Methodology

In this section, we will discuss the data sources and techniques of estimation that is used to examine the relationship between independent variables and dependent variable.

3.1. Model Specification

The model states GDP per capita (calculated as the natural logarithm of GDP per capita) is the function of human and physical capital, which is represented by the adult literacy rate and life expectancy at birth in N11 nations for the period of 1998 to 2022.

The previous studies investigated that human capital has a major contribution to economic growth such as the studies of Khatoon et al., (2017), Haldar and Malik, (2010). Islam, (2020) has used adult literacy rate and life expectancy as a proxy to human capital. While, many scholars said that capital formation or domestic fixed investment play a vital role in economic growth like the studies of Sial et al (2010), and Channi et al., (2012). Arsh et al., (2024) used GDP per capita to measure economic growth. Following previous literature, we have developed the econometric model of this study as follows,

$$LGDP_{it} = \beta_0 + \beta_1 LEB_{it} + \beta_2 ALR_{it} + \beta_3 LGFCF_{it} + \mu_{it} ....(1)$$

i = cross sectional unit, **t** = 1998 …. 2022. μ_{it} is error term with white noise properties. The units of variables and data source are presented in Table 1.

3.2. Dependent variable

LGDP (gross domestic product per capita) is dependent variable, which is measures the economic growth of sample region (Arsh et la., 2024). Gross Domestic Product is a degree of a country's economic production that accounts for its amount of people. It divides the republic's GDP by its entire population. That makes it a good dimension of a nation's living standard. It shows you how affluent a nation feels to each of its residents.

3.3. Independent Variable

LEXB (life expectancy at birth) and ADLR (adult literacy rate) are independent variables and used to measure human capital (Islam, 2020). LGFCF (gross fixed capital formation) is also independent variable used to measure physical capital (Adeola and Evans, 2020). It is stated as the achievement of produced resources (including procurements of second-hand goods) comprising the construction of such resources by manufacturers for their personal use, minus clearances. It is the degree of investment used in calculating GDP in the dimension of a nation's economic activity. This is a vital factor of GDP because it offers a sign of the future creative capacity of the nation (Sial et al., 2010), Channi et al., 2012; Nikoloski, 2015; Adeola and Evans, 2020).

Table 1. Description of the Variables and source

Variables	Indicator	Measurement	Source
Gross domestic product	LGDP	GDP (constant 2015 US$)	WDI
Gross fixed capital formation	LGFCF	Gross fixed capital formation (% of GDP)	WDI
Adult literacy rate	ADLR	Literacy rate, adult total (% of people ages 15 and above)	WDI
Life expectancy at birth	LERB	Birth rate, crude (per 1,000 people)	WDI

3.4. Econometric Methodology

This study addresses the challenges of dealing with macro panel data, specifically the issue of cross-sectional dependence (CSD) due to economies' increased integration. It highlights the importance of analyzing CSD's effects on cross-country panels, as unobserved common shocks can cause inconsistent standard errors in estimated parameters (De-Hoyos and Sarafidis, 2006). The study uses Pesaran, (2007) parametric test to test CSD.

As with any long-term connection study, it is imperative to verify the integration of the variables. Therefore, this study checks the series' stationarity before moving on to cointegration analysis. The data from the four panel series spans 23 years, so the number of cross sections (N=10) in the panel is less than the number of years (Y). Because

nonstationary series can yield erroneous results, this research uses the panel unit root test to confirm whether the data series are stationary. In addition, panel unit root tests are becoming frequently used in empirical research. Since due to the existence of CSD among sample, traditional unit root test becomes powerless. Therefore, Pesaran (2007) introduced CADF for heterogeneous panels with cross-sectional dependency, extending conventional ADF regression with cross-sectional mean and 1st difference. H0 asserts all data series are stationary, with non-standard asymptotic distribution and critical values for P and N values.

In this research, we apply Pedroni cointegration test, based on Engle and Granger's approach, to confirm panel stationarity. It considers heterogeneity of vectors among individual series and generates seven test statistics, including within dimension and between dimension statistics. These tests are valid when the variables are I(1) and allow for individual deterministic trends, fixed effects, and heterogeneous slope coefficients. Based on Monte Carlo simulations, the Pedroni, (1999) test has its own set of critical values for these seven statistics. To rule out the null hypothesis that there is no cointegration, the computed values must be less than the tabulated critical values.

After confirming that every variable has a cointegration relationship with every other variable, the next step is to determine the coefficients of the long run cointegration parameters. The estimate using FE, RE, and GMM techniques may yield inconsistent and deceptive findings when applied to cointegrated panel data. For this reason, we employ fully modified OLS (FMOLS) strategies for the long-run model estimate. According to Pedroni, (2001), the FMOLS technique eliminates the problem of large size distortions caused by endogeneity and heterogeneity dynamics and yields trustworthy results even in small sample cases. The following is the equation of the panel FMOLS φ coefficient estimator;

$$\hat{\varphi} = N^{-1} \sum_{i=1}^{N} \left(\sum_{k=1}^{Q} (y_{ik} - \overline{y})^2 \right)^{-1} \left(\sum_{k=1}^{Q} (y_{ip} - \overline{y}) \right) x_{ip}^* - K \hat{v}_i \qquad (2)$$

Lastly, the panel causality test created by Dumitrescu and Hurlin, (2012) is used in this work. Based on individual Wald statistics of Granger non-causality averaged over the cross-sectional units, this test is a straightforward adaptation of Granger, (1969) non-causality for heterogeneous panel data models. It makes no assumptions about cross-sectional reliance, but Monte Carlo simulations demonstrate that this test can still yield significant results even in the presence of cross-sectional dependency.

4. Empirical Results and Discussion

First, the simple descriptions about the sample and the observations are provided by descriptive statistics. The Tables 2 displays the summary statistics for all variables of research model for LGDP, LEXB, ADLR, and LGFCF. It shows that all the variables in show a positive mean. In the same way, standard deviation value for LGDP, LGFCF, and LEXB implies moderate fluctuations while there is significant variations in ADLR suggesting that the adult literacy rate is highly volatile N11 nations. The study employed the Jarque and Bera, (1980) test to verify the

null hypothesis of normality. The results showed that all variables have a positive values for Jarque and Bera and are significant at 1%, 5%, and 10% indicating that we may reject the alternative hypothesis. This implies that each of these variables has a non-normal statistical distribution except ADLR.

The high levels of correlation between independent variables, or multicollinearity, skew the estimated results and negatively affect multiple regressions. When the correlation coefficients in the correlation matrix are higher than 0.80, there is a multi-collinearity issue (Cohen et al., 2013). The findings indicate the correlation between LGDP, LEXB, ADLR, and LGFCF in Table 3. The correlation coefficient values for all variables are less than 0.7 according to the results. The results show no multicollinearity among the selected variables in the sample dataset.

Table 2. Descriptive Analysis

Variable	Mean	S.D	Min	Max	Jarque-Bera
LGDP	26.690	0.783	25.050	28.185	9.228
					(0.009)
LEXB	71.649	4.450	61.090	84.019	4.020
					(0.133)
ADLR	79.476	17.446	32.035	102.09	32.18
					(0.000)
LGFCF	3.161	0.275	2.521	3.577	22.04
					(0.000)

Source: Author

Table 3. Correlation Analysis

	LGDP	LEXB	ELR	LGFCF
LGDP	1			
LEXB	0.624	1		
ELR	0.314	0.319	1	
LGFCF	0.243	0.574	0.315	1

Source: Author

4.1. Empirical Results

This section presents the outcomes of statistical analysis, which were acquired by employing EViews and Stata software. The first part of this section shows the pre-estimation technique while the outcomes of theory-based FMOLS is presented in the second part.

Table 4 presents the outcomes of the Pesaran test of cross sectional independence. Results of Pesaran cross-sectional dependency test reveal that there is problem of cross-sectional dependency since probability values are significant, thus, rejecting the null hypothesis of cross sectional independence (see Table 4). When cross sectional dependency exists in data, all of the conventional PURT become invalid to apply. To resolve this difficulty, we used Pesaran, (2007) CADF in order to find out the variables' unit root characteristics. Thus, we moved towards second generation Pesaran' unit root test, through the results of CADF test we discovered that none of the variables are level stationary but at first difference (see Table 6). So all of the series are integrated of first order and represented as I(1).

Table 4. Cross-sectional Dependence Test

Variable	LGDP	LEXB	ADLR	LGFCF
		Pesaran CD test		
Statistic	32.84	11.34	23.33	1.67
P- value	0.000	0.000	0.033	0.095

Source: Author

Table 5. IPS Unit Root Test

Variable	IPS			
	Level		1st Difference	
	Coefficient	p-value	Coefficient	p-value
LGDP	2.130	0.983	-3.934	0.000
LEXB	-0.331	0.370	-2.750	0.003
ADLR	-0.108	0.456	-6.966	0.000
LGFCF	-0.564	0.286	-3.972	0.000

Source: Author

Table 6. Pesaran (CADF) Unit Root Test

Variable	CADF			
	Level		1st Difference	
	Coefficient	p-value	Coefficient	p-value
LGDP	-1.876	0.353	-2.546	0.005
LEXB	-1.745	0.519	-3.555	0.000
ADLR	-1.503	0.798	-3.758	0.000
LGFCF	-1.758	0.503	-3.805	0.000

Source: Author

After checking for the stationarity of all variables, it is confirmed that there is need to check panel cointegration equation by Pedroni cointegration test in order to get reliable estimates. Table 7 demonstrates different panel cointegration estimates for the research model. The outcomes indicate that within dimension: Panel PP statistic and Panel ADF statistic are significant at a 1% level of significance while between dimension: Group PP statistic and Group ADF statistic are also significant at 1% level of significance. Based on this evidences, we conclude that long run equilibrium relationship exist between variables in N11 countries (see Table 7). For robustness estimates we also performed Kao, (1999) residual cointegration test (see Tables 8).

Finally, we moved further to assess the FMOLS and DOLS estimator for parameter estimates. Table 9 shows the FMOLS and DOLS estimates for parameters. Concerning human capital, the results elaborates that LEXB and ADLR have positive impact on economic growth and are significant statistically. While physical capital (LGFCF) also positively influences economic growth as indicated by positive coefficient of LGFCF. Outcomes of DOLS also indicate the positive and significant effect of human and physical capital on economic growth in N11 nations. The second column of Table 9 reveals that increase in LEXB leads to increase economic growth by 13.6 while ADLR increase economic growth by 1.1%. In other words, increased per capita income results from capital formation in the form of improved education and training, and per capita GDP increases as a result of population growth in terms of education and knowledge via increased output and increased income. increase economic growth by 1.1%. In other words, increased per capita income results from capital formation in the form of improved education and training, and per capita GDP increases as a result of population growth in terms of education and knowledge via increased output and increased income. The results of this study are consistent with those of earlier research (Sakamoto and Powers, 1995; Schultz 1961; Psacharopoulos and Woodhall, 1993; Islam, 2020).

Table 7. Pedroni Cointegration Test

	Within-dimension			
			Weighted	
	Statistic	p-value	Statistic	p-value
Weighted Panel v-Statistic	-0.257	0.601	0.690	0.244
Weighted Panel rho-Statistic	-1.952	0.025	-0.939	0.173
Weighted Panel PP-Statistic	-4.329	0.000	-2.859	0.002
Weighted Panel ADF-Statistic	-4.019	0.000	-2.528	0.005
Between-dimension				
Group rho-Statistic	0.113	0.545		
Group PP-Statistic	-2.724	0.003		
Group ADF-Statistic	-2.174	0.014		

Source: Author

Table 8. Kao Cointegration Test

Statistic	p-value
1.807	0.035

Source: Author

Finally, LFGCF increases economic growth by 0.57%. The fourth column of Table 9 reveals that increase in LEXB leads to increase economic growth by 34.8% while ADLR increase economic growth by 1.9%. Finally, LFGCF increases economic growth by 1.046%. Aviral and Mihai, (2011) and Boamah et al., (2018) support this conclusion.

Table 9. FMOLS and DOLS Results

	FMOLS		DOLS	
	Coef.	p-value	Coef.	p-value
LEXB	0.136	0.000	0.348	0.000
ADLR	0.011	0.063	0.019	0.060
LGFCF	0.576	0.000	1.046	0.071

Source: Author

Finally, the panel causality test created by Dumitrescu and Hurlin, (2012) is used in this research. It makes no assumptions about cross-sectional reliance, but Monte Carlo simulations demonstrate that this test can still yield good results even in the presence of cross-sectional dependency. Table 10 presents a summary of the Dumitrescu-Hurlin panel causality test results, indicating the presence of bidirectional causality between LEXB and LGDP at the 1%, 5%, and 10% significant level. This implies that an increase in GDP per capita income is a direct result of a higher life expectancy at birth, and that an increase in per capita income is a direct result of improved health care.

At the 1% level of significance, there is also another bidirectional causal relationship between ADLR and LGDP. Through improved skill and increased production, the adult literacy rate favorably affects GDP per capita income, which in turn enhances per capita. By spending on education, particularly on infrastructure and facilities worldwide, income drives up the adult literacy rate. The current findings are supported by literature (Ranis and Stewart, 2005; Maitra and Mukhopadhyay, 2012; Islam, 2020). The results of Ranis and Stewar,t (2005), who found a strong correlation between economic expansion and human development, further support the conclusions. Finally, there is a third bidirectional causation between LGFCF and LGDP. Gross fixed capital formation increases LGDP.

Table 10. Dumitrescu Panel Causality Test

Null Hypothesis	W-Stat.	Zbar-Stat	p-value
LEXB does not homogeneously cause LGDP	4.710	3.050	0.002
LGDP does not homogeneously cause LEXB	19.813	21.769	0.000
ADLR does not homogeneously cause LGDP	4.019	2.193	0.028
LGDP does not homogeneously cause ADLR	4.552	2.854	0.004
LGFCF does not homogeneously cause LGDP	3.836	1.966	0.049
LGDP does not homogeneously cause LGFCF	4.442	2.717	0.006
ADLR does not homogeneously cause LEXB	7.239	6.184	6.E-1
LEXB does not homogeneously cause ADLR	2.105	-0.178	0.858

Source: Author

5. Conclusion and Recommendations

This study examines the relationship between human capital, physical capital, and GDP per capita in N11 economies Bangladesh, Egypt, Indonesia, Iran, Mexico, Pakistan, Philippines, Turkey, Korea, and Vietnam. The Pedroni and Kao cointegration tests indicate the degree of cointegration between adult literacy rate, life expectancy at birth, and GDP per capita. For parametric estimation, this research has used FMOLS and DOLS. ADLR and LGDPC have a long- and short-term association, which means that as the population becomes more educated and knowledgeable, capital formation in the form of improved training and education produces higher per capita income. Better earnings and increased productivity lead to an increase in per capita GDP. Moreover, gross fixed capital formation also has significant positive effect on economic growth.

Bidirectional causation between ADLR and LEXB, ADLR and LGDPC, and LEXB and LGDP is demonstrated using the Dumitrescu-Hurlin panel causality test. This implies that increased per capita income causes life expectancy, and higher life expectancy at birth causes GDP per capita by improved medical treatment. Likewise, GDP per capita income positively relates to adult literacy rate, and increased per capita income raises adult literacy rates by driving up educational spending.

Since human and physical capital have significant positive effect on economic growth in N11 nations, several policy suggestion evolved based on empirical results. Increase government spending on education to improve access to quality education for all segments of society. Government in N11 countries should Implement policies for compulsory and free education up to a certain level, and develop vocational training programs for relevant skills. Allocate resources to build and upgrade healthcare facilities, especially in rural areas, and promote preventive healthcare measures. It should launch public health awareness campaigns on sanitation, hygiene, and nutrition, along with initiatives to combat smoking and substance abuse. It should invest in infrastructure for clean water and sanitation, and promote community-led hygiene education. Moreover, establishment of adult literacy programs and encouraging lifelong learning through technology and continuing educationwill be beneficial. Implementation of policies for gender equality in education and healthcare access, enforcement of laws against discrimination, and provision of incentives for educating girls lead to improve human capital and ultimately economic growth.

Finally, gross fixed capital formation (GFCF) is a key driver of economic growth, enhancing productivity and efficiency. To boost GFCF, governments can increase public investment in infrastructure projects, implement tax incentives and subsidies, ensure affordable financing options, support research and development, improve the regulatory environment, invest in skills development and human capital investment, encourage foreign direct investment, and support innovation clusters and entrepreneurship. These policies can also promote collaboration among businesses, research institutions, and startups, leading to increased productivity, competitiveness, and sustainable economic growth. By implementing these policies, governments can stimulate GFCF, leading to increased productivity, competitiveness, and sustainable growth.

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