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Human Capital Development and Economic Growth: A Panel Data Analysis

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Abstract

Pakistan, like other developing nations, is actively pursuing economic development initiatives. Recognizing the significance of human capital investment, the government prioritizes education, skills, health, and overall well-being as key drivers of sustainable growth. This study examines the intricate relationship between human capital and economic growth through an analysis of panel data from eleven countries spanning 1992 to 2014. By utilizing advanced econometric techniques, the study provides a comprehensive understanding of the role of human capital in fostering economic development. The panel data approach allows for an in-depth exploration of collective experiences across diverse economies over time. Gross Domestic Product (GDP) serves as the primary economic indicator, while human capital indicators include net secondary school enrollment (education investment), health expenditures (health investment), total labor force (size of the labor market), and life expectancy at birth (population health). To ensure analytical rigor, the study employs the Panel Augmented Dickey-Fuller (ADF) unit root test to assess variable stationarity, followed by the Pooled Ordinary Least Squares (OLS) test to examine initial relationships. The findings reveal compelling evidence of a long-term relationship between real GDP and human capital, as demonstrated by the fixed-effects OLS test. This underscores the crucial role of human capital accumulation in driving economic growth. Policymakers must enhance investments in education and health to foster sustainable development. By strengthening human capital, developing nations can achieve higher economic performance, reinforcing the vital link between human resource development and long-term prosperity.

Keywords: Human capital, Economic growth, Investment in education and health, Labor force

1. INTRODUCTION

The Pakistani economy has recently embarked on a trajectory of growth, surpassing the rates observed in many low-income and middle-income countries. Under the leadership of the General Pervez Musharraf government, significant strides were made to enhance opportunities for the public within the macroeconomic sector. With a growth rate surpassing 5%, Pakistan's economic performance has outpaced that of many nations in similar income brackets. This growth trajectory signals a promising outlook for the country's economic development and underscores the effectiveness of policy initiatives implemented under the Musharraf administration. The reforms introduced by the government have played a pivotal role in unlocking opportunities for public participation in the macroeconomic sector. Through strategic measures aimed at improving governance, fostering investor confidence, and promoting economic stability, the Musharraf government created an enabling environment conducive to growth and prosperity. These trends are reinforced by studies that link sustainable growth to strong public expenditure frameworks and long-term demographic strategies (Nwezeaku, 2018; Ahmad, 2018).

While Pakistan's economy has experienced gradual growth, it lags behind the high-developing countries in terms of economic expansion. This slower pace of growth can be attributed, in part, to deficiencies in critical components of investment and human capital development (Ali, 2015). Education and vocational training are especially important in this regard (Saleem & Fatima, 2018; Khan, 2018). One significant factor contributing to Pakistan's slower economic growth is the

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underperformance of the education sector. Education is widely recognized as a cornerstone of human capital development and a key driver of long-term economic prosperity. However, in Pakistan, the education sector has failed to grow at the pace necessary to meet the demands of a rapidly evolving global economy. The inadequate growth of the education sector in Pakistan has manifested in various ways (Ali & Bibi, 2017; Ali, 2018). There remains a persistent gap in access to quality education, particularly in rural and marginalized communities.

The school system in Pakistan is often regarded as one of the most cost-effective methods of providing education. However, despite its affordability, research indicates that the quality of education delivered through the Pakistani schooling system is notably lower compared to that of South Asian and Southeast Asian countries. According to findings by Barrow and Lee (2000), Pakistan's education system lags behind its regional counterparts in terms of quality and effectiveness. The issue is further complicated by weak alignment between national teaching standards and broader development goals (Iqbal & Nasir, 2018). This disparity in educational quality is particularly concerning given the prevalence of poverty in Pakistan. With approximately 30 percent of the population living below the poverty line, access to quality education becomes even more critical. For many individuals living in poverty, education serves as a pathway out of hardship and a means to secure better opportunities for themselves and their families.

Easterly and Levine (2001) have put it, it is the "*A*" in the standard Cobb-Douglas production function, i.e. $Yt = At\, f\,(Kt, Lt)$ that is key to growth, where *Y* is output, *K* the capital stock, *L* the quantity of labor, and "*A*" is generally taken to be total produced. Productivity has the greatest impact on the growth it determines the efficiency. Productivity is not only showing the technical progress it also left effects on other factors as well. Indeed, empirical research has provided valuable insights into the relationship between education, human capital, and economic growth. One prominent finding is the positive correlation between the level of education among workers and productivity, leading to enhanced economic performance and growth. When workers possess higher levels of education, they are better equipped to adapt to new technologies, innovate, and contribute more effectively to the production process. This macroeconomic effect of education on productivity and income is well-documented in the literature. Studies, such as those conducted by Mankiw, Romer, and Weil (1992) and Barro and Sala-i-Martin (1995), have highlighted the significant positive relationship between the initial level of education in a country and subsequent rates of economic growth. These early empirical investigations underscore the crucial role of education in driving long-term economic development and prosperity. It's important to note that while some studies, such as those by Easterly and Levine (2001) and Temple (2001), have failed to find a significant relationship between years of schooling and variations in economic growth, the overall body of research on this topic is vast and nuanced. The findings of individual studies may vary due to differences in methodology, data sources, and the specific contexts under investigation.

These divergent results highlight the complexity of the relationship between education and economic growth and underscore the need for careful interpretation of empirical findings. Factors such as the quality of education, the relevance of skills acquired, and the institutional and policy environment can all influence the impact of education on economic outcomes. Studies have shown that poor alignment between vocational training and economic demands may weaken the benefits of education (Saleem & Fatima, 2018; Khan, 2018). The findings of Bosworth and Collins (2003), along with other researchers, underscore the complexity of the relationship between educational quality and economic growth. Furthermore, the role of national education standards and infrastructure quality is equally significant (Ali & Ahmad, 2014; Iqbal & Nasir, 2018; Ahmad, 2018; Ali & Audi, 2018).

The inability to distinguish between the quality of education and broader institutional factors highlights the interconnected nature of development challenges. Simply investing in education may not yield the desired economic benefits if complementary factors such as infrastructure, institutions, and governance are lacking. In this sense, human capital development must be viewed within the broader context of overall economic development (Ali & Audi, 2016; Ahmad, 2018; Iqbal & Nasir, 2018). Indeed, research suggests that there is a complementarity between investments in human capital and other determinants of economic growth, such as infrastructure and institutional quality (Nwezeaku, 2018). For example, the skills acquired through education may not translate into tangible benefits for economic growth if there are inadequate systems in place to utilize and leverage those skills effectively (Ali & Rehman, 2015; Khan, 2018). The studies conducted by Bosworth and Collins (2003), Abed and Devoid (2004), and Kemal, Musleh-ud Din, and Qadir (2002) highlight the notion that economic growth cannot solely be explained by increases in production. Instead, they emphasize the multifaceted nature of human capital and its role in driving economic development. These scholars explore various dimensions of human capital representation, recognizing that it encompasses more than just physical output.

To capture the complexities of human capital, researchers employ diverse indicators, including investment in education, gross secondary school enrollment, health expenditures, total labor force participation, and life expectancy at birth. These indicators offer insights into different aspects of human capital development, such as educational attainment, health outcomes, and workforce participation. Moreover, single-variable inflation is utilized as a proxy variable to gauge economic plans and the overall quality of organizations. This approach allows researchers to assess the macroeconomic environment and its influence on human capital accumulation and economic growth. By considering inflation alongside other human capital indicators, scholars can better understand the broader socioeconomic context in which growth dynamics unfold. Overall, this study seeks to provide comprehensive insights into the intricate relationship between human capital and economic growth, with a focus on various indicators that directly impact economic performance. By examining these relationships across a diverse set of countries, the study aims to offer valuable insights for policymakers and practitioners seeking to promote sustainable and inclusive economic development.

2. LITERATURE REVIEW

Sheiner (2014) conducted a study to analyze the perspectives on Health Care Spending Growth spanning from 1960 to 2012. Employing econometric techniques such as integration regression growth per capita, the study aimed to explore the relationship between economic growth, health expenditure, and inflation over the specified period. The findings of Sheiner's study revealed that economic growth exhibited a lower trajectory compared to health expenditure and inflation. This suggests that health care spending and inflation outpaced economic growth during the examined period. The study's use of integration regression growth per capita facilitated a comprehensive assessment of the dynamics between economic indicators and health care spending, shedding light on the relative growth patterns and their implications for economic development and health care provision. Sghari and Hammami (2013) conducted a comprehensive analysis of the relationship between health expenditure and GDP in developed countries spanning from 1975 to 2011. Employing advanced econometric techniques such as long-run causality test, Granger causality, and vector autoregressive models, the study aimed to elucidate the dynamics between health expenditure and economic growth. The findings of Sghari and Hammami's study revealed a stable long-run relationship between increases in health care expenditure and economic growth in developed countries. Furthermore, the study demonstrated a positive

relationship between health expenditure and economic growth, indicating that higher levels of health care spending were associated with stronger economic performance over the long term.

Anyanwu and Erhijakpor (2009) conducted a rigorous analysis of health expenditures and health outcomes in Africa spanning from 1994 to 2004. Employing advanced econometric techniques, including panel data regression equations for under-five mortality and infant mortality, the study aimed to assess the relationship between health expenditure and health outcomes across the continent. The findings of Anyanwu and Erhijakpor's study revealed an unambiguously negative relationship between per capita total and government expenditure on health and health outcomes in Africa. Furthermore, the study demonstrated that the coefficients associated with these relationships were statistically significant, indicating the robustness of the findings. The advocacy for increased expenditure on health outcomes, particularly in the context of reducing infant and child mortality rates, is widespread. However, despite this advocacy, there is a notable dearth of empirical evidence demonstrating the beneficial impact of such expenditure on these critical health indicators.

Ramesh and Nishant (2004) conducted a comprehensive time series analysis of private healthcare expenditures (PHE) in relation to GDP, spanning from 1960 to 2003. Utilizing advanced econometric techniques such as the ordinary least squares method, unit root tests, and co-integration analysis, the study aimed to elucidate the relationship between private healthcare expenditures and GDP, while accounting for potential structural breaks. The findings of Ramesh and Nishant's study revealed that both per capita income (PCI) and private healthcare expenditures were not stationary in their level. This indicates that these variables exhibited trends or patterns over time, rather than remaining constant. Furthermore, the null hypothesis of unit root was rejected for both variables, suggesting that they were not characterized by random fluctuations but rather displayed systematic patterns or trends.

Khan and Ssnhadji (2001) conducted an extensive analysis to estimate the threshold effects in the relationship between inflation and growth, covering the period from 1960 to 1998. Employing advanced econometric techniques, including panel data log likelihood ratio tests, the study aimed to assess the complex dynamics between inflation and economic growth. The findings of Khan and Ssnhadji's study revealed the presence of threshold effects in the relationship between inflation and growth. By utilizing innovative econometric methodologies that provided appropriate procedures for estimation and inference, the study was able to identify a threshold beyond which inflation exerted a negative effect on economic growth. These empirical results provide compelling evidence supporting the notion of a non-linear relationship between inflation and growth, highlighting the importance of considering threshold effects in economic policy formulation and decision-making. By recognizing the existence of a critical threshold, policymakers can adopt targeted interventions aimed at managing inflation levels to ensure sustainable economic growth and stability.

Attari and Javed (2013) conducted a comprehensive analysis of inflation, economic growth, and government expenditure in Pakistan spanning from 1980 to 2010. Utilizing a range of econometric techniques including Augmented Dickey Fuller (ADF) unit root tests, Autoregressive Distributed Lag (ARDL) models, Johansen co-integration analysis, and Granger-causality tests, the study aimed to investigate the relationships between these key macroeconomic variables. The findings of Attari and Javed's study revealed a negative relationship between GDP and inflation in Pakistan. This suggests that higher levels of inflation were associated with lower economic growth rates during the period under study. Additionally, the study identified a positive relationship between real income and government expenditure, indicating that increases in government spending were associated with higher levels of real income. Interestingly, similar findings were observed in the case of several other countries including Australia, Canada, Finland, New Zealand, Spain, Sweden, and the United Kingdom.

Gokal and Hanif (2004) conducted a rigorous analysis to estimate the relationship between inflation and economic growth in the case of Fiji, spanning from 1970 to 2001. Employing advanced econometric techniques such as non-linear least squares (NLLS) and NLLS methods, the study aimed to uncover the complex dynamics between inflation and economic growth. The findings of Gokal and Hanif's study revealed the presence of a threshold beyond which inflation exerts a negative effect on growth in Fiji. Specifically, the study identified that inflation levels below the threshold had no significant effect on growth, while inflation rates above the threshold were associated with a significant negative impact on economic growth.

Asari et al. (2011) conducted a comprehensive analysis of the correlation between inflation rate, employment rate, and Gross Domestic Product (GDP) in Malaya from 1982 to 2006, employing sophisticated econometric techniques. Utilizing multivariate time series analysis, unit root tests, co-integration tests, trace tests, maximal eigenvalue tests, vector error correction models, and Granger causality tests, the study aimed to elucidate the dynamic relationships among these key macroeconomic variables. The findings of Asari et al.'s study revealed that both inflation rate and employment rate significantly influenced GDP in the short term. Specifically, fluctuations in inflation rate and employment rate were found to have an impact on GDP levels over shorter time horizons. However, the study found that GDP did not exert a significant influence on inflation rate, suggesting a unidirectional relationship between these variables. Moreover, the study identified a negative relationship between employment rate and GDP in the long run. This implies that over extended periods, increases in employment may have a dampening effect on GDP growth, highlighting potential structural issues within the labor market and broader economy of Malaya

Ocaya, Ruranga, and Kaberuka (2012) conducted a comprehensive analysis of the dynamic relationship between Gross Domestic Product (GDP) and Domestic Investment (DI) in Rwanda, spanning from 1970 to 2011. Employing a range of sophisticated econometric techniques including unit root tests, Granger causality analysis, co-integration analysis, Vector Auto-regression (VAR), and Vector Error Correction Model (VECM), the study aimed to uncover the complex interplay between these two key macroeconomic variables. The findings of Ocaya, Ruranga, and Kaberuka's study revealed a unidirectional causality between GDP and DI in Rwanda, indicating that policies aimed at fostering GDP growth provide valuable insights for predicting DI in the country. The results of the estimation, supported by Granger causality tests and error correction models, underscored the relevance of the DI equation and the limited impact of the GDP equation in their adopted model. The estimated bivariate VAR (1) model demonstrated stability in first differences, albeit not in levels. The forecasted value of DI in 2011 amounted to 22.6303% of GDP, closely aligned with the actual value of 22.7% of GDP in the same year. This small discrepancy between the forecasted and actual values of DI suggests that GDP can effectively predict DI with a minimal error of 0.0697%. The study attributed the close alignment between forecasted and actual DI values to the commendable policies pursued by the Rwandan government and the private sector federation in promoting investment within the country. These findings underscore the importance of targeted policies aimed at fostering GDP growth as a means to stimulate domestic investment and drive economic development in Rwanda.

Mofrad (2012) conducted an in-depth analysis of the relationship between Gross Domestic Product (GDP) and investment in Iran spanning from 1991 to 2008. Employing econometric techniques including unit root tests and Johansen co-integration tests, the study aimed to elucidate the long-term relationship between these key macroeconomic variables.

The findings of Mofrad's study revealed the existence of a positive and significant long-term relationship between investment and export with Gross Domestic Production (GDP) at a 95%

confidence level. However, the relationship between investment and export was found to be negative, indicating a potentially complex dynamic between these variables.

Further analysis utilizing the vector error correction model (VECM) for GDP highlighted an error correction coefficient that was negative. This negative coefficient suggested that deviations from the long-term equilibrium value of GDP were corrected over time, with GDP converging towards its equilibrium level. This adjustment mechanism was attributed to the high value of GDP observed in the short run compared to its long-term equilibrium value.

Guech, Heang, and Moolio (2013) conducted an extensive analysis on the relationship between Gross Domestic Product (GDP) and investment in Cambodia spanning from 1993 to 2011. Utilizing a variety of econometric techniques including simple regression analysis, Augmented Dickey-Fuller test, Durbin-Watson test, Breusch-Godfrey Serial Correlation LM test, Breusch-Pagan-Godfrey test, and Jarque-Bera test, the study aimed to elucidate the dynamics of investment and GDP in the Cambodian context. Their findings revealed a positive relationship between investment and GDP in the long run in Cambodia. This suggests that increases in investment tend to lead to corresponding increases in GDP over time, highlighting the importance of investment as a driver of economic growth in the country. However, despite this positive relationship, the study concluded that Cambodia may benefit less from Foreign Direct Investment (FDI) due to internal factors within the country. In comparison to other countries examined in their study, Cambodia's ability to leverage FDI for economic growth may be comparatively limited.

Fatima et al. (2011) conducted a comprehensive analysis to examine the relationship between private investment, economic growth, and fiscal deficit in Pakistan spanning from 1980 to 2009. Employing econometric techniques such as Unit Root Test, Dickey-Fuller (DF), and Augmented Dickey-Fuller (ADF) tests, the study aimed to assess the stationarity of the data and understand the implications of fiscal deficit on economic variables. Their results indicated that all series strongly rejected the unit root null hypothesis at a 5 percent significance level, suggesting that the data were stationary. This provided a robust foundation for further analysis of the relationships between private investment, economic growth, and fiscal deficit. The study found that fiscal deficit had significant direct and indirect effects on economic growth. Specifically, the fiscal deficit exhibited a negative and significant impact on private investment (INV). This implies that higher fiscal deficits may hinder private investment activity, potentially limiting economic growth prospects in Pakistan.

Lahoti and Swaminathan (2013) conducted a comprehensive analysis to explore the relationship between economic growth and female labor force participation in India spanning from 1983 to 2010. Employing robust econometric techniques, the study aimed to investigate the dynamics of female labor force participation in response to changes in economic indicators. Their findings revealed a significant positive effect of growth in agricultural employment share on female employment. However, they observed that growth in agricultural value share had no significant effect on female employment. This disparity in results between value shares and employment shares could be attributed to the relatively low level of correlation between value added and employment generation in the agricultural sector. These results shed light on the nuanced relationship between economic growth and female labor force participation in India, particularly within the context of the agricultural sector.

Mujahid and Naeem Uz Zafar (2012) conducted an empirical investigation into the nexus between economic growth and female labor force participation in Pakistan spanning from 1980 to 2010. Utilizing a range of econometric techniques such as ADF Unit Root Test, Philips and Perron Unit Root Test, and Zivot-Andrews Unit Root Test, alongside the ARDL Bounds Testing Approach to Co-integration, the study aimed to elucidate the relationship between these variables. Their analysis revealed a robust link between economic growth and female labor supply in Pakistan. As a result, the

study suggests that policymakers should prioritize efforts to increase and enhance female education and skills. Additionally, the adoption of gender-specific wage laws could help reduce the earning gap between genders, fostering greater gender equality in the labor market. Moreover, the study recommends implementing measures to improve employment opportunities, particularly through the expansion of the manufacturing and industrial sectors. By enhancing the overall environment for female labor force participation, Pakistan can harness the full potential of its workforce and promote inclusive economic growth.

Hossain (2012) conducted an analysis of the labor force and GDP in Bangladesh spanning from 2000 to 2009, employing econometric techniques such as OLS methods. The study revealed a strong positive relationship between the labor force and GDP, indicating that as the labor force grows, so does the GDP. In another study, Hossain examined the relationship between health status and labor force participation in Sub-Saharan Africa (SSA) from 1990 to 2011, utilizing panel analysis to test this relationship. The results of the analysis suggested that population health status, measured by life expectancy at birth, has a positive and significant effect on total and female labor force participation across countries in SSA. This implies that higher population health status correlates with increased participation in the labor market, all else being equal.

Lechman (2014) conducted an analysis of female labor force participation and economic growth, re-examining the U-shaped curve hypothesis from 1990 to 2012. Employing econometric techniques such as GMM and panel data analysis, the study aimed to test the relationship between these variables. The findings indicated that while the hypothesis of a U-shaped relationship between female labor force participation and economic growth exists, there is significant cross-country variability in this regard. Additionally, Lechman analyzed the relationship between economic growth and female labor force participation, verifying the U-feminization hypothesis from 1990 to 2012. In their analysis, Lechman (2014) employed the pooled OLS method to determine the relationship between GDP and female labor force participation. Their findings supported the U-hypothesis, suggesting that in the early stages of economic growth, female labor force participation tends to decline. However, as a country progresses in economic development and its economy shifts towards a more service-based structure, female labor force participation systematically increases. While they empirically confirmed the U-shaped relationship, significant cross-country variability in the field persists. However, upon disaggregating the evidence and examining analogous relationships between female labor force participation and GDP per capita across four distinct income groups, variations were observed among analyzed country groups. Particularly, in high-income and upper-middle-income economies, the existence of the U-shaped relationship was positively verified, although it disappeared when introducing dynamic effects.

Qadri and Waheed (2011) conducted an analysis on the relationship between human capital and economic growth in Pakistan, where human capital is generally regarded as a positive contributor to economic growth. They estimated this relationship using time series data from Pakistan spanning the period from 1978 to 2000. Utilizing a health-adjusted education indicator of human capital within the recognized Cobb-Douglas production framework, their analysis confirms a long-term positive relationship between human capital and economic growth in Pakistan. The results of their study align broadly with findings from various other studies, indicating that factors such as employment and labor force also have significant effects on economic growth.

Kakar, Khilji, and Jawad (2011) conducted an analysis on the relationship between education and economic growth in Pakistan using time series data from the period 1980 to 2009. Employing econometric techniques such as co-integration and error correction models, they aimed to determine the long and short-run relationship between education and economic growth. Their results confirmed the presence of a long-run relationship between education and economic growth. They found that better

standards of education improve the efficiency and productivity of the labor force, ultimately impacting economic development in the long run. However, in the short run, education did not exhibit any significant relationship with economic growth.

Nawaz (2014) conducted an analysis on the factors influencing the economic growth of Pakistan from 1998 to 2012. Utilizing econometric techniques such as co-integration, Vector Error Correction Model (VECM), and Granger causality tests, the study aimed to identify these factors. However, the results of the study cannot be generalized to non-banking industries in Pakistan or other developing countries due to various reasons. The findings are applicable primarily to the banking sector in Pakistan and in developing countries with similar banking cultures and environments.

Afzal, Farooq, Ahmad, Begum, and Quddus (2010) investigated the relationship between school education and economic growth in Pakistan spanning from 1970 to 2009. Employing econometric techniques such as the ARDL approach to co-integration, as well as ADF, PP, and Ng-Perron unit root tests, they aimed to discern this relationship. Their findings revealed several significant outcomes: Firstly, they found that physical capital had a positive and significant effect on economic growth, supported by both long-run and short-run dynamic models. Additionally, they observed a significant direct effect of net school enrollment ratio on economic growth, evident in both short-run and long-run analyses. Furthermore, they noted that inflation, as a measure of macroeconomic instability, negatively impacted economic growth in both the short-run and long-run, with a significant negative effect on school education evident only in the long-run. Additionally, they underscored the importance of educational attainment, as reflected by the net school enrollment ratio, in driving economic progress. This finding suggests that policies aimed at improving access to education can have significant positive effects on long-term economic growth prospects.

Wilson and Briscoe's (2004) study, titled "Impact of Education and Training," offers a thorough examination of how human capital influences economic growth. Focused on Europe, their research delves into the implications of education and training on economic performance and employment opportunities at a macro level. Employing panel root and integration methods, they analyze the relationship between health expenditures/investments and economic growth. Their findings indicate that an increase in health expenditures leads to a corresponding increase in economic growth. This suggests that investments in healthcare and human capital development can have positive effects on overall economic performance.

Ranis, Stewart, and Ramirez (2000) conducted an analysis on the interplay between economic growth and human development. They identified two distinct chains of influence: one leading from economic growth to human development, and the other, conversely, from human development to economic growth. Their study delved into the various links within each chain, examining the intricate relationship between economic growth and the enhancement of human capabilities, such as education, health, and living standards. Additionally, they reviewed existing empirical evidence to assess the significance of these links. By elucidating these complex dynamics, Ranis, Stewart, and Ramirez contributed to a deeper understanding of the mutual relationship between economic growth and human development. They explored the significance of the relationships within the identified chains, analyzing cross-country statistics spanning from 1970 to 1992. Their findings indicated a robust positive relationship between economic growth and human development, with notable impacts observed in both directions. They highlighted that public expenditure on social services and female education played crucial roles in determining the strength of the relationship between economic growth and human development. Additionally, they noted that factors such as the investment rate and income distribution were significant determinants of the relationship between human development and economic growth. Through this analysis, they shed light on the nuanced interdependencies between economic progress

and the advancement of human capabilities, offering insights into key factors that shape these dynamics.

3. RESEARCH METHODOLOGY

Research methodology provides a framework to identify the research areas that are most likely to be academically, and practically worthwhile and realistic by using the variety of research approaches, and methods. It also provides proper guidelines for systematic planning of research by exploring new methods or replicating the existing methods to accomplish the different stages of the research process. Therefore, the choice of research approach is one of the stages of research methodology, which depends upon two factors, such as; aim of the inquiry and use of the findings. These two factors create two different approaches of research, one is structured approach which is known as quantitative research and other is the unstructured, known as qualitative (Kumar, 2008; Blessing & Chakrabarti, 2009). The current study is quantitative in nature, first the methodology that has been adopted is to quantify economic relationships among the variables and second, the data set consists of observations of several variables over period of time and cross section (Asteriou & Hall, 2007). This study try to develop the relationship between economic growth and human capital by using the panel estimation. Various proxies have been used in the literature to measure human capital, including investment, net secondary school enrollment, health expenditures, total labor force, and life expectancy at birth (Zahid, 2018; Manzoor & Agha, 2018). Additional variables, such as inflation, are also incorporated to assess economic planning and institutional quality (Ali, 2018).

$$gdp_{it} = \beta_0 + \beta_1 inf_{it} + \beta_2 inv_{it} + \beta_3 educ_{it} + \beta_4 hexp_{it} + \beta_5 tlb_{it} + \beta_6 leb_{it} + u_{it} \quad \text{eq. (3)}$$

where;

gdp_{it} = Gross domestic product, inf_{it}= Inflation, inv_{it} = Investment , $educ_{it}$ = Net secondary school enrollment, $hexp_{it}$ = Health expenditures, tlb_{it} = Total labor force, leb_{it}, Life expectancy at birth, β_i= constants (intercepts and slope), u_{it} = error term, it = i for cross section and t for time period

The data has been collected from the World Bank's (WB) *World Development Indicators* database (2014). There are different computerized packages that have been normally used to analyze the panel data, like: EViews, STATA, MicroFit etc. But EViews 9 features have the most extensive changes and improvements package since the initial release of EViews in 2014. The more powerful new estimation techniques and new methods of working with the samples are introduced in this package (Quantitative Micro Software).

4. ESTIMATIONS

Table 1 presents the descriptive statistics for the core macroeconomic and social indicators used in the analysis, namely gross domestic product (GDP), inflation (INF), investment (INV), net secondary school enrollment (EDU), health expenditures (HEXP), total labor force (TLF), and life expectancy at birth (LEB). These statistics provide an overview of the data's central tendencies, dispersion, and distributional characteristics, allowing for a preliminary understanding of the variables' behavior across the sample.

The variable GDP, measured in logarithmic form, has a mean value of 10.7123 and a median of 10.9984, indicating that GDP values are slightly left-skewed. This is confirmed by the skewness coefficient of −1.3256, suggesting that most GDP values are concentrated toward the upper end of the distribution. The standard deviation of 0.7543 shows a moderate spread around the mean, while the minimum and maximum values range from 8.7835 to 11.8576, reflecting considerable variation in

GDP across observations. The kurtosis of 4.1821 implies a leptokurtic distribution (more peaked than normal), and the Jarque-Bera statistic of 34.2885 confirms significant deviation from normality.

Inflation (INF) displays substantial volatility, with a mean of 10.1267 and a standard deviation of 11.9384. The range spans from −5.4447 to 78.9210, suggesting the presence of extreme values. The skewness is notably high at 3.1082, indicating a pronounced rightward skew due to large inflation spikes. The kurtosis of 14.3215 points to a highly peaked distribution with fat tails, and the Jarque-Bera statistic of 698.3491 strongly confirms non-normality in the inflation data.

The investment (INV) variable, also measured in logarithmic form, has a mean of 10.1934 and a median of 10.3447, with values ranging from 8.5225 to 11.0243. The standard deviation is 0.6387, indicating a relatively tight spread around the mean. The negative skewness of −1.2349 suggests that investment values are more concentrated on the higher end, while the kurtosis of 3.9122 points to a distribution that is slightly more peaked than normal. The Jarque-Bera statistic of 28.5410 indicates significant non-normality.

Net secondary school enrollment (EDU) exhibits a mean of 61.2456 and a median of 64.2187, showing a moderate central tendency. The range is wide, from 23.9106 to 88.3342, with a standard deviation of 17.9268, indicating substantial variability in educational enrollment across countries or years. The skewness of −0.2591 and kurtosis of 2.0145 both suggest a fairly symmetric and mesokurtic distribution. The Jarque-Bera statistic of 5.4382 provides mild evidence of non-normality but is not extreme.

The health expenditure (HEXP) variable, expressed in per capita terms, has a mean of 158.6172 and a median of 110.9421, suggesting a right-skewed distribution. This is supported by the skewness coefficient of 1.2968, indicating the presence of countries with disproportionately high spending. The standard deviation is 153.2648, showing large dispersion. The minimum value is 9.1245, while the maximum is 603.1154, reflecting sharp disparities in healthcare spending. The kurtosis of 3.9374 and the Jarque-Bera statistic of 31.8871 confirm a non-normal, skewed distribution.

Total labor force (TLF), measured in logarithmic terms, has a mean of 7.1561 and a median of 7.2783, with values ranging from 5.4971 to 7.8426. The standard deviation is 0.6390, indicating moderate dispersion. The skewness of −1.6528 suggests a strong left skew, meaning that the majority of the observations are concentrated at the higher end. The kurtosis of 4.9637 indicates a leptokurtic distribution, and the Jarque-Bera value of 62.0415 confirms significant departure from normality.

Table 1: Descriptive Statistics

	GDP	INF	INV	EDU	HEXP	TLF	LEB
Mean	10.7123	10.1267	10.1934	61.2456	158.6172	7.1561	69.2014
Median	10.9984	6.2819	10.3447	64.2187	110.9421	7.2783	68.8993
Maximum	11.8576	78.9210	11.0243	88.3342	603.1154	7.8426	74.9381
Minimum	8.7835	-5.4447	8.5225	23.9106	9.1245	5.4971	60.1143
Std. Dev.	0.7543	11.9384	0.6387	17.9268	153.2648	0.6390	3.3812
Skewness	-1.3256	3.1082	-1.2349	-0.2591	1.2968	-1.6528	-0.2279
Kurtosis	4.1821	14.3215	3.9122	2.0145	3.9374	4.9637	2.1732
Jarque-Bera	34.2885	698.3491	28.5410	5.4382	31.8871	62.0415	3.0416

Lastly, life expectancy at birth (LEB) has a mean of 69.2014 and a median of 68.8993, reflecting moderate average longevity across the sample. The variable ranges from 60.1143 to 74.9381, and the

standard deviation of 3.3812 shows relatively low dispersion. The skewness value of −0.2279 and kurtosis of 2.1732 suggest a relatively symmetric and normal-like distribution. The Jarque-Bera statistic is 3.0416, which is not statistically significant at conventional levels, indicating that the LEB data are approximately normally distributed.

The descriptive statistics highlight substantial variation in macroeconomic and social indicators, particularly in inflation and health expenditures. Several variables, including GDP, investment, inflation, and labor force, deviate from normality, which may have implications for model specification and estimation techniques in the subsequent analysis.

Table 2 presents the results of the Panel Augmented Dickey-Fuller (ADF) unit root test under the specification of trend and intercept, used to examine the stationarity properties of the panel data variables. The test is conducted at both the level [I(0)] and the first difference [I(1)] forms. Asterisks (*) denote statistical significance, indicating rejection of the null hypothesis of a unit root (i.e., non-stationarity). The corresponding lag lengths used in each test are also reported.

Starting with GDP, the test statistic at level is 23.1412 with a lag length of 2, which is not statistically significant, implying non-stationarity. However, after first differencing, the test statistic rises to 64.0923* at a lag length of 3, which is statistically significant, confirming that GDP becomes stationary at first difference and is therefore integrated of order one, I(1).

For INF (Inflation), the panel ADF test shows a statistically significant value of 76.3347* at level with a lag length of 3, indicating that inflation is already stationary in level form, or integrated of order zero, I(0). The first difference result is also significant (81.1209* at lag 2), reinforcing the variable's stationarity.

Table 2: Panel ADF Unit Root Test Statistic

Variables	Level I(0) Trend and Intercept	Lag Length	Level I(1) Trend and Intercept	Lag Length
GDP	23.1412	2	64.0923*	3
INF	76.3347*	3	81.1209*	2
INV	28.4461	2	98.3071*	4
EDU	11.3024	1	29.6548*	2
HEXP	16.8249	2	70.8895*	3
TLF	33.9015	3	57.7613*	3
LEB	20.3916	4	81.2376*	4

The variable INV (Investment) has a non-significant test statistic of 28.4461 at level with a lag of 2, suggesting non-stationarity in level form. However, it becomes stationary after first differencing, with a test statistic of 98.3071* at a lag length of 4, confirming that INV is I(1).

EDU (Net Secondary School Enrollment) is also non-stationary at level, as indicated by the test statistic of 11.3024 at a lag length of 1. However, at first difference, the test statistic becomes 29.6548* with a lag of 2, confirming that EDU is stationary at I(1).

HEXP (Health Expenditure) displays a non-significant test statistic of 16.8249 at level (lag 2), suggesting it is non-stationary in its level form. After first differencing, the variable becomes stationary with a significant test statistic of 70.8895* at lag 3, indicating it is also integrated of order one.

TLF (Total Labor Force) reports a level statistic of 33.9015 at lag 3, which is not significant, implying non-stationarity. The first difference statistic increases to 57.7613* with the same lag length, showing significance and establishing that TLF becomes stationary at I(1).

Lastly, LEB (Life Expectancy at Birth) is non-stationary at level with a test statistic of 20.3916 at lag 4, but becomes strongly stationary after first differencing, as shown by the highly significant test statistic of 81.2376* also at lag 4.

In conclusion, except for INF, which is stationary at level, all other variables—GDP, INV, EDU, HEXP, TLF, and LEB—are non-stationary in their level form but become stationary after first differencing. This indicates that these six variables are integrated of order one, I(1), which supports the appropriateness of econometric techniques such as panel cointegration analysis or the ARDL model, where variables can be a mix of I(0) and I(1), provided none are I(2).

Table 3 presents the results of the pooled Ordinary Least Squares (OLS) regression, where GDP is the dependent variable, and the explanatory variables include inflation (INF), investment (INV), education (EDU), health expenditure (HEXP), total labor force (TLF), and life expectancy at birth (LEB). The high R-squared value of 0.9781 and adjusted R-squared of 0.9765 suggest that the model explains a substantial proportion of the variation in GDP across observations. Additionally, the F-statistic is highly significant (p = 0.0000), confirming the overall joint significance of the regressors.

The coefficient for inflation is -0.0023 with a p-value of 0.0521, indicating a negative and marginally significant impact on GDP. This suggests that rising inflation has a slight dampening effect on economic output, consistent with economic theory that inflation, particularly when volatile, can erode purchasing power and distort investment decisions (Barro, 1996).

Table 3: Pooled OLS

Dependent Variable: GDP

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Intercept	-0.602371	0.374218	-1.609679	0.1112
INF	-0.002341	0.001198	-1.954617	0.0521
INV	0.439217	0.050184	8.751024	0.0000
EDU	0.002145	0.001031	2.080699	0.0402
HEXP	0.030912	0.008763	3.527339	0.0008
TLF	0.001102	0.000129	8.545716	0.0000
LEB	0.552839	0.071422	7.740203	0.0000
R-squared	0.978112			
Adjusted R-squared	0.976498			
F-statistic	648.7213			
Prob(F-statistic)	0.000000			

Investment has a positive and highly significant coefficient of 0.4392 (p = 0.0000), indicating that a one-unit increase in investment leads to a 0.4392 unit increase in GDP. This is expected, as investment contributes to capital accumulation, production capacity, and long-term growth (Solow, 1956). Education also shows a positive and statistically significant relationship with GDP, with a coefficient of 0.0021 (p = 0.0402). This result supports the view that increased secondary school enrollment

contributes to human capital development and productivity, a finding well-established in growth literature (Barro & Lee, 2013).

Health expenditure has a coefficient of 0.0309 and is also statistically significant (p = 0.0008), implying that better health outcomes contribute positively to economic performance. Improved health increases labor productivity and reduces absenteeism, thereby strengthening workforce efficiency (Bloom & Canning, 2000). The labor force variable shows a positive and highly significant effect on GDP (coefficient = 0.0011, p = 0.0000), indicating that a larger workforce contributes directly to economic growth, particularly in labor-abundant economies.

Lastly, life expectancy at birth has a strong and significant positive relationship with GDP (coefficient = 0.5528, p = 0.0000), reinforcing the importance of long-term health and demographic factors in influencing economic development. Longer life expectancy is often associated with better public health systems and social stability, which encourage investment and long-run planning.

In summary, the pooled OLS model in Table 3 confirms that investment, education, health expenditure, labor force participation, and life expectancy all have statistically significant and positive effects on GDP, while inflation exerts a slightly negative influence. These findings are consistent with human capital and endogenous growth theories, highlighting the multifaceted nature of economic development.

Table 4 presents the results of the Redundant Fixed Effects F-Test, which is used to determine whether fixed effects are jointly significant in a panel data model. This test compares the fixed effects model to a pooled OLS model (one that assumes no cross-sectional heterogeneity) to assess whether including fixed effects significantly improves model fit.

The Cross-section F-statistic is reported as 20.437891, with associated degrees of freedom (d.f.) (8, 76) and a probability (p-value) of 0.0000. This very low p-value indicates that the null hypothesis—which assumes that all cross-sectional effects are redundant (i.e., not different from zero)—can be strongly rejected. Therefore, the test supports the presence of significant cross-sectional fixed effects in the model.

Additionally, the Cross-section Chi-square statistic is 102.381246, with 8 degrees of freedom, and a p-value of 0.0000. This result reinforces the F-test outcome, again providing strong evidence that the fixed effects are jointly significant and not redundant.

Together, these results imply that the panel data model benefits from accounting for cross-sectional heterogeneity, and that the fixed effects model is statistically superior to the pooled OLS specification. In practical terms, this means that differences across entities (such as countries, regions, or firms) significantly influence the dependent variable and must be incorporated into the model to avoid omitted variable bias and to improve the robustness of the estimation.

Table 4: Redundant Fixed Effect F-Test

Effects Test	Statistic	d.f.	Prob.
Cross-section F	20.437891	(8, 76)	0.0000
Cross-section Chi-square	102.381246	8	0.0000

Table 5 displays the results from the fixed effect model where GDP is the dependent variable and the regressors include inflation (INF), investment (INV), education (EDU), health expenditure (HEXP), total labor force (TLF), and life expectancy at birth (LEB), along with country-specific intercepts to control for unobserved heterogeneity across countries. The model demonstrates a very high explanatory power, with an R-squared of 0.9928 and an adjusted R-squared of 0.9916, indicating that over 99% of

the variation in GDP across countries and over time is explained by the model. The F-statistic is highly significant (p = 0.0000), confirming the overall strength of the regression.

Inflation (INF) is negatively associated with GDP, with a coefficient of -0.0046 and a highly significant p-value (0.0000). This implies that a one-unit increase in inflation reduces GDP, which aligns with macroeconomic theory that high inflation can deter investment, reduce purchasing power, and destabilize economic performance (Barro, 1996).

Investment (INV) continues to show a strong and positive effect on GDP, with a coefficient of 0.3671 (p = 0.0000), reinforcing its crucial role in capital accumulation and productivity gains (Solow, 1956).

Education (EDU) also has a statistically significant positive coefficient of 0.0013 (p = 0.0000), consistent with the notion that enhanced human capital contributes directly to economic development by improving workforce skills and innovation potential (Barro & Lee, 2013).

Health expenditure (HEXP), however, is not statistically significant (p = 0.6501), indicating that within this fixed effect framework, changes in health spending do not exert a measurable effect on GDP in the short term. This may suggest a delayed or indirect impact of health investments or reflect variations in the efficiency of health systems across countries.

Table 5: Fixed Effect Model

Dependent Variable: GDP

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INF	-0.004621	0.000794	-5.821034	0.0000
INV	0.367109	0.054123	6.783401	0.0000
EDU	0.001301	0.000104	12.509612	0.0000
HEXP	0.000539	0.001184	0.455055	0.6501
TLF	0.138206	0.065901	2.097301	0.0381
LEB	0.050172	0.007102	7.064295	0.0000
Intercept-Bangladesh	2.283551	0.619847	3.682215	0.0004
Intercept-Bhutan	1.397445	0.502738	2.779322	0.0064
Intercept-China	3.627811	0.548962	6.610047	0.0000
Intercept-India	3.154912	0.662775	4.761036	0.0000
Intercept-Nepal	1.948392	0.577202	3.374406	0.0010
Intercept-Pakistan	2.713889	0.629317	4.311007	0.0000
Intercept-Sri Lanka	1.872613	0.562302	3.329885	0.0012
Intercept-Malaysia	2.201238	0.591114	3.723441	0.0003
Intercept-Thailand	2.284518	0.612208	3.731185	0.0003
Intercept-Ukraine	2.151736	0.566309	3.800117	0.0002
Intercept-Turkey	2.194843	0.589006	3.725384	0.0003
R-squared	0.992838			
Adjusted R-squared	0.991593			
F-statistic	843.1178			
Prob(F-statistic)	0.000000			

The total labor force (TLF) has a positive and significant coefficient of 0.1382 (p = 0.0381), suggesting that labor supply expansion contributes to output growth. Life expectancy at birth (LEB) also shows a strong positive influence (coefficient = 0.0502, p = 0.0000), highlighting the importance of population health and longevity in sustaining long-term economic growth (Bloom & Canning, 2000).

Country-specific intercepts capture fixed effects for each country and are all statistically significant, indicating that baseline GDP levels differ across countries due to time-invariant characteristics such as institutional quality, geographic location, or historical development paths. For example, China and India have relatively high intercepts, reflecting their large and diverse economies, while countries like Bhutan and Sri Lanka exhibit lower intercepts, consistent with their smaller economic bases.

In sum, the fixed effect model in Table 5 emphasizes the importance of investment, education, labor force participation, and life expectancy in driving GDP across countries, while inflation remains a consistent drag on economic performance. Although health expenditure is insignificant here, its long-term effects may be more nuanced and potentially visible in dynamic models or when health system quality is incorporated.

Table 6 displays the results of the Hausman test, a diagnostic used to determine the most appropriate model between fixed effects (FE) and random effects (RE) in panel data analysis. The null hypothesis of the Hausman test states that the preferred model is random effects, which assumes that the individual-specific effects are uncorrelated with the explanatory variables. In contrast, the alternative hypothesis favors fixed effects, where such correlations do exist.

The Chi-square statistic is reported as 18.927341, with 6 degrees of freedom, and the corresponding p-value is 0.0042. Since the p-value is less than 0.05, the null hypothesis is rejected at the 5% significance level. This result indicates that there is a statistically significant difference between the fixed effects and random effects estimates.

Therefore, the test provides evidence that the individual-specific (cross-sectional) effects are correlated with the explanatory variables, violating a key assumption of the random effects model. As a result, the fixed effects model is more appropriate for this analysis, as it controls for unobserved heterogeneity that may otherwise bias the results under the random effects specification.

In summary, the Hausman test strongly favors the use of the fixed effects model, aligning with the earlier findings from the redundant fixed effect F-test, and reinforcing the decision to account for entity-specific characteristics in the panel regression framework.

Table 6: Correlated Random Effects - Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	18.927341	6	0.0042

5. CONCLUSIONS

The investigation into the relationship between human capital and economic growth has been a focal point of research for many years. This particular study delves into this relationship across eleven diverse countries, namely Bangladesh, Bhutan, China, India, Malaysia, Nepal, Pakistan, Sri Lanka, Thailand, Turkey, and Ukraine. The proxies used to represent human capital include investment, education, health expenditure, total labor force, and life expectancy. By employing a panel data approach, this research aims to provide insights into how variations in human capital indicators impact economic growth across different contexts and regions, thereby contributing to a deeper understanding of the dynamics between human capital development and economic advancement on a global scale. Indeed, the relationship between human capital and economic growth is of paramount importance,

particularly for developing countries striving for economic advancement. Previous literature has employed various methodologies to explore this relationship, including linear and nonlinear models, as well as single-country and panel data analyses. These diverse approaches reflect the complexity of the topic and the need for comprehensive investigation to understand the nuances of how human capital development influences economic growth. By leveraging different analytical techniques, researchers aim to uncover the underlying mechanisms and dynamics driving this critical relationship, thereby offering valuable insights for policymakers and stakeholders involved in shaping strategies for sustainable development. The current study employs panel data analysis to examine the relationship between human capital and economic growth specifically in the context of Pakistan. Utilizing various panel econometric tools, the research aims to measure the associations among economic growth and several explanatory variables including inflation, investment, education, health expenditure, total labor force, and life expectancy. The results indicated the presence of a long-run relationship among all the variables. The F-test of pooled OLS provided insights into the combined effect of all independent variables on economic growth. Specifically, it was found that human capital exerted a statistically significant effect on economic growth at the 1% level. In the subsequent step, the redundant fixed effect F-test was utilized to determine whether the results obtained from the pooled OLS method (common constant) or the fixed effect model were more suitable. The test outcomes favored the Fixed Effect Model over the pooled OLS results. Moving forward, the Fixed Effect Model was estimated, revealing a long-run relationship among all the variables. Furthermore, it was observed that all the explanatory variables had a significant effect on economic growth at the 10% level of significance, with the exception of education. The F-test conducted on the pooled OLS method demonstrated the combined impact of all independent variables on economic growth. This implies that human capital has a statistically significant effect on economic growth at the 1% significance level. In the final step, a choice between random effects or fixed effects methods was made using the Correlated Random Effects - Hausman test. However, the results of the test indicated that the Fixed Effect Model was more suitable than the random effects model.

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