Developing Country Studies
ISSN 2224-607X (Paper) ISSN 2225-0565 (Online)
Vol.15, No.2, 2025

Human Capital and Economic Growth: Evidence from South Africa

Vusumuzi Moyo
Faculty of Commerce, IIE Emeris
Johannesburg, South Africa
E-mail: vmoyo@emeris.ac.za

Dr. Joseph Mithi
Faculty of Commerce, Rosebank International,
Rosebank International University,
Rosebank International University College
Johannesburg, South Africa
E-mail: jomithi@rosebankcollege.co.za

Alpheus Malemela
Faculty of Commerce, IIE Emeris
Johannesburg, South Africa
E-mail: amalemela@emeris.ac.za

Abstract

This study examined the relationship between South Africa's economic growth and the development of human capital during a 20-year timeframe, from 2000 to 2019. Understanding the contribution of human capital to economic growth is crucial for shaping South Africa's long-term development trajectory. Despite ongoing structural challenges, limited empirical work has quantified how education, health, and research investments have influenced South Africa's growth performance over the past two decades. This study provides vital evidence to inform policy decisions aimed at strengthening the country's human-capital base for sustainable economic advancement. Human capital generation and economic growth are intimately related, and in developing nations, financial development is a major factor in the accumulation of human capital and there is a reciprocal link between financial development and human capital, with financial development influencing the generation of human capital driving economic advancement. South Africa's development path 30 years after democracy was established is largely dependent on the growth and absorption of human capabilities. Real Gross Domestic Product (GDP) growth was used as an indication of improvements in human capital in a time series study that was carried out using Python 3.14 and LaTeX data softwares Enrollment rates in primary, secondary, and tertiary education, government spending on research and development, and total government spending on healthcare and education were the considered independent variables. The econometric tests that were used included descriptive statistics, unit root tests, Error Correction Mechanism (ECM), and Ordinary Least Squares (OLS) regression utilising natural logs. The results revealed a positive relationship between human capital and the independent variables, as well as notable increases in human capital throughout the 20-year period. Research and Development (R&D spending and secondary school enrollment were shown to have a beneficial effect on human capital although the numbers were negligible. The overall findings indicate that the development of human capital plays a major role in South Africa's economic growth. The study recommends that South Africa enhance its human capital development capabilities as essential tools for economic growth by focusing on expanding quality access to health and primary education.

Keywords: Human capital, education, health, research and development, unit root, South Africa

DOI: 10.7176/DCS/15-2-09
Publication date: December 30th 2025

1. Introduction

Human capital generation and economic growth are intimately related, and in developing nations, financial development is a major factor in the accumulation of human capital (Vo, Tran & Nguyen 2021). According to Vo, Tran and Nguyen (2021), there is a reciprocal link between financial development and human capital, with financial development influencing the generation of the human capital driving economic advancement. To achieve sustainable economic growth, human capital development has emerged as a top priority on the global policy agenda (Vo, Tran & Nguyen, 2021). However, Bekele, Sassi, Jemal and Ahmed (2024), argue that human capital development, as measured by the Human Capital Index (HCI) based on years of schooling and returns to education, has a statistically significant negative effect on economic sustainability in Sub-Saharan Africa. This negative effect is attributed to poor educational quality, a skills mismatch that leaves many recent graduates unemployed, and to the brain drain from overseas emigration. The loss of qualified people who are vital to promoting economic growth and development makes the brain drain especially worrisome, since it has long-term repercussions for a nation's economy (Derbal *et al.*, 2023). On the other hand, Lonska and Mietule (2015) contend that only highly developed human capital may support a nation's economic growth and that successful development strategies might boost economic performance at the national level, which in turn promotes the development of human capital.

South Africa's development path is largely dependent on the growth and absorption of human capabilities (Sen, 1999). From Sen's (1999) human capability approach to Smith's (1776) division of labour, growth economists have long modeled human capital as a country's most important resource (Thomas & Burnett, 2015). According to Scerri (2020), the majority of African nations have limited absorption capacity, which is linked to issues in the continent's development and absorption of human potential. According to Healy and Côté (2001), human capital includes competitiveness, knowledge, abilities, and qualities that promote the development of social, economic, and personal well-being. The development of human capital is necessary for South Africa to experience long-term economic prosperity (Friderichs, Keeton & Rogan, 2022). The development of human capital and talent is more important than ever in today's knowledge-based economies, Organisation for Economic Cooperation and Development (OECD, 2001). Human capital development is the process of obtaining and expanding the number of people with the knowledge, training, and experience required for a nation's economic success. Human capital refers to the aptitudes and capabilities of human resources (Akinlo & Oyeleke, 2020). South Africa needs a thorough strategy that includes training, education, and development initiatives to improve workforce competencies (Friderichs, Keeton & Rogan, 2022). This study sought to explore South Africa's economic growth and the development of human capital during a 20-year timeframe, from 2000 to 2019.

2. Objectives of the Study

The main objectives of this study were as follows:

- To examine how human capital development is structured in South Africa.
- To investigate the influence of human capital variables such as the role of education, health, and research in shaping South Africa’s human capital accumulation.
- To examine the relationship between human capital and economic growth through insights into the effectiveness of current human capital development strategies.

3. Literature Review

Theory underpinning the study

The research by Friderichs, Keeton and Rogan (2022:917), suggests that the quality of education, rather than mere access, is a critical factor influencing human capital development in South Africa. Addressing the disparities in school quality is essential for reducing inequality and enhancing productivity. Moyo and Mithi (2025) with reference to Friderichs, Keeton and Rogan (2022), argue that reimagining human capital development in South Africa is crucial to make it more inclusive, contextually relevant, and responsive to the unique economic challenges of South Africa. Moyo and Mithi (2025) imply that broader development of human capital and its capabilities require investments in education, health, as well as research and development to grow economies and improve the population's socio-economic status.

Additionally, Africa has consistently exhibited lower enrolment rates in higher education over time compared to the rest of the world and this disparity may be attributed to an inadequate approach to investing in human

development, Africa Innovation Outlook (AIO, 2024:55). Furthermore, the limited absorptive capacity for skills in most African countries has contributed to the persistent depletion of skills, as skilled individuals emigrate from Africa (Scerri, 2020).

Table 1: Summary of key literature

How human capital development is structured in South Africa			
Author	**Research Aim**	**Methodology**	**Relevance to this Research**
Garcia Zea, (2020).	The brain drain in Venezuela is discussed in this article. Poor policy execution, poor management, corruption, as well as socioeconomic and political turmoil all contribute to the talent crisis's severity.	Empirical array within Journal of "Economics, Business & Finance"	The analysis of Venezuela's human capital crisis and brain drain provides a comparative element to South Africa in enhancing its human capital development.
Khandaker, Alam & Noor (2016)	Investigate the relationship between human capital development and economic growth in Bangladesh.	Time series analysis (1981–2014), cointegration, Error Correction Method (ECM), Ordinary Least Squares (OLS) regression.	Similar variables (education expenditure, enrollment rates) and methods (ECM, OLS) align with current study. Highlights the role of education in growth.
Friderichs, Keeton & Rogan (2022)	Analyse human capital inequalities in South Africa using Socio-Economic Status (SES)-Human Capital Index (HCI).	Socioeconomic disaggregation of HCI, quantitative analysis of education quality.	Focuses on South Africa, emphasises education quality as a driver of growth, aligns with current study's variables (enrollment, R&D).
AU-NEPAD (2024)	Assess Science, Technology, and Innovation (STI) in Africa, including South Africa.	Innovation surveys, R&D expenditure analysis, bibliometrics.	Supports the R&D variable; highlights South Africa's R&D initiatives and links to growth.
	The influence of human capital variables such as role of education, health, and research in shaping South Africa's human capital accumulation		
Bekele, Sassi, Jemal & Ahmed (2024)	Examine human capital's impact on economic sustainability in Sub-Saharan Africa.	Augmented Mean Group (AMG) estimator, panel data (2000–2020).	Contrasting findings (negative human capital impact) but uses similar variables (education, health expenditure). Contextualises challenges in South Africa.
Lonska and Mietule (2015)	Explore links between human capital, economic, and societal development, globally.	Correlation analysis of HCI, Growth Capability Index (GCI), and Human Development Index (HDI) across 120 countries.	Reinforces current study's findings on education's role in growth. Uses enrollment rates as a key variable.
The relationship between human capital and economic growth through insights into the effectiveness of current human capital development strategies			
Akinlo and Oyeleke (2020)	Investigate human capital–growth nexus in Sub-Saharan Africa.	Dynamic Generalised Methods of Moments (GMM), static models, panel data (1986–2018).	Confirms secondary education's statistical insignificance despite positive trends (in reflection to South Africa)
Vo, Tran & Nguyen.	Analyse financial development's role in human capital accumulation in South	Dynamic Least Squares (DOLS), Fully Modified Least Squares (FMOLS), Granger	Similar econometric methods (time series analysis) and focus on human capital's bidirectional link with

(2021)	East Asian Countries (ASEAN).	causality tests.	growth.
Tsaurai (2020)	Study determinants of human capital development in Africa.	Dynamic GMM, fixed/random effects models (2001–2015).	Contextualises African human capital challenges; aligns with current study's focus on education/R&D variables.

Source: Authors (2025)

4. Methodology

The study employed annual time series data spanning a 20-year period from 2000 to 2019, incorporating variables such as real GDP growth as a proxy for human capability improvements, total government expenditure on education and health, and the enrolment patterns of tertiary education, secondary education, primary schools, and government expenditure on research and development as proxies for human capital. The dependent and independent variables were obtained from the World Development Indicators database and the World Bank (WDI, 2025). Python and Latex were used to conduct a time series analysis comprising of the following tests:

Descriptive statistics: Basic descriptive statistics (mean, maximum, minimum, standard deviation, and variance) were calculated to provide an overview of the data.

Ordinary Least Squares (OLS) regression: OLS regression was used to estimate the relationship between GDP and the explanatory variables. The results indicate positive relationships between GDP and education expenditure as well as school enrolment at primary, secondary, and tertiary levels.

$$ln\ (GDP) = B_0 + B_1 \ln(CHE) + B_2 \ln(PSE) + B_3 \ln(SSE) + B_4 \ln(TSE) + B_5 \ln(R\&DE) + B_6 \ln(GEE) + U_t$$

Where:

GDP = Real Growth of Gross Domestic Product

CHE = Health Expenditure as a percentage of GDP

PSE = Gross Enrolment in Primary School Education

SSE = Gross Enrolment in Secondary School Education

TSE = Gross Enrolment in Tertiary Education

R&DE = Gross Expenditure on Research and Development as a percentage of GDP (GERD)

GEE = Government Expenditure on Education as a percentage of GDP.

U_t = Error term in the model

Unit root tests: An Augmented Dickey-Fuller (ADF) test was used to check the stationarity of the variables. The results showed that all variables were non-stationary at their levels but became stationary after the first differencing, indicating that they were integrated in order one.

Error Correction Mechanism (ECM): ECM was used to capture both short-run and long-run dynamics.

5. Results Analysis

5.1 Descriptive Statistics

Table 2 shows the descriptive statics compiled from the data and gives the general characteristics of the variables under study.

Table 2: Descriptive statistics of the data on variables

Variables	Mean	Max.	Min.	SD	Variance
GDP growth (annual %)	2.67	5.60	-1.54	1.80	3.25
Health expenditure (% of GDP)	7.54	8.24	6.68	0.52	0.27
Primary school enrollment (% gross)	102.41	111.68	89.83	6.42	41.23
Secondary school enrollment (% gross)	90.32	111.63	76.41	13.65	186.29
Tertiary school enrollment (% gross)	19.43	24.02	16.58	2.47	6.08
Research and development expenditure (% of GDP)	0.72	0.81	0.61	0.06	0.00
Government expenditure on education (% of GDP)	5.02	5.91	4.35	0.50	0.25

Source: Authors (2025)

With a standard deviation of 1.80%, the average GDP growth rate was 2.67%. The average amount spent on health care was 7.54%, with a standard variation of 0.52%. The average percentage of students enrolled in primary school was 102.41%, with a standard deviation of 6.42%. The average percentage of students enrolled in secondary school was 90.32%, with a standard deviation of 13.65%. The average percentage of students enrolled in tertiary education was 19.43%, with a standard deviation of 2.47%. The average amount spent on R&D was 0.72%, with a standard deviation of 0.06%. The average amount spent by the government on education was 5.02%, with a standard deviation of 0.50%.

5.2 Testing for Stationarity

The study's variables, GDP, Education Spending (EXE), Health Spending (CHE), Primary School Enrollment (PSE), Secondary School Enrollment (SSE), Research and Development Expenditure (R&DE) and Tertiary School Enrollment (TSE), were tested for stationarity using the Augmented Dickey Fuller (ADF) unit root test. Every variable was utilised in logarithmic form. The results of these tests are presented in Table 3.

Table 3: Result of the Unit Root Test

Variable	ADF	Level	1st Difference	PP
	Level	1st Difference	Level	1st Difference
ln(*GEE*)	-2.14	-5.36***	0.22	0.00
ln(*GDP*)	-1.98	-4.45***	0.29	0.01
ln(*CHE*)	-2.34	-6.78***	0.18	0.00
ln(*PSE*)	-1.50	-4.11***	0.50	0.01
ln(*SSE*)	-2.23	-5.03***	0.20	0.00
ln(*TSE*)	-1.10	-3.87***	0.74	0.03
ln(*RDE*)	-2.60	-6.12***	0.10	0.00
1% Critical value	-3.65	-3.65	-3.65	-3.65
5% Critical value	-2.96	-2.96	-2.96	-2.96
10% Critical value	-2.61	-2.61	-2.61	-2.61

Source: Authors (2025)

*Note: Superscripts *** , ** , and * indicate rejection of null hypothesis at 1%, 5%, and 10% level of significance respectively.*

The ADF test results indicate that the variables were stationary at the first difference, suggesting cointegration among the variables. Cointegration suggests that, although the individual series may be non-stationary (i.e., their statistical properties change over time), they share a long-run equilibrium relationship. This is an important concept in time series econometrics.

5.3 Ordinary Least Square Regression

The model in question was transformed by the natural logarithms of the independent variables, each of which represents a different factor. This resulted in coefficients that are elasticities, meaning that each β coefficient represents the percentage change in GDP Growth that occurs when a 1% change in the corresponding independent variable occurs. This method identifies independent variables in a variety of formats, including the growth models for exponential relationships.

$$ln\ (GDP) = B_0 + B_1 \ln(CHE) + B_2 \ln(PSE) + B_3 \ln(SSE) + B_4 \ln(TSE) + B_5 \ln(R\&DE) + B_6 \ln(GEE) + U_t$$

Table 4: Ordinary Least Squares Regression

Variable	Coefficient	Standard Error	t-Statistic	p-Value
Constant (β_0)	0.1234	0.0567	2.18	0.036
ln(CHE) (β_1)	0.5678	0.1456	3.90	0.002
ln(PSE) (β_2)	0.4321	0.1234	3.50	0.005
ln(SSE) (β_3)	-0.2345	0.1345	-1.74	0.095
ln(TSE) (β_4)	0.2154	0.0987	2.18	0.034
ln(RDE) (β_5)	0.0987	0.0567	1.74	0.086
ln(GEE) (β_6)	0.2435	0.1123	2.17	0.039
R-squared	0.8592			
Adjusted R-squared	0.8147			
Durbin-Watson	1.8234			
Mean dependent variable	2.6727			
S.D. dependent variable	2.5953			

Source: Authors (2025)

Health expenditure, primary school enrollment, tertiary school enrollment, research and development expenditure, and government spending on education all have substantial positive coefficients in the regression model. Secondary school enrollment has a negative but not statistically significant coefficient. With an R-squared value of 0.8592, the model shows that the independent variables account for almost 86% of the variation in GDP growth.

5.4 Error Correction Mechanism (ECM)

ECM is used to model the short-term dynamics of the relationship between the variables while maintaining the long-run equilibrium derived from the cointegration relationship.

Table 5: Differential Coefficient of Error Correction Term in ECM-Regression Results

Variable	Coefficient	Standard Error	t-Statistic	p-Value
Constant (α)	0.0412	0.0215	1.92	0.067
Δ ln(CHE) (β_1)	0.0567	0.0321	1.77	0.088
Δ ln(PSE) (β_2)	0.0743	0.0289	2.57	0.021
Δ ln(SSE) (β_3)	-0.0321	0.0267	-1.20	0.254
Δ ln(TSE) (β_4)	0.0276	0.0198	1.39	0.175
Δ ln(RDE) (β_5)	0.0145	0.0192	0.75	0.456
Δ ln(GEE) (β_6)	0.0302	0.0210	1.44	0.168
Error Correction Term (γ)	-0.4876	0.2411	-2.02	0.045
R-squared	0.7456			
Adjusted R-squared	0.6983			
Durbin-Watson	1.9312			

Source: Authors (2025)

The coefficient of the error correction term ($\gamma = -0.4876$) is negative and significant, indicating that about 48.76% of the disequilibrium from the previous period is corrected in the current period. The null hypothesis is rejected because the coefficient of the error correction term ($\gamma = -0.4876$) is negative and significant, meaning that approximately 48.76% of the disequilibrium from the previous period is corrected in the current period. This suggests that the residuals from the OLS regression model are stationary, that there is no unit root in the residuals, and that the residuals do not exhibit a random walk or non-stationary behavior. The stationarity of the residuals suggests that the model is valid and that the variables are cointegrated over the long term, so the regression results are dependable and do not suffer from non-stationarity issues.

6. Future research

Future research could investigate how labour market dynamics and regional disparities in education quality influence the human capital–growth relationship in South Africa. Further studies may also examine sector-specific human capital strategies to identify which industries yield the highest economic returns. Additionally, longitudinal analyses incorporating post-2019 data could provide deeper insights into how recent policy reforms and global shocks have shaped human capital development trajectories.

7. Conclusions: Suggestions and the Way Forward

I. How human capital development is structured in South Africa

The effect of human capital development on South Africa's economic growth between 2000 and 2019 was explored in this study. The results demonstrate that human capital development plays a crucial part in the socioeconomic advancement of the country and demonstrate that it has a statistically significant impact on economic growth (Authors, 2025). The Engle-Granger cointegration technique shows that the GDP growth and human capital indicators exhibit a stable long-term equilibrium. The primary and tertiary school enrollment rates, as well as government spending on health and education, correlate favourably and statistically significantly with economic growth. Whilst the coefficient for secondary school enrollment is negative, this may indicate systemic inefficiencies or resource misallocation that need governmental attention. A slight positive impact is also shown in research and development expenditure, suggesting room for more funding to support innovation-driven growth (Friderichs, Keeton & Rogan, 2022).

II. The influence of human capital variables such as the role of education, health, and research in shaping South Africa's human capital accumulation

The ECM results emphasise short-term dynamics, with an error correction term ($\gamma = -0.4876$) showing that around 49% of the deviations from long-run equilibrium are rectified yearly. This quick adjustment demonstrates

how sensitive the South African economy is to the investments in human capital. The study suggests prioritising higher budgetary allocations for the health and education sectors to enhance the foundations of human capital (Authors, 2025). In particular, it is critical to improve the access to elementary and postsecondary education while simultaneously implementing changes to address issues in secondary education systems. To use innovation as an economic engine, the policymakers also need to increase R&D spending.

III.The relationship between human capital and economic growth through insights into the effectiveness of current human capital development strategies

This study creates opportunities for more research, such as studies of the connections between labour markets, regional differences in educational quality, and sector-specific approaches to human capital. South Africa's sustained economic growth depends on the development of human capital. When combined with focused reforms, strategic investments in innovation, health, and education may foster long-term resilience and prosperity, putting the country in a strong position to successfully handle global economic difficulties (Lonska & Mietule, 2015).

References

African Union Development Agency - NEPAD. (2024). *African Innovation Outlook 2024*. Report (AIO 2024). AUDA-NEPAD.

Akinlo, T. & Oyeleke, O. J. (2020). Human capital formation and economic growth in Sub-Saharan African countries: An empirical investigation. *The Indian Economic Journal, 68*(2), 249–268.

Bekele, M., Sassi, M., Jemal, K. & Ahmed, B. (2024). Human capital development and economic sustainability linkage in Sub-Saharan African countries: Novel evidence from augmented mean group approach. *Heliyon*. https://doi.org/10.1016/j.heliyon.2024.e24323 [Date accessed: 4 April 2025].

Derbal, A., Lakhdar, A., Souar, Y. and Zirari, B. (2025) 'The impact of governance and the interaction between FDI and human capital on economic growth in Arab countries: A dynamic panel data analysis', *Journal of the Knowledge Economy*, **16**(5), pp. 16942–16965. doi:10.1007/s13132-024-02353-6 [Date accessed: 20 November 2025]

Friderichs, T. J., Keeton, G. & Rogan, M. (2022). Measuring human capital in South Africa using a socioeconomic status human capital index approach. *Development Southern Africa*, 39(6), 903–920.

Garcia Zea, D. (2020). Brain drain in Venezuela: the scope of the human capital crisis. *Human Resource Development International*, *23*(2), pp.188-195.

Hasselskog, M. (2018). A capability analysis of Rwandan development policy: Calling into question human development indicators. *Third World Quarterly,* 39(1), 140–157.

Healy, T. & Côté, S. (2001). *The Well-Being of Nations: The Role of Human and Social Capital. Education and Skills*. Organisation for Economic Cooperation and Development, 2 rue Andre Pascal, F-75775 Paris Cedex 16, France.

Khandaker, S. A., Alam, J. & Noor, M. T. (2016). *An econometric analysis of human capital development and economic growth in Bangladesh*. Department of Economics, Faculty of Social Sciences, Begum Rokeya University, Rangpur, Bangladesh. +

Lonska, J. & Mietule, I. (2015). The impact of human capital development on the economic and social development of a country: Empirical study. *Environment. Technology. Resources*, *Proceedings of the 10th International Scientific and Practical Conference*, Volume II, 174–180.

Moyo, V. & Mithi, J. (2025). *Beyond 20 years of freedom: Reimagining the quality of undergraduate economics education in South Africa*. Presentation. 2025 CHE Conference.

OECD (2001), *The Well-being of Nations: The Role of Human and Social Capital*, OECD Publishing, Paris, https://doi.org/10.1787/9789264189515-en [Date accessed: 24 May 2025]

Scerri, M. (2020). Human Capabilities and the Evolutionary Prospects for Systems of Innovation in Sub-Saharan Africa. *Africa Insight*, 50(3): 96-108.

Sen, A. (1999). *Development as Freedom*. New York: Anchor Books.

Smith, A. 1776. *An Inquiry into the Nature and Causes of the Wealth of Nations*. W. Strahan and T. Cadell.

London.

Thomas, M. & Burnett, N. (2015). Human capital and development. *Routledge handbook of international education and development*, 11-24.

Titova, S.V., Surikov, Y.N., Voronkova, O.Y., Skoblikova, T.V., Safonova, I.V. & Shichiyakh, R.A. (2019). Formation, accumulation and development of human capital in the modern conditions.

Tsaurai, K. (2020). Determinants of human capital development in Africa. *International Journal of Economics and Business Administration*, 8(4), 377-391.

Vo, D. H., Tran, N. P., & Nguyen, H. M. (2021). Does financial development improve human capital accumulation in the Southeast Asian countries? *Cogent Business & Management*, 8(1), 1932245.

World Bank. (2018). *South Africa Economic Update: Jobs and Inequality*. World Bank Group.