



Effect of Human Capital on Economic Development in Rwanda

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Abstract: This study analysed the effect of human capital on economic development in Rwanda from 2000 to 2023. It adopted a quantitative, econometric research design. The population comprised Rwanda's 24 annual national time-series observations for the period; all were used, so no sampling was applied. Secondary data were collected through documentary review of official statistical publications and analysed in E-Views 7 using descriptive statistics, Augmented Dickey-Fuller unit root tests, Johansen cointegration, Granger causality, diagnostic tests, and multiple regression. The model explained 55.6% of the variation in real GDP growth ($\text{Prob}(F) = 0.0077$). School enrolment had a significant positive effect on growth ($\beta = 0.173$, $p = 0.0103$), whereas labour force participation ($\beta = -1.147$, $p = 0.0225$), wage and salaried employment ($\beta = -0.783$, $p = 0.0239$), and current health expenditure ($\beta = -1.456$, $p = 0.0263$) had significant negative effects. The NEET rate, the proxy for skills and training, was not significant ($p = 0.1168$). The study recommends that the Government of Rwanda sustain investment in education, align vocational training with high-growth sectors, expand social services that support productive labour force participation, evaluate the efficiency of health expenditure, and promote formal, high-value jobs.

Keywords: Human capital, Education, Health, Wages, Employment, Rwanda

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1. Introduction

Economic development generates new jobs and raises the standard of living of present and future citizens by widening their access to the opportunities that economic expansion creates (Sukmawati & Maryanti, 2021). Development is usually associated with rising production, with governing structures that reflect the preferences of citizens (Klitgaard, 2021), and with the capacity of the state to manage its economy, society, and public administration, including increasingly complex tasks such as taxation and public service delivery (Farazmand, 2023). Across these accounts, the quality of a country's people is a recurring theme.

At the global level, human capital refers to the skills, abilities, and experience that individuals acquire and that allow them to take part in economic life and earn income; it can be strengthened through investment in education, health, and training (Gruzina et al., 2021). Many governments therefore treat education as a development investment. Chankeliani et al. (2021) show that higher education contributes to local, national, and global development, which explains why some states actively finance its expansion. The East Asian experience is frequently cited in this regard: Asongu and Tchamyou (2020) contrast South Korea, where rising human capital in science, education, and management supported innovation and productivity, with African economies where knowledge creation and diffusion have been weaker.

Regionally, investment in human capital has been identified as one of the most important influences on growth in Sub-Saharan Africa, where health and education jointly shape the composition of production (Akinlo & Oyeleke, 2020). A more educated workforce is also more inclined to innovate, which raises aggregate productivity (Kong et al., 2022). In East Africa, Uganda has introduced programmes to raise the quality of its labour force through Business, Technical and Vocational Education and Training (BTSET) (Guloba et al., 2021); enrolment in BTSET institutions rose from 40,830 students in 2015 to 49,654 in 2017 (Nganda et al., 2021). In Tanzania, strategic human capital development has likewise been linked to the performance of productive sectors such as tourism (Mweta et al., 2024).

In Rwanda, human capital is a central pillar of national development, and the government has worked to widen access to essential social services (Williams et al., 2020). Nevertheless, Rwanda scored 0.38 on the World Bank Human Capital Index, which implies that a child born in the country today will reach only 38% of the productivity that would be possible with complete education and full health (Hategeka, 2020). Data from the Fifth Rwanda Population and Housing Census show that 22% of the population has never attended school, 54% have completed primary education, 15% have completed secondary education, and only 3% hold a university degree (National Institute of Statistics of Rwanda [NISR], 2023). Rural residents are more likely than urban residents never to have attended school (24% versus 18%), and more men than women hold university degrees (3.8% versus 2.8%) (NISR, 2023).

Human capital is widely regarded as a driver of growth because it raises the knowledge and skills of citizens (Prasetyo & Kistanti, 2020), directly influences productivity and innovation (Widarni & Bawono, 2021), and enables workers to develop new technologies and produce higher-quality goods and services (Ngoc & Tien, 2023). Yet, despite substantial public investment in education and training, initiatives to raise labour force participation, and targeted health and skills programmes, the pace of economic development in Rwanda remains a critical concern and shows areas of inefficiency. This tension between sustained investment in human capital and uneven development outcomes is the problem that motivates the present study.

Study gap. Most of the empirical evidence on human capital and growth comes from cross-country panels or from other economies, and the Rwandan studies that exist tend to examine a single dimension, such as health investment (Jacques, 2025), life expectancy (Iyakaremye & Tripathi, 2024), or the quality of education (de Dieu et al., 2022). There remains a lack of comprehensive time-series analysis that examines, within one model, how

education participation, labour force participation, skills and training, health outcomes, and wage and income levels jointly relate to Rwanda's economic development.

Justification. Rwanda's Vision 2050 commits the country to building a healthy and highly skilled workforce so that its population becomes a productive economic asset. Evidence on which dimensions of human capital are associated with growth, and in which direction, is therefore needed to guide education, skills, health, and labour-market policy. The study also adds Rwandan evidence to the literature on human capital and development.

The general objective of the study was to analyse the effect of human capital on economic development in Rwanda. The study was guided by the following research questions:

- RQ1: What is the effect of education participation on Rwanda's economic development?
- RQ2: What is the effect of labour force participation on Rwanda's economic development?
- RQ3: What is the effect of employees' skills and training on Rwanda's economic development?
- RQ4: What is the effect of health outcomes on Rwanda's economic development?
- RQ5: What is the effect of wage and income levels on Rwanda's economic development?

Corresponding to these questions, the study tested five null hypotheses (H_{01} – H_{05}) stating that education participation, labour force participation, employees' skills and training, health outcomes, and wage and income levels, respectively, have no significant effect on Rwanda's economic development.

2. Literature Review

2.1 Conceptual and Theoretical Perspectives

Human capital, comprising health, knowledge, and abilities, influences employee efficiency and productivity and is therefore central to growth and development (Widarni & Bawono, 2021). Education raises knowledge and skills, which in turn increase output and improve health (Raghupathi & Raghupathi, 2020), while healthy workers contribute more to production and learning (Piwowar-Sulej et al., 2024). Deming (2022) adds that longer life expectancy lengthens the period over which people benefit from education, which strengthens incentives to invest in skills. Roffia et al. (2023) similarly link life expectancy to the size and quality of the workforce, and Yang (2020) notes that the positive association between life expectancy and economic performance is usually explained by health gains that reinforce investment in human capital.

Each dimension examined in this study has a distinct rationale. Education broadens opportunities and motivates learners to contribute through entrepreneurship and community service (Ahmad et al., 2023), and it accelerates production by giving people access to modern ideas and technologies (Pal, 2023). The labour force participation rate is a key measure for interpreting employment and unemployment data, and changes in it influence output and unemployment outcomes (Ahn & Hamilton, 2022). A well-trained workforce creates positive externalities for all firms and can give an economy a competitive advantage (Aidara et al., 2021), whereas regional skill gaps and shortages reduce firm productivity (Morris et al., 2020). Wages and incomes are closely tied to the distribution of human capital: Castelló-Climent and Doménech (2021) show that inequality in human capital contributes directly to income inequality. Economic development itself is understood as a process that encourages business growth, attracts investment, and diversifies the economy to improve quality of life (Sugiardi, 2024), and GDP per capita remains the most common summary measure of a nation's economic health and living standards (Wang & Li, 2021).

Three theories frame the study. Human capital theory, associated with Schultz and Becker, treats spending on people's education, training, and health as an investment comparable to investment in physical capital, undertaken when expected future benefits exceed present costs (Gruzina et al., 2021). Neoclassical growth theory, formalised in the Solow–Swan model, explains output through capital, labour, and technology, with technological progress sustaining long-run growth (Li, 2024). Endogenous growth theory, associated with Paul Romer, argues that growth is driven by internal factors such as human capital, knowledge, and innovation rather than by external forces alone (Chandra, 2022). Together, these theories imply that the education, skills, health, and employment characteristics of Rwanda's population should be systematically related to its economic performance.

2.2 Empirical Studies: Global to Local

Globally, Hanushek and Woessmann (2007) conclude that the cognitive skills of a population, rather than school attainment alone, are strongly related to economic growth, income distribution, and individual earnings, and that skill deficits in developing countries are larger than enrolment figures suggest. Using OLS fixed-effects and GMM estimation on 10 Middle Eastern and 24 OECD countries between 2000 and 2017, Habibi and Zabardast (2020) found that education and ICT were positively associated with economic growth in both groups. For labour force participation, Altuzarra et al. (2019) estimated static and dynamic panel models for the 28 European Union member states over 1990–2016 and found a U-shaped relationship between economic development and female labour force participation. Yu et al. (2021) showed that epidemics

reduce labour force participation, especially among younger workers and men in low- and middle-income countries.

On skills, Oliynyk et al. (2021) used cluster and correlation-regression analysis to show that the immigration of highly educated workers significantly strengthens national competitiveness and economic growth. Morandini et al. (2023) reviewed evidence on artificial intelligence and concluded that organisations must map transversal skills and provide upskilling and reskilling opportunities if productivity gains are to be realised. On wages, Lupu et al. (2023) applied wavelet coherency to 11 Eastern European economies over 1995Q1–2020Q4 and found that growth mainly drives increases in the wage share, while wages influence growth only in specific periods, which casts doubt on wage-led growth strategies.

Within Africa, Anetor (2020) used dynamic panel threshold regression and system GMM for 28 Sub-Saharan African countries over 1999–2017 and found that human capital and foreign direct investment (FDI) had no discernible independent effect on growth; the growth effect of FDI became positive only when it was interacted with human capital, which suggests that the region lacks a sufficiently large pool of skilled workers. In Nigeria, Akintunde and Olaniran (2022) applied an ARDL bounds-testing approach to data for 1981–2020 and found that government health spending had a negative short-run but positive long-run effect on life expectancy.

At the local level, Jacques (2025) reported that health investment has supported economic growth in Rwanda, while Iyakaremye and Tripathi (2024) examined the contribution of economic development to life expectancy in the country. De Dieu et al. (2022) documented significant advances in Rwandan education alongside persistent quality challenges, including gender inequality in education and a wide skills gap in the workforce. These studies confirm the relevance of human capital to Rwanda's development, but none of them models education, labour force participation, skills, health, and wage employment together against a national measure of economic performance. The present study addresses that gap.

3. Methodology

3.1 Research Design

A research design provides the framework that guides data collection and analysis (Ganesha & Aithal, 2022). This study adopted a quantitative research design with an econometric modelling approach to examine the effect of human capital on economic development in Rwanda over the period 2000–2023.

3.2 Population and Sampling Procedures

The population of the study consisted of annual national time-series observations on Rwanda's economic development and human capital indicators. Because the study covered the entire 2000–2023 period, all 24 annual observations for each variable were included; no probability or non-probability sampling of observations was undertaken. The unit of analysis was the country-year.

3.3 Data Collection Instrument and Measurement of Variables

The study relied on documentary review of secondary sources as its data collection instrument. Data on the human capital indicators and on economic development were drawn from World Bank annual reports and archives, the National Institute of Statistics of Rwanda (NISR), and the National Bank of Rwanda (BNR). Table 1 presents the variables, their proxies, and their sources.

Table 1: Variables, Measurement, and Data Sources

Code	Variable (type)	Measurement / indicator	Source
GDP	Economic development (dependent)	Real GDP growth (annual %)	NISR; BNR
SCHE	Education participation (independent)	School enrolment	NISR
LFP	Labour force participation (independent)	Labour force participation rate (% of population aged 15–64)	NISR
YET	Employees' skills and training (independent)	NEET rate (% of youth not in employment, education, or training)	NISR
CHEX	Health outcomes (independent)	Current health expenditure (% of GDP)	NISR
WS	Wage and income levels (independent)	Wage and salaried workers (% of female employment)	NISR

Note. BNR = National Bank of Rwanda; NISR = National Institute of Statistics of Rwanda; NEET = not in employment, education, or training.

3.3.1 Validity

Validity was addressed through the choice of data and through model checks. All series were obtained from official national and international statistical publications, and each construct was measured with an established macroeconomic indicator (Table 1). The validity of the estimated model was examined with the Ramsey RESET test for functional-form misspecification and the CUSUM test for parameter stability.

3.3.2 Reliability

Because the study relied on secondary time-series data rather than a questionnaire, internal-consistency coefficients were not applicable. The reliability of the estimates was instead assessed through Augmented Dickey-Fuller (ADF) unit root tests, to guard against spurious regression, and through residual diagnostics: the Jarque-Bera normality test, the Breusch-Godfrey serial correlation LM test, and the Breusch-Pagan-Godfrey heteroskedasticity test.

3.4 Data Collection Procedure

The annual series for each variable were extracted from the published reports and archives of the institutions listed in Table 1 and compiled by year. The compiled data were then checked through editing, coding, and tabulation before

being entered into E-Views 7 for analysis. No primary data were collected.

3.5 Data Analysis Plan

Data were analysed in E-Views 7. The analysis proceeded from descriptive statistics to ADF unit root tests, the Johansen cointegration test (trace statistic), pairwise Granger causality tests with two lags, and the diagnostic tests described above. The effect of each human capital dimension on economic development was estimated by ordinary least squares using the following multiple linear regression model:

$$GDP_t = \beta_0 + \beta_1 SCHE_t + \beta_2 LFP_t + \beta_3 YET_t + \beta_4 WS_t + \beta_5 CHEX_t + u_t$$

where t denotes the year, β_0 is the constant, β_1 – β_5 are the coefficients of the human capital variables, and u is the error term. Each null hypothesis was rejected when the p -value of the corresponding coefficient was below 0.05. The regression was estimated on all 24 annual observations; where another procedure rests on a different number of observations, this is reported with the relevant table.

3.6 Ethical Considerations

The study used only aggregate secondary data published by official institutions. It involved no human participants, and

no personal or confidential information was collected. All data sources and scholarly works were acknowledged, the data were used solely for the purposes of this study, and the results are reported as they were obtained from the analysis.

4. Results and Discussion

4.1 Preliminary Analysis

Table 2 summarises the variables. Real GDP growth averaged 7.92% with a standard deviation of 2.38, and its

Jarque-Bera probability (0.717926) indicates an approximately normal distribution. Current health expenditure averaged 6.82% of GDP; its high kurtosis (4.496461) and Jarque-Bera probability of 0.001958 show that it departs from normality. Labour force participation averaged 43.02% with relatively low dispersion (SD = 2.75), while the NEET rate was tightly clustered around its mean of 27.18% (SD = 1.31).

Table 2: Descriptive Statistics

Statistic	GDP	SCHE	LFP	YET	WS	CHEX
Mean	7.919396	139.9417	43.02130	27.17657	48.99696	6.819600
Median	8.249903	139.3100	43.48800	27.08200	48.76754	7.303784
Maximum	13.19207	156.6143	48.29400	29.22300	57.63857	8.102233
Minimum	2.202388	97.39991	36.41000	25.51100	42.20907	3.127873
Std. Dev.	2.381821	14.75772	2.746522	1.305001	4.074511	1.485145
Skewness	-0.291526	-1.048875	-0.627556	0.109721	0.419502	-1.641268
Kurtosis	3.592996	3.962912	3.477258	1.456110	2.634692	4.496461
Jarque-Bera	0.662777	5.105765	1.727954	2.330429	0.802488	12.47217
Probability	0.717926	0.077857	0.421483	0.311856	0.669487	0.001958
Observations	23	23	23	23	23	23

Note. E-Views 7 output. The 23 observations cover 2000–2023 excluding 2020.

Table 3 reports the ADF unit root tests. GDP ($p < 0.001$), SCHE ($p = 0.0178$), and CHEX ($p < 0.001$) were stationary at level. LFP ($p = 0.7722$), YET ($p = 0.1295$), and WS ($p = 0.9996$) were non-stationary at level but became stationary

after first differencing ($p < 0.001$, $p < 0.001$, and $p = 0.0021$, respectively). The series are therefore a mixture of $I(0)$ and $I(1)$ processes.

Table 3: Augmented Dickey-Fuller Unit Root Tests (p-values)

Variable	Level	First difference	Order of integration
GDP	0.0000*	–	$I(0)$
SCHE	0.0178*	–	$I(0)$
LFP	0.7722	0.0000*	$I(1)$
YET	0.1295	0.0000*	$I(1)$
WS	0.9996	0.0021*	$I(1)$
CHEX	0.0000*	–	$I(0)$

Note. E-Views 7 output; MacKinnon one-sided p-values. *Stationary at the 0.05 level.

The Johansen trace test (Table 4) rejected the null hypotheses from no cointegration through "at most 4" cointegrating equations, but not "at most 5" (trace statistic = 3.301791 < critical value = 3.841466; $p = 0.0692$). The test therefore indicates five cointegrating equations at the

0.05 level, which suggests that the variables share long-run relationships and do not drift apart over time. Because only 19 observations were available for a system of six variables, three of which are stationary at level, this result should be interpreted with caution.

Table 4: Johansen Unrestricted Cointegration Rank Test (Trace)

Hypothesised no. of CE(s)	Eigenvalue	Trace statistic	0.05 critical value	Prob.**
None*	0.999915	325.1296	95.75366	0.0000
At most 1*	0.956496	147.1475	69.81889	0.0000
At most 2*	0.900643	87.58450	47.85613	0.0000
At most 3*	0.710442	43.71276	29.79707	0.0007
At most 4*	0.588314	20.16418	15.49471	0.0092
At most 5	0.159517	3.301791	3.841466	0.0692

Note. E-Views 7 output. Series: GDP, SCHE, LFP, WS, YET, CHEX; linear deterministic trend; lags interval in first differences: 1 to 1; 19 included observations. CE = cointegrating equation. *Rejection of the hypothesis at the 0.05 level.

**MacKinnon-Haug-Michelis p-values.

The diagnostic tests in Table 5 did not reject any of the null hypotheses. The RESET test ($p = 0.9661$) indicates no functional-form misspecification, the Breusch-Godfrey test ($p = 0.1691$) indicates no serial correlation up to two lags, the Breusch-Pagan-Godfrey test ($p = 0.7426$)

indicates constant residual variance, and the Jarque-Bera probability of 0.368085 indicates normally distributed residuals. The CUSUM statistic also remained within the 5% significance bounds, so there was no evidence of structural instability in the parameters.

Table 5: Diagnostic Test Results

Test	Statistic	Prob.	Decision
Ramsey RESET	$F(1, 16) = 0.001860$	0.9661	Correctly specified
Breusch-Godfrey serial correlation LM	$F(2, 16) = 1.990174$	0.1691	No serial correlation
Breusch-Pagan-Godfrey heteroskedasticity	$F(5, 17) = 0.541186$	0.7426	Homoskedastic
Jarque-Bera normality of residuals	–	0.368085	Normally distributed

Note. E-Views 7 output. The tests are based on 23 observations (2000–2023, excluding 2020).

4.2 Regression Results

Table 6 presents the estimated model. The explanatory variables jointly accounted for 55.6% of the variation in real GDP growth ($R^2 = 0.555967$; adjusted $R^2 = 0.432624$),

and the model was statistically significant as a whole ($F = 4.507500$; $\text{Prob}(F) = 0.007713$). Table 7 complements these estimates with the Granger causality results for each human capital variable paired with GDP. The subsections that follow answer each research question in turn.

Table 6: Regression Results (Dependent Variable: Real GDP Growth)

Variable	Coefficient	Std. error	t-statistic	Prob.
Constant	60.85041	39.67629	1.533672	0.1425
SCHE	0.173434	0.060566	2.863559	0.0103*
LFP	−1.146541	0.459186	−2.496901	0.0225*
YET	0.743327	0.451147	1.647638	0.1168
WS	−0.782743	0.317388	−2.466205	0.0239*
CHEX	−1.456218	0.601672	−2.420284	0.0263*

Note. E-Views 7 output. Method: least squares; sample: 2000–2023; $N = 24$. $R^2 = 0.555967$; adjusted $R^2 = 0.432624$; $F = 4.507500$; $\text{Prob}(F) = 0.007713$; Durbin-Watson = 2.155234. *Coefficient is significant at the 0.05 level.

Table 7: Pairwise Granger Causality Tests Between Human Capital Variables and GDP (Lags: 2)

Null hypothesis	Obs.	F-statistic	Prob.
SCHE does not Granger-cause GDP	19	3.03851	0.0802
GDP does not Granger-cause SCHE	19	0.06617	0.9363
LFP does not Granger-cause GDP	23	1.33145	0.2889
GDP does not Granger-cause LFP	23	15.4997	0.0001*
YET does not Granger-cause GDP	23	5.28444	0.0156*
GDP does not Granger-cause YET	23	5.67169	0.0123*
WS does not Granger-cause GDP	23	1.64773	0.2202
GDP does not Granger-cause WS	23	12.1739	0.0005*
CHEX does not Granger-cause GDP	23	0.10674	0.8993
GDP does not Granger-cause CHEX	23	1.13729	0.3427

Note. E-Views 7 output. *Null hypothesis rejected at the 0.05 level.

4.2.1 RQ1: Effect of Education Participation on Economic Development

School enrolment had a positive and significant effect on real GDP growth ($\beta = 0.173434$, $p = 0.0103$), so H_{01} was rejected: holding the other variables constant, higher education participation is associated with faster growth. The Granger test for $SCHE \rightarrow GDP$ ($p = 0.0802$) was not significant at the 0.05 level, so the predictive direction is not established. The positive effect agrees with Habibi and Zabardast (2020) and with the broader argument that educational attainment raises workforce productivity, skills, and output (Bykova et al., 2024; Hanushek & Woessmann, 2023). More educated workers are also better able to conduct research and adopt new technologies (Wu & Liu, 2021). However, Hanushek and Woessmann (2007) caution that enrolment alone may overstate skill levels, a caution that also applies to the enrolment proxy used here.

4.2.2 RQ2: Effect of Labour Force Participation on Economic Development

Labour force participation had a significant negative effect on growth ($\beta = -1.146541$, $p = 0.0225$), which led to the rejection of H_{02} . The Granger results show that GDP Granger-causes LFP ($p = 0.0001$), but not the reverse ($p = 0.2889$), which indicates that growth has shaped participation more than participation has shaped growth. This finding contrasts with studies that report a positive link between a larger workforce and output (Abdeldayem et al., 2021; Virjan et al., 2023). It is, however, compatible with the non-linear, U-shaped relationship between development and participation found by Altuzarra et al. (2019). In the Rwandan context, a plausible interpretation is that high participation in low-productivity informal work coexists with a structural shift from agriculture to services and industry, and that expanded education temporarily draws young people out of the labour force.

4.2.3 RQ3: Effect of Employees' Skills and Training on Economic Development

The NEET rate, used as the proxy for skills and training, had a positive but statistically insignificant coefficient ($\beta = 0.743327$, $p = 0.1168$), so H_{03} was not rejected. Granger causality ran in both directions between the NEET rate and GDP ($YET \rightarrow GDP$, $p = 0.0156$; $GDP \rightarrow YET$, $p = 0.0123$), which suggests a dynamic, two-way relationship even though the contemporaneous effect was not significant. Because a higher NEET rate signals less engagement in employment, education, and training, the proxy is an inverse indicator of skills, and the result should be read with that in mind. The literature emphasises that training raises workers' abilities and output (Rivaldo & Nabella, 2023; Singh et al., 2022) and that closing skill gaps improves flexibility and creativity (Braun et al., 2024). The absence of a significant effect in this study may therefore reflect the limitations of the proxy as much as the underlying relationship.

4.2.4 RQ4: Effect of Health Outcomes on Economic Development

Current health expenditure had a significant negative coefficient ($\beta = -1.456218$, $p = 0.0263$), and H_{04} was rejected. The Granger tests found no predictive relationship in either direction ($CHEX \rightarrow GDP$, $p = 0.8993$; $GDP \rightarrow CHEX$, $p = 0.3427$). This result differs from Jacques (2025), who associated health investment with growth in Rwanda, and from the view that healthier populations work longer and more productively (Khan et al., 2020; Laaksonen, 2021). One possible explanation is timing: Akintunde and Olaniran (2022) found that health spending in Nigeria had a negative short-run but positive long-run effect on health outcomes, and a contemporaneous regression such as the one estimated here may capture mainly the short-run cost. The measure is also an expenditure input rather than a direct health outcome, which limits the interpretation.

4.2.5 RQ5: Effect of Wage and Income Levels on Economic Development

Wage and salaried employment had a significant negative effect on growth ($\beta = -0.782743$, $p = 0.0239$), which led to the rejection of H_{05} . GDP Granger-causes WS ($p = 0.0005$), whereas WS does not Granger-cause GDP ($p = 0.2202$). This pattern mirrors the evidence of Lupu et al. (2023) that growth tends to drive changes in wages rather than the reverse and that wage-led growth strategies have limited effects. The negative contemporaneous association suggests that Rwanda's growth has not been accompanied by a proportional rise in formal wage employment, as much economic activity remains in informal and low-productivity work. Because the indicator refers to female employment only, the result describes one segment of the labour market.

These findings should be read with three limitations in mind. First, the sample is small and the number of usable observations differs across procedures: the regression uses all 24 annual observations, whereas the descriptive statistics and residual diagnostics are based on 23 observations and the cointegration test on 19. Second, the regression is estimated in levels on series with mixed orders of integration, so the coefficients describe contemporaneous associations rather than established causal effects. Third, several constructs are measured with indirect proxies, notably the NEET rate for skills and training, current health expenditure for health outcomes, and female wage and salaried employment for wage and income levels.

5. Conclusion and Recommendations

This section brings together the answers to the five research questions and the actions that follow from them. Section 5.1 states the conclusion reached on each research question, and Section 5.2 presents the corresponding recommendations.

5.1 Conclusion

The study analysed the effect of human capital on economic development in Rwanda between 2000 and 2023. The estimated model was statistically significant and explained 55.6% of the variation in real GDP growth, which shows that human capital, taken as a whole, matters for the country's economic performance. Its dimensions, however, do not all act in the same direction. Based on the findings, the following conclusions are drawn, one for each research question.

1. **Education participation (RQ1).** Education participation has a significant positive effect on Rwanda's economic development. Expanding school participation is associated with faster growth, and it is the only dimension of human

capital in the model with a significant positive coefficient.

2. **Labour force participation (RQ2).** Labour force participation has a significant negative effect on growth, and growth drives participation rather than the reverse. Participation that is not matched by productive employment does not by itself raise output.
3. **Employees' skills and training (RQ3).** Skills and training, proxied by the NEET rate, have no significant contemporaneous effect on growth, although the two are linked dynamically in both directions. The proxy is indirect, so this conclusion is tentative.
4. **Health outcomes (RQ4).** Current health expenditure has a significant negative contemporaneous effect on growth, which suggests that the returns to health spending are not realised within the same period.
5. **Wage and income levels (RQ5).** Wage and salaried employment has a significant negative effect on growth, and growth drives wage employment rather than the reverse. Growth has therefore not generated a proportional increase in formal wage employment.

5.2 Recommendations

Based on the findings of this study, the following recommendations are made. The recommendations are based on each research question and are presented in the same order as the conclusions, so that each research question has its own recommendation.

1. **Education participation (RQ1).** The Government of Rwanda should sustain investment in education participation and strengthen partnerships between educational institutions and the private sector, so that enrolment translates into the skills demanded by high-growth sectors.
2. **Labour force participation (RQ2).** The government should expand supportive social services, particularly for women, and strengthen initiatives such as the National Employment Programme and support for small and medium-sized enterprises, so that participation moves into productive employment.
3. **Employees' skills and training (RQ3).** The government should align vocational training with high-growth sectors in order to reduce the NEET rate, and future studies should measure skills with a direct indicator.

4. **Health outcomes (RQ4).** The Ministry of Health and the Ministry of Finance and Economic Planning should evaluate the efficiency of current health expenditure and monitor its longer-term effects on labour productivity.
5. **Wage and income levels (RQ5).** The government should promote labour-intensive industries and high-value formal jobs, establish an equitable national minimum wage, and extend social protection to informal workers.

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