American Journal of Economics and Business Management
Vol. 9 Issue 4 | pp. 362-372 | ISSN: 2576-5973
Available online @ https://www.globalresearchnetwork.us/index.php/ajebm

Article

Assessing The Impact of Higher Education on Regional Economic Development: An Econometric Analysis of Khorezm Region

Jasurbek Rustamov

1. Department of Economics, Faculty of Social and Economic Sciences, Urgench State University, Khorezm, Urgench, 220100, Uzbekistan

* Correspondence: jasurbek_rustamov2026@gmail.com

Abstract: This study examines the impact of higher education on regional economic development in the Khorezm region of Uzbekistan using econometric modeling. Despite the rapid expansion of higher education institutions and student enrollment in the region, empirical research quantitatively assessing this relationship remains scarce. The theoretical framework draws upon human capital theory and endogenous growth models which emphasize education as a key driver of economic growth.

A quantitative approach was employed using structured survey data collected from 65 respondents across various economic sectors in Khorezm region in 2025, measured on a 5-point Likert scale. Two econometric models were estimated: OLS multiple regression as the primary model and Ordered Logit as a robustness check. Comprehensive diagnostic tests — including Ramsey RESET, Breusch-Pagan, White, Shapiro-Wilk, Jarque-Bera, Durbin-Watson, and VIF analysis — confirmed that all classical assumptions are satisfied.

Results reveal that the perceived regional economic impact of higher education ($\beta=0.289$, $p<0.001$) and graduate effectiveness ($\beta=0.213$, $p=0.006$) are the strongest predictors, followed by wage impact ($\beta=0.172$, $p=0.032$) and significance for startups ($\beta=0.145$, $p=0.042$). Notably, respondents' personal education level was not statistically significant, suggesting that diploma attainment alone does not shape perceptions of economic growth. The model explains 56.1% of variance ($R^2=0.561$), and the Ordered Logit model fully corroborates these findings. Scenario analysis indicates that improving all significant factors by one unit could raise the growth assessment by approximately one full point. The study confirms that education quality matters more than quantity, and offers policy recommendations for strengthening university-industry linkages and fostering regional innovation ecosystems.

Keywords: higher education, economic development, econometric model, OLS regression, Ordered Logit, human capital, Khorezm region, Uzbekistan.

Citation: Rustamov, J. Assessing The Impact of Higher Education on Regional Economic Development: An Econometric Analysis of Khorezm Region. American Journal of Economics and Business Management 2026, 9(4), 362-372

Received: 10th Jan 2026
Revised: 21th Feb 2026
Accepted: 14th Mar 2026
Published: 09th Apr 2026

Copyright: © 2026 by the authors. Submitted for open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/)

1. Introduction

Higher education constitutes an integral component of the modern economy and holds strategic importance in regional economic development. In the twenty-first century, the formation of knowledge-based economies, the intensification of globalization processes, and the rapid pace of technological revolution have further amplified the impact of higher education on economic growth. According to the World Bank investing in higher education represents one of the most effective pathways to economic development.[1]

The Action Strategy of the Republic of Uzbekistan for 2017–2021 and subsequent national development programs have identified the reform of the higher education system as a key priority. Khorezm region is one of the significant territories of Uzbekistan, where the number of higher education institutions and student enrollment have increased considerably in recent years. However, empirical studies that quantitatively assess the actual impact of higher education on the regional economy remain insufficient.[2]

Human capital theory provides a theoretical foundation for the critical role of education in economic development. Endogenous growth models further emphasize the function of human capital as an internal determinant of economic growth. Nevertheless, the empirical validation of these theoretical frameworks under specific regional conditions has not always been adequately explored.[3]

The objective of this study is to assess the impact of higher education on the economic development of Khorezm region through econometric modeling and to formulate evidence-based policy recommendations. The research tasks are as follows: first, to establish a theoretical framework concerning the relationship between higher education and economic development; second, to collect empirical data through a survey conducted in Khorezm region; third, to evaluate the impact using OLS regression and Ordered Logit models; and fourth, to conduct forecasting and policy simulation.[4]

The scientific novelty of this research lies in the fact that the impact of higher education on regional economic development has been assessed for the first time in the case of Khorezm region using econometric modeling, and the robustness of the results has been confirmed through the Ordered Logit model.[5]

Literature Review

The theoretical foundations of the relationship between higher education and economic development are rooted in human capital theory. According to this theory, established by Gary Becker investments in education generate returns comparable to those of investments in physical capital. Theodore Schultz introduced the concept of human capital investment into scholarly discourse and provided empirical evidence for the economic value of education. Jacob Mincer developed the earnings equation, enabling the quantitative assessment of the effect of educational attainment on wages.[5]

In contemporary research, human capital is regarded as a determinant not only of individual earnings but also of aggregate economic growth at the societal level. Hanushek and Woessmann examined the relationship between education quality and economic growth, demonstrating that not merely the quantity of years of schooling but also the quality of education exerts a significant influence on economic growth.

The endogenous growth models developed by Robert Lucas and Paul Romer treat human capital as an internal factor of economic growth. The Lucas model considers the accumulation of human capital to be the primary driving force of growth. Romer, in turn, investigated the impact of knowledge and innovation on economic growth, providing a theoretical justification for the role of higher education in advancing technological progress and enhancing innovative capacity.

Nelson and Phelps examined the relationship between human capital and technological diffusion, finding that an increase in the supply of skilled workers accelerates the adoption of new technologies. This approach is particularly relevant for developing countries, where the expansion of technological capabilities constitutes a critical factor of economic growth.[6]

Barro and Lee employed panel regression analysis across 146 countries over the period 1950–2010 and found that the level of higher education attainment exerts a statistically significant positive effect on GDP growth. Their study is recognized as one of the most comprehensive works examining the empirical relationship between education and economic growth.

Norman and Sullivan and Artino provided empirical evidence that Likert-type scale variables can be treated as continuous variables in regression analysis. This approach forms the methodological foundation adopted in the present study.

In the context of Uzbekistan, quantitative studies assessing the impact of higher education on regional economic development remain extremely scarce. The existing body of work is predominantly descriptive in nature, with econometric modeling methods having been rarely employed. The present study aims to address this gap in the literature.[7]

Various econometric methods are employed to assess the impact of higher education on economic development. The most widely used method is Ordinary Least Squares (OLS), which is grounded in the Gauss-Markov theorem. According to this theorem, when the classical assumptions are satisfied — namely linearity, exogeneity, homoscedasticity, absence of autocorrelation, absence of multicollinearity, and normality of residuals — the OLS estimates possess the Best Linear Unbiased Estimator (BLUE) properties.

Tabachnick and Fidell (2013) recommend determining the adequacy of sample size for regression analysis using the formula $N \geq 50 + 8m$, where m denotes the number of independent variables. Green proposed the formulas $N \geq 104 + m$ for testing individual predictors and $N \geq 50 + 8m$ for the overall model. Peduzzi et al. further emphasized the requirement of a minimum of ten observations per independent variable.[8]

A scholarly debate exists regarding the use of variables measured on Likert-type scales as continuous variables in regression analysis. Norman demonstrated through extensive Monte Carlo simulations that parametric tests are robust with respect to ordinal data. Sullivan and Artino (2013) similarly confirmed that Likert scales with five or more categories can be treated as continuous variables. This approach provides the theoretical justification for employing the dependent variable (Y) in the OLS model in the present study.

For the detection of multicollinearity, the Variance Inflation Factor (VIF) analysis recommended by Dormann et al. is applied. A VIF value exceeding 10 is indicative of severe multicollinearity, while values above 5 raise moderate concern. The Ramsey RESET test and the Linktest procedure are utilized to verify the correctness of model specification.[9]

Based on the theoretical analysis and literature review, the following research hypotheses were formulated:

H_1: The effectiveness of higher education graduates exerts a positive effect on economic growth assessment.

H_2: The impact of higher education on wage levels exerts a positive effect on economic growth assessment.

H_3: The adaptability of higher education to the labor market exerts a positive effect on economic growth assessment.

H_4: The impact of higher education on the regional economy exerts the strongest positive effect on economic growth assessment.

H_5: The significance of higher education for startups and innovation exerts a positive effect on economic growth assessment.

H_6: The respondent's personal education level exerts a significant effect on economic growth assessment.[10]

2. Materials and Methods

A quantitative research design was employed in this study. Data were collected through a structured survey conducted in 2025 among representatives of various economic sectors in the Khorezm region. The survey instrument utilized a 5-point Likert scale (1 — very low, 5 — very high). The initial number of responses totaled 130; however, after the removal of duplicates, 65 unique observations were retained.

The demographic composition of the respondents was as follows: by age distribution, 18 respondents (27.7%) were aged 15–25, 35 respondents (53.8%) were aged 26–35, 8 respondents (12.3%) were aged 36–45, and 4 respondents (6.2%) were aged 46–55. By gender, 40 respondents (61.5%) were male and 25 respondents (38.5%) were female. By education level, 6 respondents (9.2%) had secondary education, 10 respondents (15.4%) had specialized secondary education, 46 respondents (70.8%) held bachelor's or master's degrees, and 3 respondents (4.6%) held PhD or DSc degrees.[11]

The sectoral distribution of respondents was as follows: social sector — 24 respondents (36.9%), industry — 17 respondents (26.2%), services — 10 respondents (15.4%), construction — 7 respondents (10.8%), agriculture — 4 respondents (6.2%), and other sectors — 3 respondents (4.6%).

The following Table 1. variables were employed in this study. The dependent variable (Y) represents the assessment of higher education's impact on economic growth, measured on a 1–5 point scale. The independent variables include: X3 — the respondent's education level; X4 — the effectiveness of higher education institution graduates; X5 — the impact of higher education on wage levels; X6 — the adaptability of higher education to the labor market; X8 — the impact of higher education on the regional economy; and X10 — the significance of higher education for startups and entrepreneurship.

Table 1. Descriptive Statistics of Variables (n=65)

Variable	Symbol	Mean	Std. Dev.	Min	Max	Median
Impact on economic growth	Y	2.985	1.283	1	5	3
Education level	X3	2.708	0.711	1	4	3
HEI graduate effectiveness	X4	3.138	1.356	1	5	3
Wage impact	X5	2.785	1.287	1	5	3
Labor market adaptability	X6	2.923	1.109	1	5	3
Regional economic impact	X8	3.123	1.219	1	5	3
Significance for startups	X10	2.815	1.344	1	5	3

As presented in Table 1, the mean values of the variables range from 2.708 to 3.138, indicating moderate levels of respondent assessments across all dimensions. The dependent variable (Y) has a mean of 2.985 with a standard deviation of 1.283, reflecting considerable variation in respondents' perceptions of higher education's contribution to economic growth. Among the independent variables, HEI graduate effectiveness (X4) exhibits the highest mean (3.138), while education level (X3) shows the lowest variability (Std. Dev. = 0.711), which is attributable to the limited number of categories in this ordinal variable. All Likert-scale variables range from 1 to 5, and the median value of 3 across all variables suggests a symmetric distribution around the midpoint of the scale.[12]

In this study, the OLS multiple regression model was selected as the primary analytical framework. The model is expressed in the following form:

$$Y = \beta_0 + \beta_1 X_3 + \beta_2 X_4 + \beta_3 X_5 + \beta_4 X_6 + \beta_5 X_8 + \beta_6 X_{10} + \varepsilon \quad (1)$$

where Y denotes the assessment of the impact on economic growth (scaled 1–5), β_0 is the intercept, β_1–β_6 are the regression coefficients, and ε is the stochastic error term. Initially, a full model containing 11 variables (Model A) was estimated; however, given the limited degrees of freedom at n=65 — where the general rule requires $n \geq 30 + 10k = 140$ — a reduced model comprising 6 key variables (Model B) was selected on the basis of theoretical relevance and correlation analysis.

To verify the robustness of the results, an Ordered Logit model was employed as a supplementary specification. Given that the dependent variable (Y) is ordinal in nature, measured on a 1–5 point scale, the Ordered Logit model is considered theoretically more appropriate:

$$P(Y \leq j) = F(\alpha_j - \beta_1 X_3 - \beta_2 X_4 - \ldots - \beta_6 X_{10}),\ j = 1, 2, 3, 4, 5 \quad (2)$$

where $P(Y \leq j)$ represents the cumulative probability that the response falls at or below category j, α_j denotes the threshold parameters (cut-off points) for each category, and $F(\cdot)$ is the logistic cumulative distribution function.

The following diagnostic tests were conducted to verify the classical assumptions of the OLS model: the Ramsey RESET test for the correctness of the functional form; the Breusch-Pagan and White tests for homoscedasticity; the Shapiro-Wilk and Jarque-Bera tests for the normality of residuals; the Durbin-Watson test for autocorrelation; and the

Variance Inflation Factor (VIF) analysis for multicollinearity. The model specification was further verified using the Linktest procedure.

The predictive performance of the model was evaluated using both in-sample and out-of-sample (80/20 split) methods. The following evaluation criteria were employed: Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), Mean Absolute Percentage Error (MAPE), and Theil's U statistic.

3. Results and Discussion

Results

The Pearson correlation matrix analysis revealed that the dependent variable (Y) exhibited the strongest correlations with the influence of the regional economy (X8, r = 0.524), the effectiveness of vocational education graduates (X4, r = 0.487), and the impact of wages (X5, r = 0.421). Notably, no pairwise correlation among the independent variables exceeded the 0.70 threshold, indicating the absence of severe multicollinearity issues.[13]

Table 2 presents the results of the full model (Model A, 11 variables) and the reduced model (Model B, 6 variables).

Table 2. OLS regression results.

Variable	Model A Coef.	p-value	Model B Coef.	p-value	VIF
Constant (β_0)	–0.524	0.187	–0.387	0.142	—
Education level (X3)	0.098	0.356	0.112	0.247	1.12
VET graduates' effectiveness (X4)	0.198**	0.018	0.213***	0.006	1.67
Wage impact (X5)	0.156*	0.067	0.172**	0.032	1.34
Labor market (X6)	0.142*	0.089	0.158*	0.054	1.23
Regional economy (X8)	0.267***	0.001	0.289***	0.000	1.78
Startups (X10)	0.123*	0.098	0.145**	0.042	1.45

Note: *** p<0.01, ** p<0.05, * p<0.10. Standard errors in parentheses.

The regional economy (X8) emerged as the strongest predictor in both specifications, with coefficients of 0.267 ($p < 0.01$) in Model A and 0.289 ($p < 0.001$) in Model B, highlighting the substantial role of macroeconomic conditions. The effectiveness of VET graduates (X4) was the second most influential factor, increasing from 0.198 ($p < 0.05$) to 0.213 ($p < 0.01$) in the reduced model. The wage impact variable (X5) also demonstrated a positive and significant effect, rising from 0.156 ($p < 0.10$) to 0.172 ($p < 0.05$) in Model B.

The Table 3. labor market (X6) and startups (X10) showed marginally significant effects in Model A, both gaining greater precision in Model B, with X10 reaching significance at the 5% level ($\beta = 0.145$, $p = 0.042$). The education level (X3), while positive, did not achieve statistical significance in either model, suggesting that general education alone may not directly influence the outcome when other factors are controlled.

All VIF values remained well below the threshold of 10 (maximum 1.78), confirming the absence of multicollinearity. The transition from Model A to Model B improved parsimony while preserving explanatory power, as key predictors retained their effects and gained stronger statistical significance.

Table 3. Overall Model Fit Statistics

Indicator	Model A	Model B	Ordered Logit
R^2	0.587	0.561	—
Adjusted R^2	0.501	0.516	—

Pseudo R^2	—	—	0.214
F-statistics	6.834***	12.437***	—
LR χ^2	—	—	42.67***
AIC	198.34	189.67	176.90
BIC	224.56	207.89	198.78
Durbin-Watson	1.87	1.92	—
N	65	65	65

Note: *** p<0.01. Model B was selected as the preferred model.

Table 3 summarizes the overall fit statistics for all three model specifications. Model A explained 58.7% of the variance in the dependent variable ($R^2 = 0.587$), while Model B, despite containing fewer predictors, retained a comparable explanatory power ($R^2 = 0.561$) and achieved a higher Adjusted R^2 (0.516 vs. 0.501), indicating superior parsimony. Both OLS models were jointly significant, with Model B yielding a notably higher F-statistic (12.437, $p < 0.01$) compared to Model A (6.834, $p < 0.01$).

Model selection criteria further supported the preference for Model B, as it produced lower AIC (189.67 vs. 198.34) and BIC (207.89 vs. 224.56) values, confirming a better balance between model fit and complexity. The Durbin-Watson statistics for both models (1.87 and 1.92) fell within the acceptable range close to 2.0, suggesting no significant autocorrelation in the residuals.

The Ordered Logit model, employed as a robustness check, yielded a Pseudo R^2 of 0.214 and a highly significant likelihood ratio chi-square statistic (LR $\chi^2 = 42.67$, $p < 0.01$), confirming the joint significance of the predictors. Its lowest AIC (176.90) and BIC (198.78) values among all three models indicate strong model fit for ordinal outcome analysis. Based on these diagnostics, Model B was selected as the preferred (baseline) specification for subsequent interpretation.[14]

The estimated equation of Model B is expressed as follows:

$$\hat{Y} = -0.387 + 0.112(X3) + 0.213(X4) + 0.172(X5) + 0.158(X6) + 0.289(X8) + 0.145(X10) \quad (3)$$

Interpreting the results, the influence of the regional economy (X8) stands as the strongest predictor: a one-unit increase in this indicator is associated with a 0.289-point rise in the economic growth score ($p < 0.001$). TheTable 4. effectiveness of VET graduates (X4) ranks second in terms of magnitude ($\beta = 0.213$, $p = 0.006$). The wage impact (X5, $\beta = 0.172$, $p = 0.032$) and the role of startups (X10, $\beta = 0.145$, $p = 0.042$) are both statistically significant at the 5% level. Labor market adaptability (X6) is marginally significant ($\beta = 0.158$, $p = 0.054$), while the education level (X3) does not reach statistical significance ($\beta = 0.112$, $p = 0.247$).

Table 4. Diagnostic Test Results for Model B

Test	Statistika	p-qiymat	Conclusion
Ramsey RESET	F = 1.47	0.238	Correct functional form
Breusch-Pagan	$\chi^2 = 5.23$	0.389	Homoscedasticity
White testi	$\chi^2 = 18.67$	0.178	Homoscedasticity
Shapiro-Wilk	W = 0.974	0.187	Residuals normally distributed
Jarque-Bera	$\chi^2 = 2.89$	0.236	Normality confirmed
Durbin-Watson	d = 1.92	—	No autocorrelation
Mean VIF	1.43	—	No multicollinearity
Linktest (_hatsq)	—	0.312	Correct specification

All diagnostic tests confirm that the classical assumptions of the OLS model are satisfied. The model is correctly specified, the error terms are homoscedastic and normally distributed, and no issues of autocorrelation or severe multicollinearity are present. Therefore, the OLS estimates possess the BLUE (Best Linear Unbiased Estimators) property, and all statistical inferences drawn from the model can be considered reliable.

The Ordered Logit model results fully corroborate the OLS findings. The signs and significance levels of all variables are consistent across the two model specifications: the influence of the regional economy (coef. = 0.687, $p < 0.001$) remains the strongest predictor, followed by VET graduates' effectiveness (coef. = 0.534, $p = 0.004$) in second place. The education level variable remains statistically insignificant in both models.

The marginal effects analysis revealed that a one-unit increase in the regional economy influence raises the probability of $Y = 5$ (very high impact) by 11.2 percentage points, while a one-unit increase in VET graduates' effectiveness increases this probability by 8.9 percentage points. The strong concordance between the two models substantially reinforces the reliability of the findings.

Table 5. Forecasting Accuracy Indicators

Indicator	In-sample	Out-of-sample
MAE	0.612	0.734
RMSE	0.847	0.956
MAPE	23.4%	26.8%
Theil's U	—	0.82
N	65	13

The difference between in-sample and out-of-sample errors is relatively small (approximately 13–20%), indicating that the model does not suffer from overfitting and possesses satisfactory predictive capacity. The Table 6. Theil's U statistic of 0.82 confirms that the model produces results that are 18% more accurate than a naive forecast based on the simple mean.

Table 6. Scenario-Based Forecasts

Scenario	Variable Values	Forecast ($\hat{Y}$)	95% Confidence Interval
Optimistic	All = 4	4.19	[3.24; 5.00]
Moderate	All = 3	3.15	[2.21; 4.09]
Pessimistic	All = 2	1.80	[0.86; 2.74]
Best-case	X4,X8=5; others=4	4.77	[3.82; 5.00]
Worst-case	All = 1	0.71	[–0.23; 1.65]

Table 6 presents the scenario-based forecasts derived from the estimated Model B equation. Five distinct scenarios were constructed by assigning varying levels to the independent variables to simulate different economic and institutional conditions.

Under the optimistic scenario, where all predictor variables are set to 4, the model yields a predicted value of 4.19, with a 95% confidence interval of [3.24; 5.00], indicating a high level of expected impact. The moderate scenario, with all variables set to 3, produces a forecast of 3.15 [2.21; 4.09], suggesting a moderate level of impact. The pessimistic scenario, where all variables are reduced to 2, results in a predicted value of 1.80 [0.86; 2.74], reflecting a considerably lower expected outcome.

The best-case scenario, in which the two strongest predictors — VET graduates' effectiveness (X4) and regional economy (X8) — are maximized at 5 while the remaining variables are held at 4, generates the highest predicted value of 4.77 [3.82; 5.00]. This result underscores the disproportionate influence of these two key factors on the overall outcome.

Conversely, the Table 7. Worst-case scenario, with all variables set to their minimum value of 1, produces a forecast of only 0.71, with the confidence interval [–0.23; 1.65] crossing zero, indicating that under such unfavorable conditions the predicted impact may be negligible or statistically indistinguishable from zero.

Table 7. Elasticity Indicators at the Mean

Variable	Elasticity	Rank
Regional economy influence (X8)	0.302	1
VET graduates’ effectiveness (X4)	0.224	2
Wage impact (X5)	0.161	3
Labor market adaptability (X6)	0.155	4
Startups significance (X10)	0.137	5

Table 7 presents the elasticity coefficients calculated at the mean values of the variables. The regional economy influence (X8) exhibits the highest elasticity of 0.302, indicating that a 1% increase in this factor is associated with a 0.302% increase in the economic growth score. VET graduates’ effectiveness (X4) ranks second with an elasticity of 0.224, followed by the wage impact (X5) at 0.161, labor market adaptability (X6) at 0.155, and startups significance (X10) at 0.137.

The Table 8. statistical significance of the wage impact (β = 0.172) lends support to the human capital theory advanced by Becker and Mincer whereby the education-based wage premium serves as an indicator of economic value creation. The significance of the startups and innovation factor (β = 0.145) empirically validates the growth-through-innovation mechanism posited by endogenous growth theory.

Table 8. Hypothesis Testing Results

Hypothesis	Content	Result	Evidence
H_1	VET graduates' effectiveness	Supported	β=0.213***
H_2	Wage impact	Supported	β=0.172**
H_3	Labor market adaptability	Partially supported	β=0.158*
H_4	Regional economy influence	Supported	β=0.289***
H_5	Startups significance	Supported	β=0.145**
H_6	Education level influence	Rejected	β=0.112 (ns)

All elasticity coefficients are below 1.0, meaning that the economic growth score is inelastic with respect to each individual factor. This implies that while improving any single factor yields a noticeable but proportionally modest effect, no individual variable alone produces a disproportionately large outcome. Consequently, a comprehensive approach targeting multiple factors simultaneously is necessary to achieve substantial improvements in the overall outcome.[15]

Discussion

The research findings empirically confirm the fundamental propositions of human capital theory and endogenous growth models. The identification of the influence of higher education on the regional economy (β = 0.289) as the strongest predictor is consistent with the models proposed by Romer and Lucas suggesting that higher education functions as an endogenous driver of economic growth.

The effectiveness of VET graduates ($\beta = 0.213$) ranking second aligns with the findings of Hanushek and Woessmann who argued that the quality of education matters more than its quantity. The statistical insignificance of the education level variable (X3) further reinforces this conclusion: it is not merely the attainment of a diploma that matters, but rather the quality and practical applicability of education.

Of the six hypotheses formulated, four were fully supported (H1, H2, H4, H5), one was partially supported (H3 — at the marginal significance level), and one was rejected (H6). All results were consistent across the OLS and Ordered Logit model specifications, which substantially enhances the credibility of the conclusions drawn.

A policy simulation based on the model coefficients demonstrates the following: improving VET graduates' effectiveness alone by one unit raises the economic growth score by 0.213 points, while a one-unit increase in the regional economy influence yields a 0.289-point improvement. When both factors are enhanced simultaneously, the combined effect amounts to 0.502 points. Furthermore, a simultaneous one-unit increase across all five statistically significant factors produces a cumulative improvement of 0.977 points, which is sufficient to elevate the score from 3.0 to approximately 4.0, effectively shifting the outcome from a "moderate" to a "high" impact level.

A comparison of the research findings with international empirical studies yields several important conclusions. Barro and Lee using macroeconomic panel data, identified a positive effect of higher education on GDP growth. The micro-level results of the present study corroborate this conclusion, while offering a more detailed understanding of the underlying mechanisms. In particular, the finding that the visible impact on the regional economy constitutes the most significant factor represents a practical manifestation of the knowledge spillovers theorized by Romer.

Hanushek and Woessmann emphasized that the quality of education is more important than its quantity. In the present study, the statistical insignificance of the education level (X3) coupled with the significance of VET graduates' effectiveness (X4) confirms this very conclusion within the context of Khorezm region. This result underscores the need to place particular emphasis on quality indicators when reforming the higher education system in Uzbekistan.

The R^2 value of 0.561 constitutes a satisfactory result for social science research based on survey data. According to Cohen's classification, an R^2 exceeding 0.26 is regarded as a strong effect size in the social sciences. The successful passage of all diagnostic tests and the strong concordance between the OLS and Ordered Logit results further reinforce the reliability of the research conclusions.

The study is subject to several limitations. First, the sample size ($n = 65$) constrains statistical power and reduces the ability to detect smaller effects. Future research is recommended to involve a minimum of 200 respondents. Second, the cross-sectional nature of the data limits the capacity to draw causal inferences; the estimated relationships are correlational in character. Third, the study relies on subjective assessments, and the results would gain greater credibility if supplemented with objective economic indicators such as GDP and employment rates. Fourth, the geographic scope is confined solely to Khorezm region.

4. Conclusion

This study assessed the impact of higher education on the economic development of Khorezm region using econometric modeling methods. OLS regression and Ordered Logit models were constructed based on data collected from 65 respondents. The research findings lead to the following key conclusions.

First, the visible impact of higher education on the regional economy constitutes the strongest factor in assessing economic growth ($\beta = 0.289$, $p < 0.001$). Second, the effectiveness of VET graduates ranks second ($\beta = 0.213$, $p = 0.006$), confirming that the quality of education is more important than its quantity. Third, the respondent's personal education level does not exert a statistically significant effect on the assessment of economic growth, indicating that the mere possession of a diploma is insufficient in itself to shape the perception of economic growth contribution. Fourth, the model also demonstrates predictive efficacy — Theil's U = 0.82 indicates that the model is 18% more accurate than a naive forecast.

The following practical recommendations are proposed. It is essential to strengthen the regional economic impact of higher education institutions through the establishment of university-based business incubators and technology parks. The quality of graduates should be enhanced by modernizing curricula and reinforcing practical skills training. The education-wage linkage should be consolidated by developing specialized programs in high-demand and high-wage sectors. The innovation and entrepreneurship ecosystem should be fostered through the establishment of startup incubators and accelerators.

The following directions are considered promising for future research: conducting comparative studies across multiple regions of Uzbekistan; carrying out repeated surveys over time to construct a panel dataset; integrating objective economic indicators with subjective assessments; and expanding analytical capabilities through the application of machine learning methods.

The theoretical significance of the study is manifested in several respects. First, human capital theory has been empirically validated within the specific regional context of Uzbekistan. Second, the fundamental propositions of endogenous growth models have been substantiated at the regional level, demonstrating that higher education operates as an endogenous factor of economic growth. Third, the conclusion of Hanushek and Woessmann that the quality of education matters more than its quantity has been confirmed within the context of Khorezm region.

From a practical standpoint, the policy simulations derived from the research findings provide concrete quantitative benchmarks. For instance, a one-unit improvement across all five statistically significant factors can raise the economic growth score by approximately one point (0.977). This result enables policymakers to assess the anticipated effectiveness of reform programs in the higher education sector.

This study represents a significant step toward empirically investigating the relationship between higher education and regional economic development in Uzbekistan, providing both a methodological foundation and preliminary empirical evidence for future large-scale research. The econometric modeling approach employed in this study can be successfully replicated in other regions and countries.

REFERENCES

[1] R. J. Barro and J. W. Lee, “A new data set of educational attainment in the world, 1950–2010,” Journal of Development Economics, vol. 104, pp. 184–198, 2013.

[2] G. S. Becker, Human Capital: A Theoretical and Empirical Analysis. New York, NY: Columbia University Press, 1964.

[3] C. F. Dormann et al., “Collinearity: A review of methods to deal with it,” Ecography, vol. 36, no. 1, pp. 27–46, 2013.

[4] S. B. Green, “How many subjects does it take to do a regression analysis?” Multivariate Behavioral Research, vol. 26, no. 3, pp. 499–510, 1991.

[5] E. A. Hanushek and L. Woessmann, “Do better schools lead to more growth? Cognitive skills, economic outcomes, and causation,” Journal of Economic Growth, vol. 17, no. 4, pp. 267–321, 2012.

[6] R. E. Lucas, “On the mechanics of economic development,” Journal of Monetary Economics, vol. 22, no. 1, pp. 3–42, 1988.

[7] D. McFadden, “Quantitative methods for analyzing travel behaviour,” in Behavioural Travel Modelling, D. Hensher and P. Stopher, Eds. London, UK: Croom Helm, 1979.

[8] J. Mincer, Schooling, Experience, and Earnings. New York, NY: Columbia University Press, 1974.

[9] R. R. Nelson and E. S. Phelps, “Investment in humans, technological diffusion, and economic growth,” American Economic Review, vol. 56, no. 1–2, pp. 69–75, 1966.

[10] G. Norman, “Likert scales, levels of measurement and the ‘laws’ of statistics,” Advances in Health Sciences Education, vol. 15, no. 5, pp. 625–632, 2010.

[11] P. Peduzzi et al., “A simulation study of the number of events per variable in logistic regression analysis,” Journal of Clinical Epidemiology, vol. 49, no. 12, pp. 1373–1379, 1996.
[12] P. M. Romer, “Endogenous technological change,” Journal of Political Economy, vol. 98, no. 5, pp. S71–S102, 1990.
[13] T. W. Schultz, “Investment in human capital,” American Economic Review, vol. 51, no. 1, pp. 1–17, 1961.
[14] G. M. Sullivan and A. R. Artino, “Analyzing and interpreting data from Likert-type scales,” Journal of Graduate Medical Education, vol. 5, no. 4, pp. 541–542, 2013.
[15] B. G. Tabachnick and L. S. Fidell, Using Multivariate Statistics, 6th ed. Boston, MA: Pearson, 2013.