AR&P sciendo Financial Markets, Institutions and Risks, Volume 7, Issue 4, 2023
ISSN (online) – 2521-1242; ISSN (print) – 2521-1250
Sumy State University

Effect of Human Capital on Economic Growth in South Africa: an ARDL Approach

http://doi.org/10.61093/fmir.7(4).1-13.2023

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Abstract. *This study tests the influence of human capital expressed by spending on education on South African GDP during the period 2021-2000, depending on the self-regression model of the distributed time gaps (ARDL). This work aimed to study the effect of Human Capital (H) on GDP per capita in South Africa during the period 2000-2021, based on the autoregressive distributed lag (ARDL) model. The study results concluded that there is a long-run equilibrium relationship between GDP and the independent variables (physical capital K, labor force L, and Human Capital H). The results revealed that there is a positive effect of Human Capital on GDP (moral for K) in the short run, and an adverse effect of Human Capital on GDP in the long run due to the interest in employing internationally qualified professionals, contributing to an increase in unemployment and indigenous workers' health and well-being rates. These findings are consistent with the H-related literature. Likewise, from the results of the short-run test, L is the largest among the independent variables by (0.65), K by (0,086), the least of which is H with a coefficient of (0,029). This indicates that H (skilled workforce) in South Africa does not play an important role in the individual GDP in South Africa compared to the regular labor force due to its large size compared to the qualified labor. With regard to the long-run results, there is a negative impact of H on the local product due to the fact that the interest in supporting the qualified workforce coming to South Africa contributed to increasing unemployment rates and influencing the luxury of indigenous workers in South Africa. The study recommended the necessity of supporting local skills. The support must include enhancing skills for all three categories of workers (skilled, semi-skilled, and unskilled).*

Keywords: human capital, per capita GDP, physical capital, labor force.

JEL Classification: J24, O16, J21.

Type of manuscript: research paper

Received: 15.09.2023 **Accepted:** 28.10.2023 **Published:** 31.12.2023

Funding: There is no funding for this research.

Publisher: Academic Research and Publishing UG (i. G.) (Germany)

Cite as: Djamal, D., Fariou, C. & Brahim, L. (2023). Effect of Human Capital on Economic Growth in South Africa: an ARDL Approach. *Financial Markets, Institutions and Risks*, *7*(4), 1-13. http://doi.org/10.61093/fmir.7(4).1-13.2023

Introduction

Economic growth (EG) is a top-level priority that all developed, and developing countries are being taken, because of its repercussions on society in general, such as an increase in the standard of living and economic well-being. Studies and research have proven that it is necessary for a country -to achieve a satisfactory level of economic

expansion - to invest in all available economic resources, whether human, capital, or natural, and that investing in only one resource is no longer sufficient to achieve the desired goals, as an investment in Human Capital (H) is no less important than investment in physical capital. Indeed, the return on H may be greater. Recent studies have found that in light of the trend towards the knowledge economy, investment in H has a positive effect on promoting economic expansion. This is why further action should be taken because economies invest significantly in developing human resources in the best and most effective way. This interest is achieved by spending in order to raise capabilities and make human resources compatible with modern technologies. Therefore, the investment expenditures allocated for acquiring knowledge (labor force, education, and training) significantly affect modern economies.

1. Previous studies on the effect of Human Capital on Economic Growth

Numerous economic theories have been proposed in the recent century concerning the issue of economic expansion and the factors that influence interest, with corresponding explanations that the classical economists linked the level of production to both physical capital and labor and showed that increasing both resources would contribute therefore to raising production, and accordingly, raising the levels of growth. Other economists have come up with a different explanation for the role of H in economic expansion. Indeed, this is a plausible explanation because most of the theoretical and applied studies in this field agreed on one principle: H contributes to economic expansion. In Table 1 below, the most notable studies related to the subject of interest:

Table 1. Review of the Effect of Human Capital on GDP

Authors	Title	Period & Country	method & tools	Results
(Ngepah, Saba and Mabindisa, 2021)	Human Capital and Economic Expansion in South Africa: A cross-municipality panel data analysis	South Africa 1993- 2016	generalized method of moments estimation techniques and the panel causality test	A panel causality test reveals the existence of bidirectional causality between H and total output and employment and total output. In South Africa, H positively affects both economic output and growth.
(Garzarelli and Limam, 2019)	Total factor productivity, Physical capital, and economic expansion in sub-Saharan Africa	36 sub-Saharan African (SSA) countries 1996–2014	stochastic frontier analysis	In 22 of the 36 countries, physical capital contributes more to overall growth than TFP. The result is resistant to TFP-induced effects on inputs.
(Altiner and Toktas, no date)	Relationship between H and economic expansion: An application to developing countries	32 developing countries 2000-2014	panel data analysis method independent variables	H positively affects economic growth.
(Wang et al., 2016)	Education, H, and Economic Expansion: Empirical Research	55 Countries and Regions 1960- 2009	Panel data analysis	H education has a significant positive effect on economic expansion. Higher education has a particularly positive effect on economic expansion; primary and secondary education has no significant effect.
(Derviş Boztosun, Semra Aksoylu and Zübeyde Şentürk Ulucak, 2016)	The Role of H in Economic Expansion	Turkey 1961-2011	Cointegration and causality tests	A dual causality relationship between H and economic expansion variables.
(Khan, Chaudhry and Farooq, 2020)	Effect of H on Employment and Economic Expansion in Developing Countries	developing countries 1996-2018	Panel Data analysis	H variables (life expectancy and education expenditures) are significant and serve as a growth and employment opportunity generator in developing nations.
(Jihène, 2013)	The Effect of Human Capital on Economic Expansion	Japan, South Korea, and Tunisia for 1960-2012	LUCAS model (1988) and Cointegration and Granger - Causality Tests	There is a co-integration only in the case of Japan and Korea

Table 2 (cont.). Review of the Effect of Human Capital on GDP

(Geng, 2022)	The Relationship between H and Economic. Growth Beyond Logarithmic Production Function	China 2003-2016	Solow model	After 2013, growth rates in China ranged within 10% due to the new approach, "The New Vision of Chinese People - H".
(Affandi, Anugrah and Bary, 2019)	H and economic expansion across regions	Indonesia 1985–2014	Panel model analysis	The independent variables have a significant and positive effect on economic expansion.
(Intisar et al., 2020)	Effect of Trade Openness and H on Economic Expansion	19 Asian countries 1985-2017	FMOLS and DOLS models	Trade openness and H have a significant and positive association, whereas labor force participation has a negative effect on economic expansion in Southern Asia.

Source: prepared by the researcher using previous data

By reviewing most of the previous studies on the relationship of interest or the effect of H on economic expansion, expressed in terms of domestic product, it is revealed that the studies agreed on the existence of a positive impact, relying on the internal growth models that developed in the eighties and contributed to reviving the Growth Theory. The models are related to knowledge and based on the stock of ideas and H. Therefore, growth becomes a cumulative process (Gil Ospina, 2021) through the Romer model (Paul M. Romer, 1990), which considers that the technical progress resulting from the production of ideas by researchers under the profit motive generates an effect of savings and an increasing rate of return. Likewise, the LUCAS model (Aulin, 1996) is the first to make H an element of economic progress as a basic engine of growth. For the Rebelo model (Rebelo, 1991), the model stipulated the integration of H (knowledge).

2. An Overview of The South African Economy

Geographical location

Southern Africa is located in the southernmost region of the continent of Africa, along both the Indian Ocean and the South Atlantic Ocean. It borders Namibia, Botswana, Mozambique, and Zimbabwe to the north. South Africa also surrounds Lesotho and nearly surrounds Eswatini (Swaziland).

Gross Domestic Product (GDP)

South Africa is second in Africa in terms of GDP (Figure 1) after Nigeria, reaching US$ 386.73 trillion in 2021. In parallel, South Africa had about 60 million people in 2021.

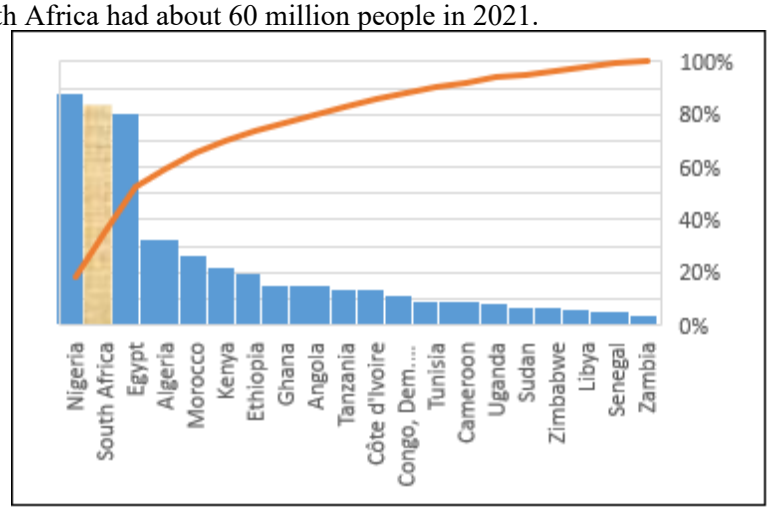

Figure 1. Ranking of African countries in terms of GDP (US $ Trillion)

Source: prepared by the researcher relying on (Africa: GDP by country 2021, Statista, no date).

Fortunes

South Africa has long been known for its vast mineral fortunes of diamonds, gold, antimony, asbestos, chromite, coal, iron ore, copper and uranium. Everything is available in the country except oil.

Workforce

For the workforce in South Africa, the country's workforce relied on dividing the population into groups, where the whites have high-earning occupations and take over crafts, administrative, executive, professional and technical occupations that require high skill. As for non-whites, they work in high-earning occupations that do not require special skills, such as handicrafts, industry, mining and agriculture.

3. Econometric Study

Depending on the theoretical framework and previous studies of the effect of H on GDP in South Africa during the period 2000-2021, a set of independent variables were added, represented by Physical Capital and Labor. At that point, it was meant to project the theoretical study on the applied aspect by addressing three (03) main parts, namely:

- Defining the variables;
- Testing stationarity and stability with ADF and Phillips-Perron Test; and
- ARDL bounds testing approach; and
- Examining the effect of the independent variables on GDP per capita growth rate in South Africa using the ARDL cointegration technique.

3.1. Study model and variables

This study uses the ARDL cointegration (ARDL-CI) technique to examine the extent to which there is a long-term complementary relationship between the variables and the ARDL- Error Correction Model (ARDL-ECM) technique to test the short-term dynamics. The ARDL model was used in this study as it helps in studying the effect of the independent variables on the dependent variable during the study period and the effects of variable time lag. The autoregressive distributed lag (ARDL) model combines an autoregressive AR-based model with a distributed lag (DL). The good advantage of the model is that it is an unbiased and effective model because of its feasible use with small samples. It offers the possibility to estimate the short-term and long-term relationships in the same time period.

In order to study the effect of H on economic expansion in South Africa during the period 2000-2021, an empirical model used in (Xu and Li, 2020), (Suryaning Bawono, 2021), (Yu and Liu, 2021) was applied which the researchers relied on an empirical model consisting mainly of GDP per capita as a dependent variable and each of H as well as L (number of workers) as independent variables (Cf. Table 3). Hence, the model adopted herein is the same one which the aforementioned studies used, with a slight change in measuring H, so that we will rely on Education Spending as a percentage of GDP over the period 2000-2021 instead of the average number of years of schooling in South Africa population.

Based on the previous, the model used in this study will be as follows:

$$\boldsymbol{GDPH} = (\boldsymbol{H}, \boldsymbol{K}, \boldsymbol{L}) \quad (1)$$

After converting the variables into logarithms in order to give more homogeneity to the data due to the difference in the unit of measurement, equation (1) takes the form:

$$lnGDPH_t = a_0 + a_1 lnH_t + a_2 lnK_t + a_3 lnL_t + u_t \quad (2)$$

Where,

u_t Is the error, a_0 is the constant, and a_1, a_2, and a_3Represent the coefficients of the variables.

The model (M. Hashem Pesaran, Yongcheol Shin and Richard J. Smith, 2001) used in this study is written in the form:

$$\Delta lnGDPH_t = a_0 + \sum_{i=1}^{p} \beta_i \ \Delta lnGDPH_{t-1} + \sum_{i=1}^{p} \delta_i \ \Delta lnH_{t-1}$$
$$+ \sum_{i=1}^{p} \gamma_i \ \Delta lnK_{t-1} + \sum_{i=1}^{p} \varphi_i \ \Delta lnL_{t-1}$$
$$+ \sum_{i=1}^{p} \lambda_{lnGDPH} \ \Delta lnGDPH_{t-1} + \sum_{i=1}^{p} \lambda_{lnH} \ \Delta lnH_{t-1}$$
$$+ \sum_{i=1}^{p} \lambda_{lnK} \ \Delta lnK_{t-1} + \sum_{i=1}^{p} \lambda_{lnL} \ \Delta lnL_{t-1} + \varepsilon_t \quad (3)$$

Where,

$\boldsymbol{\beta_i}, \boldsymbol{\delta_i}, \boldsymbol{\gamma_i}, \boldsymbol{\varphi_i}$ Represent the constant coefficients and $\boldsymbol{\lambda_{lnGDPH}}, \boldsymbol{\lambda_{lnH}}, \boldsymbol{\lambda_{lnK}}, \boldsymbol{\lambda_{lnL}}$ Represent the long-run coefficients.

In the short run, the equation can be estimated from the form:

$$\boldsymbol{\Delta lnGDPH_t} = a_0 + \sum_{i=1}^{p} \beta_i \ \Delta lnGDPH_{t-1} + \sum_{i=1}^{p} \delta_i \ \Delta lnH_{t-1}$$
$$+ \sum_{i=1}^{p} \gamma_i \ \Delta lnK_{t-1} + \sum_{i=1}^{p} \varphi_i \ \Delta lnL_{t-1} + \lambda_{ECM} ECM_{t-1} + \varepsilon_t \quad (4)$$

Where ECM is the error correction coefficient

The variables in equation (1) are defined in Table 3.

Table 3. Definition of study variables

Code	Variable	Unit of Measurement
GDPH	Per capita GDP	GDP per capita ($ US constants of 2015)
K	Physical capital as a percentage of GDP	Gross fixed capital formation (% of GDP)
H	Human Capital	Public spending on education, total (% of GDP)
L	Total number of workers	Labor force participation rate, total (% of total population ages 15+), 'The labor force participation rate is defined as "the proportion of the population aged 15 and older who is economically active: all people who supply labor for the production of economic goods and services during a given period."

Source: prepared by the researcher**.**

3.2. Descriptive analysis of the study variables

In order to study the evolution of the study variables during the examined period, Table 4 demonstrates the descriptive analysis of the variables to address some of the statistical indicators of the model, such as; maximum and minimum values, mean, median, standard deviation and normal probability distribution to centre a variable around its mean.

Table 4. Descriptive statistics for the study variables

	GDPH	H	K	L
Mean	5795.531	5.148072	17.00562	54.65050
Median	5986.199	5.211975	16.96040	55.21500
Maximum	6263.104	6.604660	21.28725	56.93800
Minimum	4735.666	4.352100	12.40005	50.55000
Std. Dev.	513.5307	0.636687	2.196357	1.792338
Skewness	-0.947032	0.488521	-0.360307	-0.621749
Kurtosis	2.423374	2.397320	2.711075	2.319779
Jarque-Bera	3.593313	1.208017	0.552531	1.841573
Probability	0.165852	0.546616	0.758611	0.398206
Sum	127501.7	113.2576	374.1237	1202.311
Sum Sq. Dev.	5537989.	8.512768	101.3037	67.46201
Observations	22	22	22	22

Source: Prepared by the researcher using EViews 10.

Table 3 shows South Africa's GDP per capita amounted to US$ 6263.104 trillion in 2013, while the lowest value amounted to US$ 4735.666 trillion in 2000. This is due to the removal of economic sanctions on the

country in 1996. South Africa's GDP doubled to reach US$ 4735.66 trillion in 2013, as the South African economy is one of the most industrialized, developed and diversified economies on the African continent. As it is clear from Fig. 3, there is a significant difference in the total GDP per capita between Algeria and South Africa. In 2021, for instance, the GDP per capita of South Africa amounted to US$ 353.26 trillion, while in Algeria, the GDP per capita amounted to US $ 174.2 trillion (about half). This indicates the great development of South Africa and its position on the African continent.

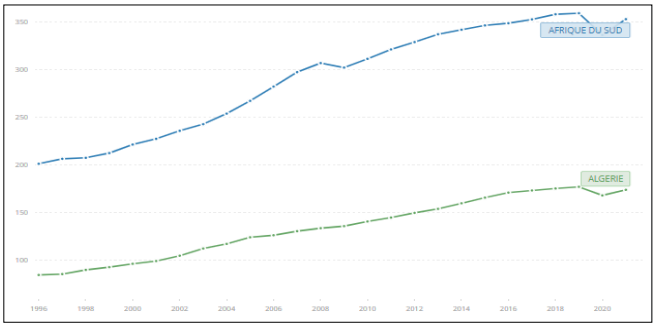

Figure 2. Evolution of GDP per capita in Algeria compared to South Africa

Source: (PIB ($ US constants de 2015) - South Africa, Algeria | Data, no date).

For H, which is expressed in the amount of education spending (% of GDP), it reached 6.6 % of GDP in 2021, after it was 4.90% of GDP in 2000, which indicates an increase in education spending as the artery of technology and the backbone of development in any economy;

Physical capital K expressed as a percentage of GDP, also recorded growth from 2000 to 2018 with values ranging from 15.06% to 16.18%, respectively, and then recorded a decrease after that, reaching 12.79% in 2021;

The number of workers in relation to the total population 'L' recorded a variation in the development rates, reaching a value of 52.87% in 2021.

All the variables follow a normal distribution, where the Jarque-Bera (JB) test registers a probability of 0.00 < 0.05;

The number of study variables is n=22.

3.3. Matrix of correlation between variables

The matrix of correlation aims to give an initial view of the nature of the correlation between the independent variables and the dependent variable, as shown in Table 5 below:

Table 5. Matrix of correlation between variables

	LNGDPH	LNHC	LNK	LNL
LNGDPH	1	0.5451	0.4552	-0.5733
LNHC	0.5451	1	-0.4168	-0.6728
LNK	0.4552	-0.4168	1	0.07463
LNL	-0.5733	-0.6728	0.0746	1

Source: prepared by the researcher using EViews 10.

From Table 5, it is clear that H has a significant positive correlation with GDP per capita by 54.51%. Also, physical capital K has a significant positive correlation with a rate of 45.52%, while the number of workers 'L' has a statistically significant negative correlation with GDP per capita of 57.33%.

These remain the preliminary data pertaining to the effect of each independent variable (H, physical capital K and labor force L) on the dependent variable GDP, while the real results will be addressed by estimating the empirical model.

3.4. Stationarity study of the variables

In this section, the study checks the variables (in)stationarity to avoid the false discovery rate (FDR) regression, as it leads to good results concerning the t-test, F-test, and r2.

The ADF unit root test (Amassoma, Sunday and Onyedikachi, 2018) was performed using EViews to test the stationarity.

Table 6. Stationarity test

			LNGDPH	LNHC	LNK	LNL
ADF test	Level	T-Stat	-2.6947	0.9790	-0.6941	-1.9164
		Prob	**0.0915**	**0.9946**	**0.8275**	**0.3189**
	First Diff	T-Stat	-3.3141	-3.2488	-4.3057	-5.1768
		Prob	**0.0279****	**0.0319****	**0.0035****	**0.0005****
PP test	Level	T-Stat	-2.6765	0.5790	-0.7594	-1.8731
		Prob	**0.0946**	**0.9854**	**0.8099**	**0.3375**
	First Diff	T-Stat	-3.3141	-3.2488	-4.3066	-5.1715
		Prob	**0.0279****	**0.0319****	**0.0035****	**0.0005****
Order of integration			1	1	1	1
Optimal Lag lenght[1]			1	2	1	1

(*) Significant at the 10%, (**) Significant at the 5%, (***) Significant at the 1%, (no) Not Significant

1Optimal Lag length selections follow the Akaike Information Criteria AIC

Source: prepared by the researcher using EViews 10.

When augmented Dickey-Fuller (ADF) (Dickey and Fuller, 1979) and Phillips Perron (PP) unit root testing (Phillips and Perron, 1988) methods are used. As noted from the previous table, the dependent variable LNGDPH is unstable at the level because the t-value of 2.69 is less than the c-value of 3.01 at the significance level of <0.05 (5%). Therefore, the null hypothesis H0 is accepted, which states that there is a unit root, but it becomes stationary after making the first difference (The c-value equals 3.01 less than the crit-value 3.31). All the independent variables (Human Capital H, physical capital K and labor force L) are not stationary in the level because the c-value of 3.02 is greater than the t-values 0.97, 0.69, and 1.91, and therefore the null hypothesis H0 is accepted, which states that there is a unit root. After making the first difference, the t-values 3.24, 4.30, and 5.17 become greater than the c-value of 3.02, and therefore, we reject the null hypothesis and accept the alternative hypothesis H1, which states that the variables of interest are stationary at the first difference.

3.5. Optimal lag-length Selection Criteria

After studying the stationarity of the variables and making sure that there is no stationary variable at the difference 2 (Li et al., 2022), the ARDL test is performed (Pesaran and Shin, 1998), given the fact that it is proportional to a small sample size of 22 years. But before that, an optimal deceleration period that achieves the best estimate for the model will be determined **(Figure 3).**

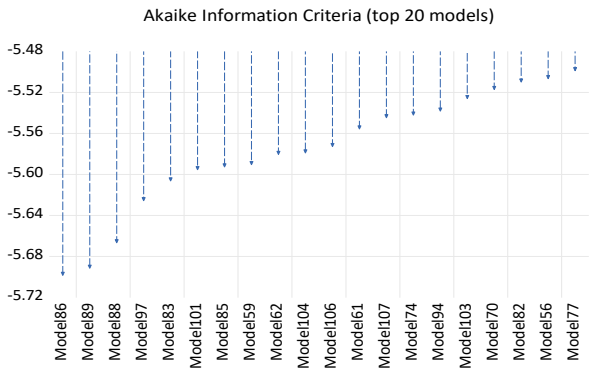

Figure 3. Optimum deceleration for ARDL model

Source: prepared by the researcher using EViews 10.

It is clear from the figure that the lowest value of the optimum deceleration degree corresponds to the ARDL (1, 2, 1, 1) model; therefore, it is the chosen model for the present study.

3.6. Bounds test

We began our investigation by using the unit root to establish the order of integration of the variables in the order of I(1) (Table 6). Although the autoregressive distributed lag model is valid for variables with various integration orders, specifically I(0) and I(1), The estimator is unable to capture the I(2) series type. After this verification, we examined for a long-run relationship between variables in linear specifications, as shown in Eqs. (3) and (4), respectively, utilizing bounds testing for the cointegration of (Pesaran, Shin and Smith, 2001) and (Shin, Yu and Greenwood-Nimmo, 2014) in an unrestricted error correction model, as shown in Eq. (3). The bounds test results are shown below in Table 7.

Table 7. Bounds test results

Model Specification	F-statistic	Lower Bound	Upper Bound	Conclusion
Linear ARDL	5.5680573	2.79	3.67	Cointegration

Source: Prepared by the researcher using EViews 10.

As results from Table 7, it is clear that F-Statistic= 5.568057 > I(1) = 3.67 at the level of significance of <0.05 (5%), indicating that there is an integration between the variables resulting in a long-run relationship (Mohd Nasir et al., 2021).

As results from **(Figure 3)** the optimal level of deceleration for the ARDL model, the results on the estimation of the ARDL model in the short-run are shown in Table 8.

The following table summarizes our operating results. The coefficients of the stationary variables have expected a positive sign and are statistically insignificant except for the variable L, and this confirms the results of previous studies on the effect of production factors; labor force, capital and H.

In comparison, the error correction coefficient (ECM) (1) = -0.083256 carries the expected negative sign and is significant at the 5% significance level, indicating a long-term equilibrium relationship. The study test also incorporates an error correction mechanism between our short-run and long-run outcome measures at a rate of 56.67%. The rebalancing time period is = 12 1/0.083256 (i.e., 12 years).

Table 8. Short-run dynamics

	Short run			
Dependent variable: D(LNGDPH)	Coefficient	St-error	T-statistic	Prob
D(LNHC)	0.029225	0.077074	0.379187	0.7118
D(LNH(-1))	0.243768	0.073003	3.339133	0.0066
D(LNK)	0.086967	0.058829	1.478318	0.1674
D(LNL)	0.655327	0.163821	4.000262	0.0021
CointEq(-1)*	-0.083256	0.013512	-6.161495	0.0001
R^2	0.983401			
F-statistic (1 , 17)	81.45980, Prob=0.000000			
DW	2.569956			
Diagnostic test				
Serial Correlation LM test	$\chi^2_{(1)}$	1.568521	Prob	0.2604
Normality	$\chi^2_{(2)}$	1.481055	Prob	0.47686
Heteroscedasticity Test ARCH	$Obs * R - squared$	4.32E-05	Prob	0.9948

Source: Prepared by the researcher using EViews 10.

Insofar as Table 8 was aligned with **Figure 3**, both can interpret the results. H positively affects the GDP per capita by 0.029 units, meaning that an increase in H by one unit leads to a rise in output by 0.029 units. The results are consistent with (Sharma, Sahni and Prof, 2015) showed that investing in education contributes to increasing worker productivity, including growth rates.

The main results herein could be completed by those of another study conducted in Nigeria (Keji, 2021) and (Curea and Ciora, 2015), who showed that there is a positively significant and long-run relationship between H and economic expansion. Both studies recommended the need to allocate additional resources for education and scientific research. According to a study conducted in Pakistan, (Akbar et al., 2022) came up with a concrete conclusion that an increase in H (education) by one unit leads to an increase in growth rate by

0.0091%. Therefore, an additional research study conducted in Nigeria by (Shobande and Asongu, 2022), found that returns on investment in education are reflected in a strong correlation between knowledge and growth and that the transformative education system in the country can provide an initial knowledge base to promote and sustain economic expansion. These results were also the top effect found in the initial study conducted by (Vittadini et al., 2022) on the same subject of interest. The authors found that increased education spending positively affects growth in Macedonia.

Moreover, physical capital has a positive and significant effect on GDP by 0.086 units, meaning that an increase in physical capital K by one unit leads to a rise in GDP per capita by 0.086 units. The present study's findings are in accordance with (Pasara and Garidzirai, 2020) and (Pegkas and Tsamadias, 2014) studies on the effect of physical capital on economic expansion in South Africa. However, the percentage revealed herein is slightly lower than what was found by (Rani and Kumar, 2019). The authors uncovered that physical capital contributes approximately 0.12 % to the GDP of South Africa and physical capital is considered one of the most important determinants of the productive capacity needed to produce goods and services and create job opportunities. These findings are consistent with those of (Amidi and Fagheh Majidi, 2020) and (Shakina Sultana Pomi, Sabrina Maria Sarkar and Bablu Kumar Dhar, 2021) in so far as there is a positive and significant effect of physical capital on economic expansion. Further, the number of workers in relation to the total population also positively affects GDP per capita by 0.65 units, meaning that an increase in L by one unit contributes to a rise in GDP per capita. The same results were stated by (Hassan, Mahmood and Javaid, 2022), which confirmed a positive and significant effect of L on Economic expansion in the short and long run in France and Finland. (Ali, 2022) went further and proved in a study he published in 2022 that the availability of physical capital and an active labor force has a two-way causal relationship with economic expansion.

Additionally, it can be concluded by observing the coefficients in the results demonstrated in Table 9 that labor coefficient L is the largest (0.65), followed by physical capital coefficient LNK (0.086), and the least is H LNH (0.029). This indicates that H (qualified labor force) does not play an important role in increasing the per capita GDP in South Africa compared to the labor force because of its large size compared to the qualified labor force. Added to that, it can be noticed from the table of results (Cf. Table 8) that the correlation coefficient is 0.98, which indicates that the independent variables explain the dependent variable by 98%. The value of DW = 2.56 suggests no autocorrelation, and JB=0,47 (>0.05) test results showed that none of the model residuals followed a normal distribution.

However, besides what is already mentioned, there is a long-run relationship between H and economic expansion. These findings are consistent with those reached (Bhattacharyya, 2019) and (Zoran Tomić, 2017). The results of Table 9 confirm what is known based on other data sources, H (expressed by education spending) and physical capital contribute inversely to the GDP per capita of South Africa. These results are in accordance with those reached by (Benhabib and Spiegel, 1994). The authors measured the effect of H investment on promoting economic expansion and found a barely negative correlation between both variables. (Quiggin, 1999) also confirmed that education does not offer monetary or other forms of economic benefits, leading to a decline in economic expansion. (Devarajan, Swaroop and Zou, 1996) found that education spending does not contribute to economic growth. Accordingly, based on the evidence provided by economists such as (Benhabib and Spiegel, 1994) and (Quiggin, 1999), some governments decided to cut education spending to balance their budgets.

Table 9 below illustrates data related to long-run dynamics.

Table 9. Long-run dynamics

	Long run			
Dependent variable: LNGDPH	Coefficient	St-error	T-statistic	Prob
LNHC	-1.217973	4.463398	-0.272880	0.7900
LNK	-0.175280	1.672060	-0.104829	0.9184
LNL	0.865683	2.321533	0.372893	0.7163
C	7.799799	15.44738	0.504927	0.6236

Source: Prepared by the researcher using EViews 10.

As caring about competencies without other groups (unqualified labor force) would contribute to increasing unemployment among groups, especially as they represent the majority of the labor force, (Halstein, 2021)

conducted a study on skilled labor emigration in South Africa – exploring the long-term implications. Using a recursive dynamic general equilibrium framework, the author simulates the long-term implications of skilled labor emigration in South Africa. Halstein's results reveal that interest in employing skilled labor emigration to South Africa contributed to increasing unemployment rates and enhancing the welfare of indigenous workers in the country. The key implication is that a skill-support policy should include improving skills for all three labor categories. Similarly, De (De Jong and Steinmetz, 2004), in their study, explained the need for developing the skills of the indigenous labor of South Africa so that they have the largest contribution to the country's production compared to other skilled labor emigrants to South Africa. It is believed that the findings dovetail with a study carried out (Obialor, 2017) that examined the effect of government H investment on economic expansion in three Sub-Saharan African countries. The study's objective was to analyze the growth effect of three government H investment health, education and literacy rate variables on the economies between 1980 and 2013. For the best examination of the relationship among investment in health, education, literacy and economic expansion, he employed VECM and reached a result of a positive association among the variables and added that a country with more commitments to health, education, literacy advancement tends to do better than others with lesser commitments.

Lastly, and for the forecast of structural changes, it was decided to test for structural change using the CUSUM and CUSUM of squares tests **(Figure 4).** These two tests indicate any structural change in the data and the stability of long-term features with short-run parameters (Abbasi et al., 2021). The condition for achieving structural stability is determining the confinement graphs of the two dynamic tests within the domain at the 5% significance level.

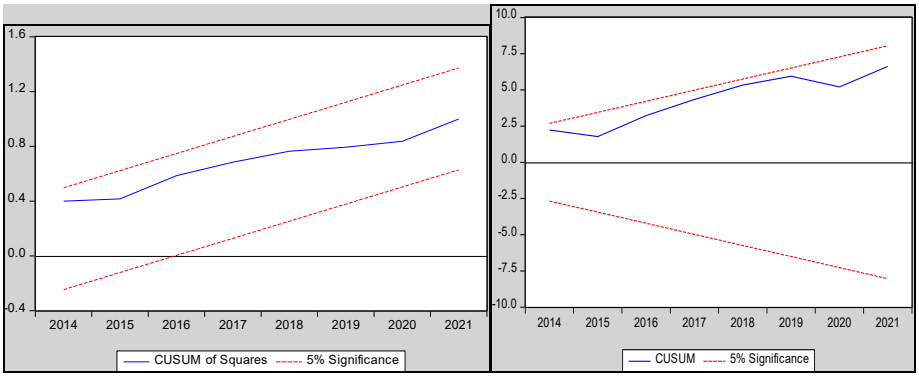

Figure 3. The plot of cumulative sum and the sum of squares of the recursive residuals
Source: Prepared by the researcher using EViews 10.

As shown in **(Figure 4)** it is stated that if the CUSUM and CUSUMSQ statistics are within the critical range of the 5% level of significance, we can't reject the null hypothesis, and the regression will be called stable.

Conclusion

Human capital has received great attention of many economists by studying its influence on economic growth in the long term, as economists realized that the human element represents an important component of wealth.

The present study examines the effect of H, expressed by education spending, on GDP per capita in South Africa during 2000-2021, using the autoregressive distributed lag (ARDL) model and both labor and physical capital as the explanatory variables. The present study's findings uncover a long-run equilibrium relationship in addition to a positive effect of the variables of interest on GDP in the short run (in favour of physical capital). Otherwise, the study concluded that there is a long-run equilibrium relationship between H and growth, where H (expressed by education spending) contributes negatively to the GDP per capita of South Africa, meaning that education spending does not contribute to economic expansion in the long run. Therefore, the study has proven that a country must pay attention to developing the skills of indigenous labor so that they have the largest contribution to the country's production compared to other skilled labor emigration to South Africa. Moreover, the study urges the need for more commitments to health, education, and literacy advancement to do better for improving the indigenous workers' health and well-being and preventing degradation, which was the main reason for the skilled labor emigration from South Africa in the previous years. Thus, a better understanding of the dynamics was needed to adopt tremendous immigration laws and

skill-support policies to combat discrimination against the labor force that may have a vaguely positive and/or adversely negative effect on the total GDP per capita growth of South Africa.

The study recommended the necessity of supporting local skills that must include enhancing skills for all three categories of workers (skilled, semi-skilled and unskilled). This provides a good starting point for discussion and further research on policy measures to turn brain drain into brain gain.

Acknowledgment

This article has been translated, proofread and reviewed by Sara OUENNAS the representative of Trans-Office; Professional Translation Services - Annaba, Algeria.

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