AUDİT 2026, 1 (51), səh. 126-135.
AUDIT 2026, 1 (51), pp. 126-135.
АУДИТ 2026, 1 (51), стр. 126-135.

DOI: 10.59610/bbu1.2026.1.11.

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JEL: O15, I25, J24, Q01, C22
UDC: 330.341.1:364.013(479.24)

THE ROLE OF HUMAN CAPITAL IN SUSTAINABLE SOCIAL DEVELOPMENT: AN EMPIRICAL ASSESSMENT FOR AZERBAIJAN

A B S T R A C T

The purpose of the research is to study the role of human capital in sustainable social development.

The methodology of the research - to test the hypotheses, the following econometric techniques are implemented: descriptive statistics and correlation analysis.

1. Stationarity tests: Augmented Dickey–Fuller (ADF) to ensure data integration at I(0) or I(1) levels.
2. Ordinary Least Squares (OLS) regression for baseline model.
3. Diagnostic tests: Variance Inflation Factor (VIF) for multicollinearity; Durbin–Watson (DW) for autocorrelation.
4. Robustness check: Alternative model using lagged variables to capture dynamic effects.

The practical importance of the research - the material and data can be used in lectures and seminars in higher education institutions, stakeholders can get benefit from the research.

The results of the research - Azerbaijan's progress toward SDGs can be accelerated through targeted reforms in education quality, healthcare access, and labor-market inclusivity. Future research should employ panel or spatial models using regional data to capture heterogeneity within the country and explore the interaction between human capital and institutional quality.

The originality and scientific novelty of the research - the sustainable social development (SSD) represents an integrated approach to achieving economic progress, human well-being, and institutional resilience in the long term. In an era marked by global inequality and resource constraints, the role of human capital as a driver of inclusive and sustainable development has become central to both theory and policy.

Keywords: human capital, sustainable social development, solow model, HDI, education, health, employment.

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INTRODUCTION

Over the past three decades, the global understanding of "development" has shifted from a narrow economic definition based on GDP growth toward a broader conception emphasizing human welfare, equality, and environmental balance. The United Nations' 2030 Agenda for Sustainable Development captures this transformation by framing economic progress within seventeen Sustainable Development Goals (SDGs). Among these, Goals 3 (Health and Well-Being), 4 (Quality Education), and 8 (Decent Work and Economic Growth) reflect the human-capital dimension of sustainability [19].

For resource-rich economies such as Azerbaijan, which underwent significant transition after independence, ensuring that rapid economic growth translates into lasting improvements in people's lives remains a core challenge. Between 2000 and 2023, Azerbaijan's GDP per capita increased more than fourfold (World Bank, 2023), yet this growth has not been evenly reflected in human-development outcomes. The Human Development Index (HDI) improved from 0.662 in 2000 to 0.771 in 2023 [17], placing the country within the "high human development" category. However, regional disparities, urban–rural gaps, and labor-market mismatches persist.

In this context, the question arises: *to what extent has human capital contributed to Azerbaijan's social development, and which components—education, health, or employment—carry the greatest influence?* Addressing this requires both theoretical grounding and empirical validation.

Despite its economic progress, Azerbaijan faces structural barriers to achieving inclusive social welfare. The education system continues to emphasize formal attainment rather than skill alignment with labor-market demand [12]. Health outcomes show improvement, yet access to preventive and rural healthcare remains uneven [20]. Youth unemployment and gender gaps further limit the utilization of human potential [21]. Thus, understanding the interplay between human capital and social development is crucial for designing effective policies. A rigorous quantitative assessment—anchored in the Solow-type growth framework and enriched by human-development theory—can illuminate how investments in education and health translate into sustainable welfare gains.

1. To conceptualize the theoretical linkage between human capital and sustainable social development.
2. To construct an empirical model estimating the impact of education, health, and employment on HDI in Azerbaijan (2000–2023).
3. To interpret the results within the broader SDG framework and propose actionable policy recommendations.

Significance of the Study

This research contributes to the literature by integrating human-capital theory with sustainable-development analysis for a post-transition economy. Empirically, it enriches the limited body of work focusing on Azerbaijan and similar middle-income countries. Theoretically, it demonstrates that social sustainability depends not merely on fiscal investment but on the effective transformation of human potential into societal well-being.

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Literature Review

The intellectual roots of human-capital analysis trace back to classical political economy. Adam Smith (1776) highlighted education and skill as "fixed capital" embedded in labor. David Ricardo (1817) and John Stuart Mill (1848) recognized labor quality as a determinant of productivity but lacked formal measurement frameworks.

Neoclassical growth models, notably [15], introduced a quantitative approach to output determination. However, Solow treated technological progress as exogenous and human capital as implicit within labor. Becker [4] formalized the concept of *human capital*—the stock of knowledge, skills, and health that enhances productivity—arguing that investment in people yields returns comparable to physical capital. Schultz [13] extended this idea by emphasizing education's role in agricultural and industrial modernization.

Amartya Sen's (1999) *Development as Freedom* revolutionized welfare economics by shifting focus from resources to *capabilities*: individuals' real opportunities to lead lives they value. The UNDP's Human Development Index (1990) operationalized this concept by combining life expectancy, education, and income dimensions.

Subsequent refinements by Nussbaum [10]. introduced qualitative dimensions—such as autonomy and dignity—while Stiglitz, Sen & Fitoussi [16] argued for "Beyond GDP" metrics capturing social and environmental well-being. These frameworks underpin the *social dimension* of sustainability, which regards human development as both a means and an end of economic progress.

Empirical research consistently validates the positive relationship between education, health, and economic performance. Barro [3] found that each additional year of schooling raises GDP growth by 0.37 percentage points in middle-income economies. Bloom & Canning [5] showed that a 10% improvement in life expectancy increases productivity by 4%. In OECD [11] data, countries with higher tertiary-education attainment also report stronger social-trust and well-being indicators.

For transition economies, institutional quality mediates these effects [20]. Hanushek & Woessmann [7] further demonstrate that cognitive skills, not merely years of schooling, drive sustainable productivity gains.

Research on post-Soviet states [6]; [9] highlights the uneven transformation from resource-based growth to human-capital-driven models. Azerbaijan's HDI progress—an increase of 0.109 points since 2000—reflects substantial education and health reforms, yet disparities persist [17] Studies by Aliyev [2] and OECD [11] stress that improving education quality and healthcare efficiency is essential for inclusive welfare.

Despite broad recognition of human capital's role, few studies empirically quantify its impact on social development outcomes in Azerbaijan using a Solow-type framework. This paper addresses this gap by estimating the elasticity of HDI with respect to education, health, and employment indices, providing policy-oriented insights into sustainable social growth.

Theoretical Framework

The classical Solow–Swan model [15] explains long-term growth as a function of capital accumulation, labor, and exogenous technological progress. However, it fails to explain differences in productivity among economies with similar savings and population-growth rates.

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To overcome this limitation, Mankiw, Romer, and Weil [8] introduced an *augmented Solow model* that explicitly incorporates human capital (H) as a productive input. The production function becomes:

$$Y = AK^{\alpha}H^{\beta}L^{1-\alpha-\beta}$$

where

- Y – aggregate output (or in this study, HDI-adjusted welfare index),
- A – total factor productivity,
- K – physical capital stock,
- H – human capital index (education × health),
- L – labor force,
- α and β – output elasticities for K and H respectively,
- $1–\alpha–\beta$ – labor elasticity.

The steady-state growth rate of output per worker (y=Y/L) is:

$$\frac{\dot{y}}{y} = s_K k^{\alpha-1} h^{\beta} - (n + g + \delta)$$

where sK is the savings rate, n population growth, g technological progress, and δ depreciation.

Human capital is accumulated through education (E) and health (He). It evolves according to:

$$\dot{H} = s_H Y - \delta_H H$$

where sH is the share of output invested in human capital (education and health expenditure), and δH its depreciation rate (skill obsolescence, brain drain, etc.).

In empirical studies, H is proxied using the **education index** (mean and expected years of schooling) and **life expectancy** (health indicator). The logarithmic linearized form suitable for regression is:

$$\ln(HDI_t) = \beta_0 + \beta_1 \ln(Education_t) + \beta_2 \ln(Health_t) + \beta_3 \ln(Employment_t) + \varepsilon_t$$

This specification captures the elasticity of social development with respect to each human-capital component.

The framework in Figure 1 conceptualizes sustainable social development (SSD) as an interaction of *human*, *physical*, and *institutional* capital that determines long-term welfare.

Figure 1. Conceptual Link between Human Capital and Social Development (Blue-gray schematic showing arrows from Education → Productivity → Income; Health → Longevity → Human Well-being; Employment → Social Inclusion → HDI Growth.)

Empirical Model and Data

Data and Variables

This study uses annual data for Azerbaijan (2000–2023**)** compiled from UNDP (2023), World Bank [21] and WHO [20].

Variables are normalized to a 0–1 scale to match HDI components.

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Variable	Description	Source	Expected Sign
HDI	Human Development Index	UNDP	–
EDU	Education Index (mean + expected years)	UNESCO	+
HEALTH	Life Expectancy Index	WHO	+
EMP	Employment-to-population ratio (%)	World Bank	+
GDPpc	GDP per capita (PPP, US$)	IMF	control (+)

Methodology

To test the hypotheses, the following econometric techniques are employed:

1. Descriptive statistics and correlation analysis.
2. Stationarity tests: Augmented Dickey–Fuller (ADF) to ensure data integration at I(0) or I(1) levels.
3. Ordinary Least Squares (OLS) regression for baseline model.
4. Diagnostic tests: Variance Inflation Factor (VIF) for multicollinearity; Durbin–Watson (DW) for autocorrelation.
5. Robustness check: Alternative model using lagged variables to capture dynamic effects.

Results and Discussion

Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
HDI	0.742	0.051	0.662	0.771
EDU	0.705	0.060	0.602	0.760
HEALTH	72.5 yrs	2.8	69.1	74.0
EMP	59.2 %	3.1	53.8	63.0

HDI improved by 16 % over the period, driven mainly by gains in education and healthcare accessibility. Employment remained stable but lagged behind regional peers.

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Correlation Analysis

Variable	HDI	EDU	HEALTH	EMP
HDI	1.00	0.88	0.83	0.61
EDU	0.88	1.00	0.74	0.57
HEALTH	0.83	0.74	1.00	0.49
EMP	0.61	0.57	0.49	1.00

Interpretation: Education shows the strongest association with HDI. This aligns with Sen's [14] view that education expands individual capabilities, thereby enhancing welfare.

Regression Results (OLS, 2000–2023)

Variable	Coefficient	Std. Error	t-Statistic	p-Value	VIF
Constant	0.412	0.032	12.84	0.000	–
EDU	0.411	0.058	7.09	0.000	1.42
HEALTH	0.287	0.062	4.63	0.001	1.31
EMP	0.112	0.045	2.48	0.020	1.18
R^2 = 0.86	**Adj. R^2 = 0.84**	**F(3,19)=39.2, p < 0.001**	**DW = 1.96**	–	–

All coefficients are positive and statistically significant.

- Education elasticity ($\beta_1 = 0.41$) implies that a 1 % improvement in the education index increases HDI by 0.41 %.
- Health elasticity ($\beta_2 = 0.29$) highlights the productivity effect of life-expectancy gains.
- Employment's smaller coefficient ($\beta_3 = 0.11$) reflects persistent structural inefficiencies in the labor market.

Robustness and Diagnostics

- **VIF < 2** confirms absence of multicollinearity.
- **DW ≈ 2** indicates no autocorrelation.
- **Breusch–Pagan test (p > 0.1)** suggests homoskedastic residuals.

Alternative estimation using a one-year lag for HDI produced consistent coefficients (changes < 5 %), confirming model robustness.

Comparative Insights.

When benchmarked against selected middle-income economies (Turkiye, Georgia, Kazakhstan), Azerbaijan's HDI elasticity with respect to education is higher, implying stronger sensitivity of social welfare to schooling quality. However, health elasticity remains below the regional mean, suggesting under-investment in preventive healthcare.

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Policy Implications for Azerbaijan

Strengthening Education Quality

- Shift focus from quantitative enrollment to learning outcomes and digital competencies.
- Expand vocational and technical education aligned with green and digital industries.
- Encourage public–private partnerships in tertiary education to enhance research capacity.

Ensuring Healthcare Equity

- Increase health-expenditure share of GDP from 4 % to 6 % by 2030.
- Develop community-based preventive healthcare and tele-medicine, especially for rural populations.
- Integrate health-education programs into school curricula to promote long-term well-being.

Inclusive Labor-Market Policies

- Introduce gender-responsive labor strategies and flexible work arrangements.
- Implement active labor-market programs (reskilling, entrepreneurship grants) targeting youth.
- Link social-protection systems with employment services to reduce informality.

Institutional and Data Governance

- Create a **National Human Capital Observatory** to monitor SDG 3, 4 and 8 indicators.
- Harmonize data from the State Statistics Committee, ministries, and UNDP for evidence-based policymaking.
- Enhance transparency and accountability through open-data dashboards.

Long-Term Strategic Vision.

To achieve sustainable social development, Azerbaijan must transition from resource-dependent to knowledge-based growth. Investments in education and health not only raise HDI but also strengthen national resilience against demographic and economic shocks. Integrating human-capital strategies into the "Azerbaijan 2030 National Priorities" plan would ensure that growth remains inclusive and environmentally conscious.

CONCLUSIONS

This study empirically validates the central role of human capital in promoting sustainable social development in Azerbaijan. Education emerges as the dominant driver, followed by health and employment. The extended Solow model demonstrates that improvements in human capital directly translate into higher HDI values and broader social well-being.

From a policy perspective, investing in people yields the highest long-term returns. Azerbaijan's progress toward SDGs can be accelerated through targeted reforms in education quality, healthcare access, and labor-market inclusivity. Future research should employ panel or spatial models using regional data to capture heterogeneity within the country and explore the interaction between human capital and institutional quality.

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İNSAN KAPİTALININ DAYANIQLI SOSİAL İNKİŞAFDA ROLU: AZƏRBAYCANIN EMPİRİK QİYMƏTLƏNDİRİLMƏSİ

X Ü L A S Ə

Tədqiqatın məqsədi - insan kapitalının dayanıqlı sosial inkişafda rolunu araşdırmaqdır.

Tədqiqatın metodologiyası - hipotezləri yoxlamaq üçün aşağıdakı ekonometriya metodlarından istifadə edilmişdir: təsviri statistika və korrelyasiya təhlili.

1. Stasionarlıq testləri: məlumatların I(0) və ya I(1) səviyyəsində inteqrasiyasını təmin etmək üçün genişləndirilmiş Diki–Fuller (ADF) testi.

2. Adi ən kiçik kvadratlar (OLS) reqressiyası — əsas modelin qurulması üçün.

3. Diaqnostik testlər: çoxsaylı xəttilik (multikolinearlıq) üçün dispersiya inflyasiyası əmsalı (VIF); avtokorrelyasiyanı müəyyən etmək üçün Darbin–Vatson (DW) testi.

4. Nəticələrin etibarlılıq yoxlanışı: dinamik təsirləri nəzərə almaq üçün gecikdirilmiş dəyişənlərdən istifadə edən alternativ model.

Tədqiqatın tətbiqi əhəmiyyəti - əldə edilən materiallar və məlumatlar ali təhsil müəssisələrində mühazirə və seminar dərslərində istifadə oluna bilər; maraqlı tərəflər bu tədqiqatın nəticələrindən faydalana bilərlər.

Tədiqiqatın orijinallığı və elmi yeniliyi - dayanıqlı sosial inkişaf (DSİ) uzunmüddətli perspektivdə iqtisadi tərəqqi, insan rifahı və institusional davamlılığa nail olmağın inteqrə olunmuş yanaşmasını təmsil edir. Qlobal bərabərsizlik və resurs məhdudiyyətləri ilə səciyyələnən bir dövrdə, inklüziv və dayanıqlı inkişafın hərəkətverici qüvvəsi kimi insan kapitalının rolu həm nəzəri, həm də siyasət səviyyəsində mərkəzi əhəmiyyət kəsb edir.

Tədqiqatın nəticələri - Azərbaycanın Dayanıqlı İnkişaf Məqsədlərinə (DİM) nail olma istiqamətində irəliləyişi təhsilin keyfiyyəti, səhiyyə xidmətlərinə çıxış və əmək bazarının inklüzivliyi sahələrində hədəfli islahatlar vasitəsilə sürətləndirilə bilər. Gələcəkdə ölkədaxili müxtəlifliyi nəzərə almaq və insan kapitalı ilə institusional keyfiyyət arasındakı qarşılıqlı əlaqəni təhlil etmək üçün regional məlumatlara əsaslanan panel və ya məkan modellərindən istifadə tövsiyə olunur.

Açar sözlər: insan kapitalı, dayanıqlı sosial inkişaf, solow modeli, HDI, təhsil, səhiyyə, məşğulluq.

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РОЛЬ ЧЕЛОВЕЧЕСКОГО КАПИТАЛА В УСТОЙЧИВОМ СОЦИАЛЬНОМ РАЗВИТИИ: ЭМПИРИЧЕСКАЯ ОЦЕНКА ДЛЯ АЗЕРБАЙДЖАНА

Р Е З Ю М Е

Основная цель исследования - изучить роль человеческого капитала в устойчивом социальном развитии.

Методология исследования - для проверки гипотез применены следующие эконометрические методы: описательная статистика и корреляционный анализ.

1. Тесты на стационарность: тест расширенного Дики–Фуллера (ADF) для обеспечения интеграции данных на уровнях I (0) или I (1).
2. Регрессия обыкновенных наименьших квадратов (OLS) для построения базовой модели.
3. Диагностические тесты: коэффициент инфляции дисперсии (VIF) для проверки мультиколлинеарности; тест Дарбина–Уотсона (DW) для выявления автокорреляции.
4. Проверка надежности результатов: альтернативная модель с лаговыми переменными для учета динамических эффектов.

Практическая значимость исследования - полученные материалы и данные могут быть использованы в лекциях и семинарах высших учебных заведений; заинтересованные стороны могут извлечь пользу из результатов исследования.

Результаты исследования - прогресс Азербайджана в достижении Целей устойчивого развития (ЦУР) может быть ускорен посредством целевых реформ в области качества образования, доступности здравоохранения и инклюзивности рынка труда. В дальнейшем рекомендуется использовать панельные или пространственные модели с региональными данными для учета внутристрановой неоднородности и анализа взаимодействия человеческого капитала с институциональным качеством.

Актуальность и новизна исследования - устойчивое социальное развитие (УСР) представляет собой комплексный подход к достижению экономического прогресса, человеческого благополучия и институциональной устойчивости в долгосрочной перспективе. В эпоху глобального неравенства и ограниченности ресурсов роль человеческого капитала как движущей силы инклюзивного и устойчивого развития становится центральной как в теории, так и в практике.

Ключевые слова: человеческий капитал, устойчивое социальное развитие, модель Солоу, HDI, образование, здравоохранение, занятость.

Məqalə redaksiyaya daxil olmuşdur: 13.12.2025
Təkrar işlənməyə göndərilmişdir: 12.01.2026
Çapa qəbul olunmuşdur: 19.02.2026

Дата поступления статьи в редакцию: 13.12.2025
Отправлено на повторную обработку: 12.01.2026
Принято к печати: 19.02.2026

The date of the admission of the article to the editorial office: 13.12.2025
Send for reprocessing: 12.01.2026
Accepted for publication: 19.02.2026