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Analysis of the Impact of the HDI on GDP in Afghanistan (2000- 2022)

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- ARDL Model
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Abstract: This study shows effect of the Human Development Index (HDI) on Gross Domestic Product (GDP) in Afghanistan from (2000 to 2022) years. The study about how human development is related to economic growth, especially through education, health, and living conditions. The main gool of this study is to analyze the overall impact of HDI on GDP. In addition, the study also considers other important factors that can affect on economic growth, such as (total population, unemployment rate, and average years of schooling). The study uses annual data from international sources, like the World Bank and the United Nations Development Programme (UNDP). Data on HDI were taken from official UNDP Human Development Reports. To analyze the relationship between the variables, the model is the Autoregressive Distributed Lag (ARDL). This method is useful for time-series data and allows the study of both (short-run and long-run relationships). The results of the analysis show that HDI has a positive relationship with GDP in Afghanistan. This means that improvements in human development are connection with higher economic growth, also indicate that population growth and higher average years of schooling have a positive effect on GDP, while unemployment has a negative effect. The results confirm that there is a stable long-run relationship among the variables included in the model. The findings suggest that human development should not be seen only as a result of economic growth, but also as an important factor that helps to increase it. Based on the results. This study suggests that policymakers in Afghanistan should pay more attention to improving education, healthcare services, and employment opportunities. These actions can help support sustainable and economic growth at long term.

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INTRODUCTION

Sustainable economic development is a fundamental goal for countries, especially developing countries. Over the past few decades, the Human Development Index (HDI) has gained

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attention as a comprehensive measure of human progress across societies. This index, first introduced by the United Nations Development Programme (UNDP) in 1990, is derived from three vital dimensions of development: education, health, and living standards (UNDP, 1990). Since then, the HDI has become a practical tool for analyzing and comparing countries' developmental status.

Economic growth often accompanies improvements in human development indicators because investment in health and education can boost labor productivity and attract domestic and foreign investment (Sen, 1999). Moreover, a high GDP can provide the necessary financial resources to improve education and public health. Therefore, investigating the effects of the Human Development Index on GDP can offer an analytical and policy-oriented perspective on Afghanistan's development path, especially during the decades in which the country has been striving for reconstruction and development.

Studying the impact of the HDI on GDP in Afghanistan is essential because human development—particularly in education and health—plays a key role in boosting production and economic growth (Sen, 1999). In a country like Afghanistan, which faces structural deficiencies, investment in human capital can pave the way for sustainable growth and poverty reduction (UNDP, 2010).

The relationship between the Human Development Index (HDI) and Gross Domestic Product (GDP) has been extensively analyzed in the development economics literature, offering essential insights for examining Afghanistan's development trajectory. Foundational critiques by Sagar and Najam (1998) argue that while GDP measures economic output, HDI captures broader welfare dimensions—health, education, and living standards—making it a more comprehensive indicator of development, particularly in low-income countries. Subsequent methodological debates highlight weaknesses in the traditional HDI, including equal weighting and aggregation issues, which may obscure its linkage with GDP; for instance, Mahlberg and Obersteiner (2001) employ data envelopment analysis to remeasure HDI and demonstrate efficiency differences across countries that GDP alone cannot explain, while Nathan et al. (2008) propose alternative formulations that better reflect disparities among developing economies. Klugman et al. (2011) revisit these critiques in the context of HDI 2010 reforms, emphasizing that despite methodological improvements, income remains only one component of human development and does not automatically translate into social progress. Empirical studies consistently find a positive but complex relationship between HDI and GDP: Ranis et al. (2006) show that human development can serve both as a means and an end of economic growth, suggesting a virtuous cycle in which investments in education and health enhance productivity and income growth. Evidence from developing countries supports this view, as Hussain et al. (2010) find that globalization and economic development in Pakistan improved HDI through education and health channels, while Khodabakhshi (2011) reports a significant long-run relationship between GDP and HDI in India, with causality running in both directions. Similarly, Roshaniza and Selvaratnam (2015) demonstrate that GDP growth in Malaysia positively affects HDI and poverty reduction, though the strength of this relationship

depends on the effectiveness of policy. Deb (2015) further shows that the gap between GDP and HDI is more pronounced in poorer countries, suggesting that income growth without human development investment yields limited welfare gains. Broader comparative analyses reinforce these findings: Natoli and Zuhair (2011) argue that HDI complements GDP by better capturing social progress, while Anto (2011) underscores the importance of the ethical and social dimensions of development in OIC countries through the Islamic Human Development Index. Sector-specific evidence, such as that of Bray et al. (2012), links higher HDI levels to improved health outcomes, thereby indirectly supporting economic productivity.

This research, by providing analytical evidence, aims

- To assist policymakers in considering human development as an economic driver.

This research stands and offers answers to those questions. Those questions are essential to Afghanistan's development there are:

1. Is there a significant and positive relationship between the Human Development Index (HDI) and Gross Domestic Product (GDP)?
2. Is there a significant and positive relationship between total population and Gross Domestic Product (GDP)?
3. Is there a significant and negative relationship between the unemployment rate and Gross Domestic Product (GDP)?
4. Is there a significant and positive relationship between average years of schooling and Gross Domestic Product (GDP)?

Theoretical Background

Concept of the Human Development Index (HDI) The Human Development Index (HDI) is a composite measure designed to assess the level of development of countries, with a focus on human well-being. Unlike purely economic indicators such as Gross Domestic Product (GDP), this index encompasses various dimensions of human well-being. Specifically, the HDI focuses on three key components:

Health: measured by life expectancy at birth.

Education: a combination of mean years of schooling and expected years of schooling.

Per Capita Income: calculated as Gross National Income (GNI) per capita adjusted for purchasing power parity (PPP).

Concept of Gross Domestic Product (GDP) Gross Domestic Product (GDP) is one of the most important economic indicators used to measure a country’s economic performance. This indicator represents the monetary value of all final goods and services produced within a country over a specific period, usually one year or a quarter. GDP is used not only to compare economic growth across countries but also extensively in policy-making.

According to Samuelson and Nordhaus in their well-known book Economics, GDP is defined as:

"Gross Domestic Product is the market value of all final goods and services produced within the borders of a country during a specified period." (Samuelson & Nordhaus, 2010, p. 483). The emphasis on “final goods and services” means that intermediate goods are excluded to avoid double-counting. In Gregory Mankiw’s book Macroeconomics, it is stated: "GDP is defined as a measure of the total income of the economy and also total expenditure. These two amounts are equal because every dollar spent by a buyer is income to a seller." (Mankiw, 2016, p. 20)

Relationship Between Human Development Index and Gross Domestic Product The relationship between the Human Development Index (HDI) and Gross Domestic Product (GDP) is a fundamental topic in the economic development literature. Theoretically, GDP is one of the most critical factors influencing social welfare, but human development encompasses broader aspects of human life, such as education, health, and living standards (Todaro & Smith, 2020, p. 56). Therefore, economists believe the relationship between HDI and GDP is bidirectional and mutually reinforcing.

On one hand, an increase in per capita GDP can provide more financial resources for education, health, and social welfare, thereby enhancing human development indicators. On the other hand, growth in HDI components—such as education level, life expectancy, and income—can improve labor productivity and thus stimulate economic growth (Sen, 1999, p. 192). Correspondingly, statistics show that countries with higher human development rankings tend to experience more sustainable and balanced economic growth in the long run.

Economic Theories on Growth and Human Development: In financial literature, growth and human development are complementary concepts that play key roles in societal progress. Various economic theories have examined the factors affecting economic growth and human development; some of the most important are introduced below.

Human Capital Theory, developed by Gary Becker, views human capital as the set of skills, knowledge, and health of individuals that enhance their economic productivity. This theory emphasizes the importance of education and health in increasing labor productivity and economic growth. According to Becker, human capital is a form of real capital that can be used in the production process like physical capital. (Becker, 1964)

Human Development Approach the Human Development Approach, introduced by the United Nations Development Programme (UNDP), considers development to be more than just economic growth, emphasizing improvements in the quality of life, social justice, and increased freedoms. This approach stresses that human capital includes education, health, and living conditions that facilitate economic development (UNDP, 2019).

RESEARCH METHOD

This study uses a quantitative econometric approach to analyze the relationship between the Human Development Index (HDI) and Gross Domestic Product (GDP) in Afghanistan over the period 2000–2022. The analysis is based on a time-series framework and involves careful

model specification, systematic data collection, and the application of appropriate statistical techniques commonly used in empirical economic research.

Research Design

This research applies nature and uses a descriptive-analytical method based on secondary data. The study applies econometric modeling to assess both short-term and long-term relationships among variables. The positivist paradigm underpins the methodology, which assumes observable, measurable causal relationships.

Data Sources

In this research uses annual data for the period from 2000 to 2022 were obtained from reputable international databases:

- World Bank's World Development Indicators (WDI)
- United Nations Development Programme (UNDP) Human Development Reports

The data were processed using Microsoft Excel and analyzed with EViews 10.

Variables

The study includes the following variables:

- Dependent Variable: Gross Domestic Product (GDP), measured in constant USD.
- Main Independent Variable: Human Development Index (HDI), The HDI is a composite index that measures average achievement in three basic dimensions of human development—education, health, and standard of living. The education dimension is measured by mean and expected years of schooling; the health dimension is measured by life expectancy at birth; and the standard of living is measured by GNI per capita. Each sub-index is normalized from 1 to 0, and the HDI is calculated as the geometric mean of the three normalized indices. Data were used from the UNDP Human Development Reports.
- Control Variables: Total population, unemployment rate, and mean years of schooling.

Analytical Techniques

A series of econometric procedures was employed:

- Descriptive Statistics: Basic statistical properties including mean, standard deviation, skewness, kurtosis, and normality (Jarque-Bera test).
- Stationarity Tests: Augmented Dickey-Fuller (ADF) test to examine unit roots and ensure the validity of time-series modeling.
- Model Selection: The ARDL (Autoregressive Distributed Lag) model was chosen due to its flexibility with mixed-order integration (I(0) and I(1)) and suitability for small samples.
- Bounds Testing: Conducted to detect long-run cointegration among variables.

- Error Correction Model (ECM): Applied to estimate both short-term dynamics and speed of adjustment toward long-run equilibrium.
- Diagnostic Tests: Included the Durbin-Watson statistic, Breusch-Godfrey serial correlation test, Breusch-Pagan test for heteroskedasticity, Ramsey RESET for model specification, and CUSUM/CUSUMSQ tests for coefficient stability.

Model Specification

The relationship between the variables is considered in a (log-log) form, and the ARDL model is specified as follows:

$$\log(\mathrm{GDP_t}) = \alpha_0 + \sum_{i=1}^{p} \alpha_i \log(\mathrm{GDP_{t-i}}) + \sum_{j=0}^{q1} \beta_j \log(\mathrm{HDI_{t-j}}) + \sum_{k=0}^{q2} \gamma_k \log(Unemployment_{t-k}) + \sum_{l=0}^{q3} \delta_l \log(Eduacation_{t-1}) + \sum_{m=0}^{q4} \theta_m \log(population_{t-m}) + \varepsilon_t$$

This model can capture both short-term coefficients and long-run equilibrium relationships between the dependent and independent variables. After estimating the model, cointegration among the variables is tested to confirm the presence of a long-run relationship. Subsequently, the model is transformed into an Error Correction Model (ECM) to distinguish between short-term and long-term effects. The ECM model is specified as follows:

$$\Delta \log(\mathrm{GDP_t}) = \alpha_0 + \sum_{i=1}^{p-1} \phi_i \Delta \log(\mathrm{GDP_{t-i}}) + \sum_{j=0}^{q1-1} \beta_j^* \Delta \log(HDI_{t-j}) + \sum_{k=0}^{q2-1} \gamma_k^* \Delta \log(Unemployment_{t-k}) + \sum_{l=0}^{q3-1} \delta_l^* \Delta \log(Eduacation_{t-1}) + \sum_{m=0}^{q4-1} \theta_m^* \Delta \log(population_{t-m}) + \phi \cdot [\log(\mathrm{GDP_{t-1}}) - \lambda_1 \log(\mathrm{HDI_{t-1}}) - \lambda_2 \log(Unemployment_{t-k}) - \lambda_3 \log(Eduacation_{t-1}) - \lambda_4 \log(population_{t-1})] + \varepsilon_t$$

- The coefficients (ϕ_i، β_j^*،γ_k^*،δ_l^*، θ_m^*) represent the short-run coefficients in the ECM model.

To obtain the long-run coefficients, the following equation is used

The long-run coefficient of variable X is calculated as:

$$Long-run\ coefficient\ of\ X\ = \frac{Coefficient\ of\ variable\ j\ in\ the\ ARDL\ model}{\text{Coefficient of } \log(\text{GDP}_{t-1})}$$

This methodological framework ensures a robust empirical investigation into the relationship between human development and economic growth in Afghanistan.

FINDINGS

This study examines the relationship between the Human Development Index (HDI) and Gross Domestic Product (GDP) in Afghanistan using a structured econometric approach. Descriptive statistics were first used to summarize key variables, including GDP, HDI, population, unemployment, and mean years of schooling, and to identify general patterns in the data. The stationarity of the time-series variables was then tested using the Augmented Dickey–Fuller (ADF) test.

The Autoregressive Distributed Lag (ARDL) model was applied to analyze both short-run and long-run relationships, with the existence of long-run cointegration confirmed through the bounds testing approach. The ARDL framework was further extended into an Error Correction Model (ECM) to capture short-run dynamics and the speed of adjustment toward long-run equilibrium. Finally, diagnostic tests for heteroskedasticity, serial correlation, model specification, residual normality, and model stability (CUSUM and CUSUMSQ) were conducted to ensure the robustness of the results.

Descriptive Statistics

Table 1 reports the descriptive statistics of the main variables used in the analysis, including Gross Domestic Product (GDP), Human Development Index (HDI), total population, unemployment rate, and mean years of schooling (MYS), based on 23 annual observations. GDP (in billion U.S. dollars) shows substantial variation over the study period, with a mean value of 13.09, ranging from 2.81 to 20.49. The negative skewness indicates a slight leftward distribution of GDP values.

HDI ranges between 0.34 and 0.49, with an average of 0.439, reflecting generally low to moderate levels of human development in Afghanistan. The population variable records a mean of approximately 29.9 million and displays a gradual upward trend, as indicated by its small positive skewness.

The unemployment rate averages 9.07%, with values ranging from 7.75% to 14.1%, and exhibits right skewness, suggesting occasional periods of higher unemployment. Mean years of schooling average 1.98 years and show relatively low variability over time. Kurtosis values indicate that most variables follow relatively flat distributions, while unemployment displays a distribution close to normal. The Jarque–Bera test results indicate no significant deviation from normality at the 5% significance level, although unemployment is marginally close to non-normality.

Overall, the descriptive statistics reveal notable variation in Afghanistan's economic and human development indicators, providing a basis for further econometric analysis of the relationship between human development and economic growth.

***Table 1**. Descriptive Statistics*

	GDP	Human Development Index	Total population	Unemployment Rate	MYS
Mean	13.09294	0.439652	29949976	9.071174	1.97
Median	14.49724	0.457000	29347708	7.930000	1.93
Maximum	20.49713	0.492000	40578842	14.10000	2.98
Minimum	2.813572	0.340000	20130327	7.753000	1.26
Std. Dev.	6.418239	0.048044	6511314.	1.870762	0.50
Skewness	-0.375029	-0.775811	0.110621	1.235947	0.39
Kurtosis	1.543051	2.346755	1.782852	3.313712	2.11
Jarque-Bera	2.573399	2.716166	1.466630	5.949983	1.35
Probability	0.276181	0.257153	0.480314	0.051048	0.50
Sum	301.1376	10.11200	6.89E+08	208.6370	45.4
Sum Sq. Dev.	906.2633	0.050781	9.33E+14	76.99449	5.63
Observations	23	23	23	23	23

Note: variable is calculated annually by the United Nations, and in this study, HDI data are obtained from UNDP sources.

Source: Authors Calculations.

Unit Root Test Result

Table 2 shows the results of the Augmented Dickey-Fuller (ADF) unit root tests examining the stationarity of the key variables. The null hypothesis of the ADF test states that the variable has a unit root, implying non-stationarity. The test was performed at both the level and first-difference forms, with different model specifications: constant, constant and trend, and no constant or trend.

At the level, the GDP variable does not reject the null hypothesis of a unit root across all model specifications, indicating it is non-stationary in its level form. However, the HDI variable shows stationarity at the 5% significance level when tested with a constant ($t = -3.50$, $p = 0.01$), but not with other specifications. Other variables, such as total population, unemployment rate, and mean years of schooling (MYS), remain non-stationary at the level.

When the variables are tested at their first differences, stationarity is confirmed for GDP under both constant and constant plus trend specifications at the 5% and 1% significance levels, respectively, demonstrating that GDP is integrated of order one (I) (1). HDI also becomes stationary at first difference with strong significance (1% level) when tested with constant and trend. The total population shows weak evidence of stationarity at first difference with a significance level of 10% under the constant-only model. The unemployment rate and MYS remain mostly non-stationary even at first difference, except for a marginal rejection of the null for unemployment at the 10% level under some specifications.

***Table 2**. ADF Test Result*

Null Hypothesis: the variable has a unit root						
	At Level					
		GDP	HDI	Population	Unemployment	MYS
With Constant	t-Statistic	-1.5386	-3.524	1.2975	2.5901	-0.9675
	Prob.	0.4959	0.0176	0.9974	0.9999	0.7461
		n0	**	n0	n0	n0
With Constant & Trend	t-Statistic	0.0627	1.6069	-2.4925	0.294	-4.3268
	Prob.	0.9945	1	0.3271	0.9972	0.0158
		n0	n0	n0	n0	**
Without Constant & Trend	t-Statistic	0.475	0.5138	1.7641	2.8074	1.7911
	Prob.	0.8093	0.8183	0.9763	0.9977	0.9786
		n0	n0	n0	n0	n0
	At First Difference					
With Constant	t-Statistic	-3.7363	0.4327	-2.7254	-1.3374	-1.7339
	Prob.	0.0112	0.9789	0.0892	0.5922	0.4008
		**	n0	*	n0	n0
With Constant & Trend	t-Statistic	-4.5518	-5.3996	-3.1443	-3.4674	-0.7854
	Prob.	0.0084	0.0015	0.1264	0.0738	0.951
		***	***	n0	*	n0
Without Constant & Trend	t-Statistic	-3.5472	-1.6851	-0.19	-0.8035	-1.5325
	Prob.	0.0012	0.0863	0.603	0.3558	0.115
		***	*	n0	n0	n0

Notes . a: (*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1% and (no) Not Significant

b: Lag Length based on SIC

Source: Authors Calculations.

Cointegration Test

Table 3 presents the results of the ARDL bounds test, which is used to examine the existence of a long-run cointegration relationship among the model's variables. The null hypothesis of the bounds test states that there is no level relationship (no cointegration) among the variables.

The reported F-statistic is (5.60), which is compared against critical values at different significance levels for both I(0) (assuming the variables are stationary at the level) and I(1) (assuming the variables are stationary after first differencing) bounds. At the 5% significance level, the lower bound critical value (I(0)) is (2.26), and the upper bound critical value (I(1)) is (3.48). Since the calculated F-statistic (5.60) exceeds the upper bound critical value, the null hypothesis of no long-run relationship is rejected. This indicates strong evidence of cointegration among the variables, implying a stable long-run equilibrium relationship.

Similarly, the t-statistic for the error correction term is (–4.56), which is also lower than the critical values at the 5% significance level (–1.95) for I(0) and (–3.60) for I(1)), further confirming the existence of cointegration.

***Table 3**: Bound Test*

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0) Asymptotic n=1000	I (1) :
F-statistic	5.604076	10%	1.9	3.01
K	4	5%	2.26	3.48
		2.5%	2.62	3.9
		1%	3.07	4.44
t-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
t-statistic	-4.560449	10%	-1.62	-3.26
		5%	-1.95	-3.6
		2.5%	-2.24	-3.89
		1%	-2.58	-4.23

Source: Authors' Calculations.

ECM (Error Correction Model) Regression

Table 4 reports the estimated coefficients from the error-correction model (ECM) for the level's equation, with GDP as the dependent variable. The results indicate that the logarithm of the Human Development Index (HDI) has a positive and statistically significant effect on GDP, with a coefficient of (4.179) (t = 8.65, p < 0.001). Similarly, the logarithm of mean years of schooling (MYS) positively affects GDP, with a coefficient of 1.565 (t = 4.90, p < 0.01). The population size (LOG(POP)) also shows a substantial positive impact on GDP, with a coefficient of (0.509) (t = 24.07, p < 0.001). Conversely, the unemployment rate (LOG(UNEMP)) has a significant negative relationship with GDP, as indicated by its coefficient of –1.898 (t = –6.99, p < 0.001). All coefficients are statistically significant at the 1% level, suggesting robust relationships between these variables and economic output in the model.

$$EC = Log(GDP) - (4.17 * Log(HDI) + 1.5649 * Log(MYS) + 0.5093 * Log(Total\ population) - 1.8975 * Log(Unemployment\ Rate)$$

Table 4. ECM

Levels Equation				
Case 1: No Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(HDI)	4.179	0.483	8.650	0.000
LOG(MYS)	1.565	0.319	4.899	0.001
LOG(POP)	0.509	0.021	24.069	0.000
LOG(UNEMP)	-1.898	0.272	-6.988	0.000

Source: Authors Calculations.

Conditional Error Correction Regression

The estimated error-correction model (ECM) results presented show both long- and short-run dynamics among the variables. The lagged level of GDP (LOG (GDP_T (-1))) has a significant negative coefficient of (–1.603) (t = – 4.56, p = 0.0018), indicating an adjustment toward the long-run equilibrium. The lagged level of HDI positively and significantly influences GDP with a coefficient of (6.699) (t = 4.57, p = 0.0018). Likewise, the lagged mean years of schooling

(LOG (MYS (-1))) and population (LOG (POP (-1))) exhibit positive and significant long-run effects on GDP with coefficients of 2.508 (p = 0.017) and 0.816 (p = 0.0011), respectively. Conversely, the lagged unemployment rate (LOG (UNEM (-1))) negatively affects GDP, with a coefficient of (–3.042) (p = 0.0042).

In the short run, the first difference of GDP (DLOG (GDP_T (-1))) positively influences current GDP growth, with a coefficient of (0.606) (p = 0.0391). The contemporaneous change in HDI (DLOG(HDI)) shows a strong positive effect on GDP growth (11.838, p = 0.0007), while population changes (DLOG(POPU)) also positively affect GDP growth (4.739, p = 0.0339). The first lag of the change in unemployment (DLOG (UNEMP (-1))) shows a positive, statistically significant coefficient of (1.701) (p = 0.0438). Other short-run coefficients, such as changes in mean years of schooling and unemployment, are not statistically significant at conventional levels.

These findings demonstrate that HDI, mean years of schooling, population, and unemployment have significant long-run impacts on GDP. In contrast, short-run fluctuations in HDI, population, and unemployment also contribute to GDP dynamics.

***Table 5**: CERCR (Conditional Error Correction Regression)*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG (GDP_T (-1)) *	-1.602901	0.351479	-4.560449	0.0018
LOG (HDI (-1))	6.698886	1.466787	4.567048	0.0018
LOG (MYS (-1))	2.508322	0.835822	3.001023	0.0170
LOG (POP (-1))	0.816301	0.165416	4.934834	0.0011
LOG (UNEM (-1))	-3.041574	0.768205	-3.959328	0.0042
DLOG (GDP_T_ (-1))	0.606385	0.246113	2.463844	0.0391
DLOG(HDI)	11.83821	2.209919	5.356854	0.0007
DLOG(MYS)	-0.999319	0.458605	-2.179041	0.0610
DLOG (MYS (-1))	3.218284	1.998431	1.610405	0.1460
DLOG(POPU)	4.738897	1.854527	2.555313	0.0339
DLOG (POPU (-1))	-2.697760	1.590969	-1.695671	0.1284
DLOG(UNEMPT)	-0.469134	0.409238	-1.146362	0.2848
DLOG (UNEMP (-1))	1.700960	0.711535	2.390551	0.0438

Note. * p-value incompatible with t-Bounds distribution.
Source: Authors' Calculations.

Diagnostic Tests for the Regression Model

To evaluate the validity and reliability of the estimated regression model, several diagnostic tests were conducted on the residuals. Firstly, the heteroskedasticity test was applied to determine whether the residuals exhibit constant variance. The results of the Breusch-Pagan-Godfrey test (see Table 6) suggest that the residuals are homoskedastic, as the p-value of the F-statistic (0.5821) is also greater than (0.05), indicating no evidence of heteroskedasticity. Secondly, a serial correlation test was employed to examine the presence of autocorrelation in the time-series data. The Breusch-Godfrey LM test (see Table 7) indicates no serial correlation among the residuals, as the p-value of the F-statistic (0.0596) exceeds the 5% significance level (p > 0.05). Moreover, the Ramsey RESET test (see Table 8) was conducted to assess the model's specification. The findings reveal that the model is free from specification errors, as the p-value of the F-statistic (0.8482) is significantly greater than 0.05.

Additionally, the Jarque-Bera test for normality (see Table 9 and Figure 3) was used to verify whether the residuals follow a normal distribution. The results confirm that the residuals are normally distributed, as indicated by the p-value of 0.356, which is above the 0.05 threshold. Finally, the CUSUM and CUSUM of Squares stability tests (see Figures 1 and 2) were employed to assess the model's stability over time. The plots show that the blue line remains within the red critical bounds, confirming that the estimated model is structurally stable throughout the sample period.

Table 6. *Heteroskedasticity Test: Breusch-Pagan-Godfrey*

Null hypothesis: Homoskedasticity			
F-statistic	0.909563	Prob. F (13,7)	0.5821
Obs*R-squared	13.19095	Prob. Chi-Square (13)	0.4332
Scaled explained SS	1.741072	Prob. Chi-Square (13)	0.9999

Source: Authors Calculations.

Table 7. *Breusch-Godfrey Serial Correlation LM Test*

Null hypothesis: No serial correlation at up to 2 lags			
F-statistic	1.101199	Prob. F (2,6)	0.3914
Obs*R-squared	5.63864	Prob. Chi-Square (2)	0.0596

Source: Authors Calculations.

Table 8. *Ramsey RESET Test*

Omitted Variables: Squares of fitted values			
	Value	Df	Probability
t-statistic	0.198604	7	0.8482
F-statistic	0.039444	(1, 7)	0.8482
Likelihood ratio	0.117998	1	0.7312
F-test summary:			
	Sum of Sq.	Df	Mean Squares
Test SSR	0.00011	1	0.00011
Restricted SSR	0.019562	8	0.002445
Unrestricted SSR	0.019452	7	0.002779

Source: Authors' Calculations.

Table 9. *Jarque-Bera*

Mean	3.36 E* -6	S D	0.0312
Median	-0.0051	Kurtosis	0.7678
Max	0.7247	Skewness	2.8186
Min	-0.0413	Jarque-Bera	2.0923
Prob.	0.3512		

Source: Authors' Calculations.

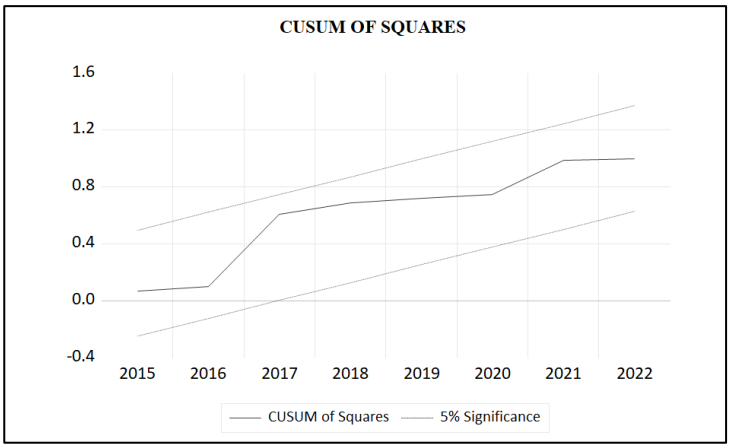

Figure 1. *CUSUM OF SQUARE TEST*

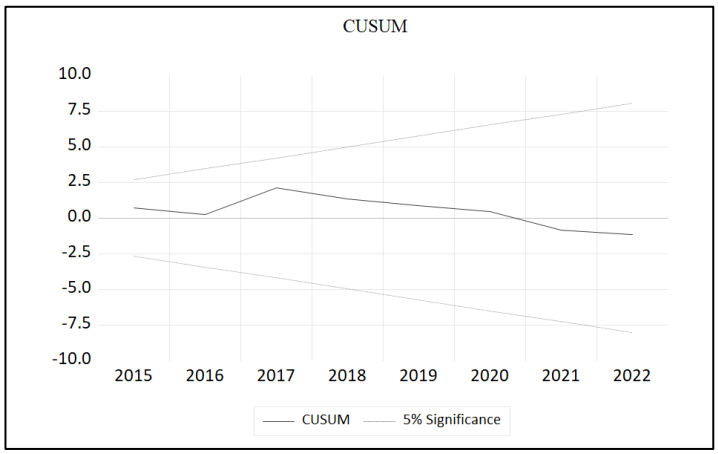

Figure 2. *CUSUM TEST*

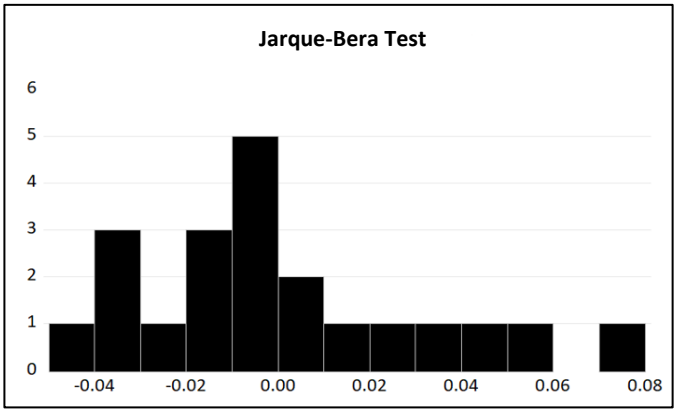

Figure 3. *Jarque-Bera Test*

DISCUSSION

The findings of this study reveal a clear relationship between the Human Development Index (HDI) and Gross Domestic Product (GDP) in Afghanistan, consistent with the research objectives and questions outlined earlier. The results indicate a bidirectional relationship between human development and economic growth, carrying both theoretical and practical implications for policymakers. The study set out to examine the impact of HDI on GDP, while also considering the roles of population size, unemployment, and education. The empirical

results confirm that HDI has a significant and positive effect on GDP, thereby supporting Hypothesis 1 (H1). This finding aligns with human capital theory (Becker, 1964), which emphasizes that investments in health and education enhance labor productivity and, in turn, stimulate economic growth. The positive relationship between population and GDP (H2) suggests that population growth may contribute to higher economic output through labor force expansion. However, this effect must be interpreted cautiously, as it depends on the economy's capacity to provide adequate employment opportunities and resources. In contrast, the negative impact of unemployment on GDP (H3) highlights the economic costs associated with underutilized labor, a result consistent with established macroeconomic theory (Mankiw, 2016). Finally, the positive effect of mean years of schooling (MYS) on GDP (H4) reinforces the critical role of education in promoting long-term economic growth, as emphasized by Sen (1999) and UNDP (2019). More specifically, the strong positive coefficient for HDI (4.179) indicates that improvements in health, education, and income significantly enhance economic output, supporting the multidimensional view of development advanced by the UNDP (2019). The positive coefficient for population (0.509) suggests that Afghanistan's growing population may stimulate economic activity, although future research should assess the sustainability of this trend. The negative coefficient for unemployment (–1.898) reflects its adverse effects on productivity and aggregate demand, consistent with Keynesian economic principles. Meanwhile, the positive coefficient for education (1.565) underscores the importance of schooling in skill formation, innovation, and sustainable growth (World Bank, 2018). These findings are broadly consistent with Deb (2015), who identified minimal differences between HDI and GDP rankings across countries. However, they contrast with Roshaniza and Selvaratnam (2015), who found a negative long-run relationship between HDI and GDP in Malaysia. Such differences may be attributed to contextual factors, particularly Afghanistan's post-conflict and fragile economic environment compared to Malaysia's more industrialized economy. The results also align with Khodabakhshi's (2011) findings in India, supporting the broader relevance of HDI as a driver of economic growth, while the role of unemployment mirrors evidence from both developing and developed economies (Natoli & Zuhair, 2011). Overall, the study highlights the importance of integrated policy approaches in Afghanistan that prioritize education, healthcare, and employment generation to effectively harness human capital for economic growth. In conclusion, this research contributes to the literature by providing empirical evidence from a fragile state, reinforcing the view that human development is not merely an outcome of growth but a key driver of economic progress. Future research could explore nonlinear dynamics or sector-specific effects to further refine policy recommendations.

CONCLUSION

This study examined the impact of the Human Development Index (HDI) on Gross Domestic Product (GDP) in Afghanistan from 2000 to 2022, employing an ARDL model to analyze both short-term and long-term relationships. The findings revealed a significant positive relationship between HDI and GDP, confirming that improvements in health, education, and

living standards contribute to economic growth. Additionally, population size and mean years of schooling were found to positively influence GDP, while unemployment negatively influenced GDP, aligning with theoretical expectations.

The results underscore the importance of prioritizing human development as a driver of sustainable economic growth in Afghanistan. By investing in education, healthcare, and employment opportunities, policymakers can foster long-term productivity and financial stability. These findings align with human capital theory and the broader development economics literature, reinforcing the bidirectional relationship between economic growth and human well-being.

In conclusion, this study provides empirical evidence for integrating human development goals into Afghanistan's economic policies. By addressing structural deficiencies and leveraging human capital, the country can pave the way for inclusive and sustainable development. The findings provide a foundation for further research and policy interventions to balance economic growth with social progress.

AUTHORS CONTRIBUTIONS

Both authors contributed equally to the conception and design of the study.

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CONFLICT OF INTEREST STATEMENT

The authors declare that there are no conflicts of interest regarding the publication of this research.

DATA AVAILABILITY STATEMENT

The data used in this study are publicly available from the World Bank's World Development Indicators (WDI) database and the United Nations Development Programme (UNDP) Human Development Reports. The datasets can be accessed directly from the official websites of these institutions. Any additional data processing or calculations performed during the study are available from the authors upon reasonable request.

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