Poverty, Education, Income Inequality Nexus in South Africa: A Multivariate Approach

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Abstract. This study investigated the causal relationship between poverty, income inequality, and education in South Africa, using annual data from 1990 to 2020. The main objective of the study was to establish the causal relationship between the three variables to provide insight to policymakers. Two poverty proxies were used, namely household consumption expenditure and infant mortality rate. Using the autoregressive distributed lag (ARDL) approach to cointegration and error correction model (ECM)-based causality analysis, the study found the causality between poverty, income inequality, and education to vary depending on the poverty proxy used. Based on these findings, it is recommended that South Africa should continue with a three-pronged policy focus on poverty, inequality, and quality education.

Keywords: inequality, Human Development Index, household consumption expenditure, autoregressive distributed lag, South Africa, poverty, education

JEL Classification: I24; I32; I38; C32

1. Introduction

South Africa has battled with poverty and inequality since its declaration of independence (Leibbrandt, Wegner, and Finn, 2011). The past political regime that favoured certain races to others contributed largely to the currently experienced inequality. Though the government has put in place programmes to redress these challenges, poverty levels and inequality have not decreased as expected (Leibbrandt et al., 2011). The government has put in place social safety nets aimed at redistributing wealth to the poor and closing the inequality gap. Several studies have examined how poverty can be alleviated in South Africa using different macroeconomic variables such as remittances (Gupta, Pattilo, and Wagh, 2009;

Nahar and Rashad, 2017; Tsaurai, 2018), foreign aid (Masud and Yontcheva, 2005; Calderon, Chong, and Gradstein, 2006), and economic growth (see Adam Jr, 2003; Zhu, Bashir, and Marie, 2022). These studies found inconclusive results, where the country of study, methodology, and measures of poverty were identified as some of the factors causing varied findings. Separate studies have also investigated the link between poverty alleviation and inequality (Chaudhary et al., 2010; Awan et al., 2011). Despite the findings in the existing literature, the fact remains that more must be done to find a lasting solution to inequality and poverty in South Africa. According to a study done by Tregenna and Tsela (2012), South Africa has a high level of inequality. The main source of inequality was found to be earnings, which require intentional government policies to redress.

This study adds value to the current literature by examining the causal relationship between education, inequality, poverty, and unemployment using the Autoregressive Distributed Lag approach to cointegration and ECM-based Granger causality approach. The ARDL approach was selected due to its numerous advantages. Among the few studies that explored the relationship between poverty and inequality, panel data was used. Given the multidimensional aspects of poverty measurement, this study employs household consumption expenditure and infant mortality rate as measures of income and health poverty respectively. This study departs from these studies by using annual time series data for South Africa. This allows an analysis of the causal relationship specifically related to South Africa without pooling data from different countries together. Although statistical techniques are used in panel data analysis to take care of in-group and between-group variation, it is expected that results from this study will be more informative in a poverty–inequality–education nexus.

According to Leibbrandt et al. (2011), South Africa continues to battle with the challenge of rising income inequality since its declaration of independence. Even National Development Plan 2030 highlights unemployment growth, poverty, and inequality as the major challenges facing the country (National Planning Commission, 2022). These factors make South Africa a suitable African country to analyse the relationship between poverty, inequality, and education. The results of this study will contribute to policy formulation aligned with poverty alleviation and redress high inequality in South Africa. This is even more important given South Africa's commitment to the Sustainable Development Goals (SDGs) on poverty alleviation and inequality.

The rest of the study is divided as follows: Section 2 outlines the literature review and is divided into subsection 2.1, which covers country-based literature, and subsection 2.2 touching on a review of related literature. Section 3 highlights the estimation techniques, Section 4 discusses the data analysis and the discussion of results, while Section 5 concludes the chapter.

2. Literature Review

2.1. Poverty, Inequality, and Education Dynamics in South Africa

For decades, the eradication of poverty has been a global goal expressed in the Millennium Development Goals and SDGs. Under the SDGs, poverty reduction is captured in Goal 1: End poverty in all its forms everywhere (Statistics South Africa [StatsSA], 2017). South Africa is among the signatories to the SDG and is expected to roll out policies that aim to meet the targets set out under Goal 1. Reducing poverty and closing inequality has been a concern for South Africa expressed in the country's economic policy documents – from the Reconstruction and Development Programme to the current National Development Plan (NDP) 2030 (StatsSA, 2018). The government's approach to poverty reduction is three-pronged. First, there is the economic empowerment of the poor through the provision of opportunities with programmes such as the public works programme, black economic empowerment, and SMME support. Second, there is a provision of basic services such as education, housing, and health to the poor. Third, there is the provision of social safety net that aims to redistribute income through several grants, namely disability, pension, foster care, care dependency, child support, and social relief (StatsSA, 2017). In March 2021 alone, R18.44 million grants were paid that benefited 11.45 million recipients (Parliament Budget Office, 2022). According to the StatsSA (2022a) analysis of the Living Conditions Survey 2014/15, approximately 49.2% of the adult population was living in poverty below the upper-bound poverty line. The provinces with the largest population living in poverty are Limpopo, Eastern Cape, KwaZulu-Natal, and Northwest (StatsSA, 2022a). *Table 1* reports poverty measured by poverty headcount and poverty severity, as well as trends in income poverty measured by poverty headcount and poverty gap.

Table 1. *Poverty headcount and poverty severity in South Africa: 1990–2020*

| Year	Poverty Gap ($2.15 per day)	Poverty Gap ($3.65 per day)	Poverty Gap ($6.85 per day)	Poverty Headcount ($2.15 per day)	Poverty Headcount ($3.65 per day)	Poverty Headcount ($6.85 per day)
1993	12	25	42.7	33.5	52.1	71.1
2000	14.3	27.7	45.7	36.8	55.4	74.3
2005	9.3	22.3	41.7	28.3	51.2	71.8
2008	5.4	15.4	32.8	18.7	39.3	62.1
2010	5.5	15.1	31.9	18	37.9	60.9
2014	6.9	16.6	33.4	20.5	40	61.6

Source: World Bank (2023)

South Africa recorded a decrease in poverty measured by poverty headcount and poverty gap across all the poverty lines from 2000 to 2010 (World Bank, 2023). However, the country experienced a surge in poverty levels across all the measures captured in *Table 1* from 2014 (World Bank, 2023). This points to a need for the government to strengthen policies aimed at poverty alleviation in South Africa incorporating the effects of external shocks to the success of the policies implemented.

Inequality is related to the difference in the share of something (income or expenditure) among persons or access to opportunities (Trapeznikova, 2019). This includes several elements such as wealth, consumption, health, education, employment, and income, among other variables. The National Development Plan acknowledges that South Africa is still a highly unequal society (National Planning Commission, 2022). This has exacerbated the severity of poverty, with most of the poor in South Africa continuously alienated from participating in economic development. This has been a challenge despite the government policy on improving access to education through some non-fee-paying institutions of learning, among other support structures. Under the NDP, South Africa aims to reduce inequality in income per capita from 0.7 to 0.6 by 2030 (StatsSA, 2017). This is in line with SDG Goal 10: Reduce Inequality within and among countries (United Nations, 2022).

Wage inequality was found to be a major source of inequality, while education was found to play an important role in bridging the inequality gap (Van der Berg, 2010). According to Keeton (2014), income inequality continues to widen due to inequalities within the workplace and a huge gap between the employed and the unemployed sitting at 32.5% in the fourth quarter of 2021 (StatsSA, 2022b). These developments are also reflected in the Gini index, which increased from 59.3% in 1993 to 63% in 2014 (World Bank, 2022). The inequality report released by Statistics South Africa jointly with the Southern Africa Labour and Development Research Unit and Agence Française de Développement indicated a fall in most inequality measures, with notable variations between provinces (StassSA, 2019).

Education, like poverty, is ingrained in the SDGs, captured under Goal 4, which calls for inclusive, quality, and equitable education that affords lifelong opportunities. This policy stance is also reflected in the Constitution, which states that every citizen has the right to education. The overarching objective of the National Education Policy Act is to make education accessible to all South Africans. Education plays a crucial role in poverty alleviation by enhancing human capital that is required in the job market. It increases the ability of the poor to earn high income and demand for their labour in the market. The ability of the poor to enhance themselves through education leads to an increase in access to social services and a better living standard. This consequently leads to poverty reduction. It is important to point out that the more educated the poor are, the more the inequality gap between the poor and the rich closes, especially in South

Africa, where income plays an important role in the livelihoods of households (Keeton, 2014). South Africa has made great strides in education, with gross secondary enrolment increasing consistently from 68% in 1990 to 103% in 2020 (World Bank, 2022). This improvement in gross enrolment was also registered in gross primary school enrolment. The figures show evidence of progress made in education although tertiary institutions have not registered high enrolment rates. *Figure 1a–b* shows the trends in the Gini coefficient, poverty captured by infant mortality rate and household consumption expenditure and education.
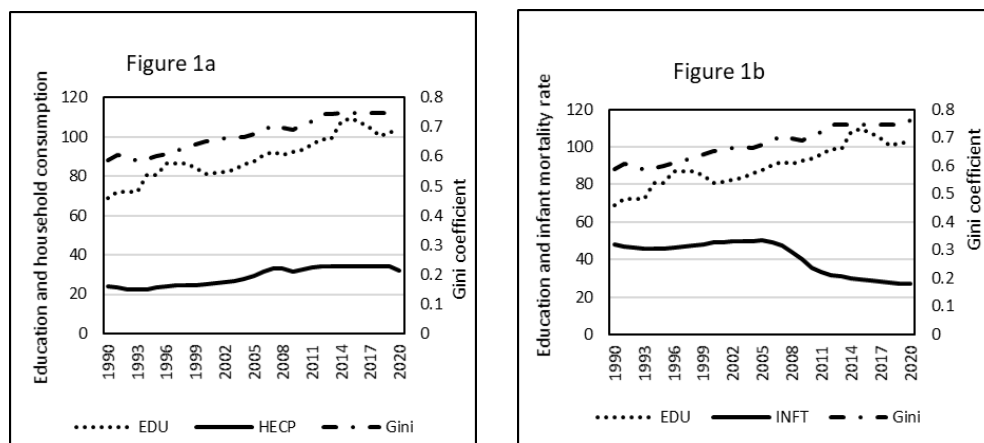
Figure 1. *Trends in poverty, inequality, and education: 1990–2020*

Figure 1 reports education, inequality measured by the Gini coefficient and poverty – captured by household consumption expenditure and infant mortality rate. South Africa experienced a steady increase in household consumption expenditure though the figures remain depressed throughout the study period (World Bank, 2023). Infant mortality rate, on the other hand, drastically decreased from 2008, a reflection of government efforts to make health accessible to everyone. Secondary school enrolments also increased during the study period, while the GINI coefficient continued to increase over the study period. The growth in the Gini coefficient reflects widening inequality in South Africa despite government effort to redress the results of the past political regime. This points to the inadequacy of policies that have been implemented to address inequality in South Africa.

2.2. Review of the Related Studies

There is still no consensus on the best measure of poverty, which is a multi-dimensional phenomenon that captures multiple facets, such as income poverty, health, and education. Some tend to prefer multidimensional measures of poverty

like the Human Development Index, while others settle for income poverty measures. There are multiple theories on poverty, among them the cultural theory of poverty and the structural theory of poverty (Jordan, 2004; Ogbeide and Agu, 2015). Cultural poverty involves poverty inherited due to a lack of resources to send children to school, access to health and the laziness to work and improve one's welfare or lack of skills that are required in the market (Jordan, 2004; Ogbeide and Agu, 2015). Structural poverty centres on the economic structure of the economy that favours those who are well off (Jordan, 2004; Ogbeide and Agu, 2015). Income inequality can be measured using multiple dimensions that include income outcomes or access outcomes. On income measures, the most common measures are the Gini index and the Lorenz curve. Income measures may be broken down further into income, wealth, and pay inequality (Trapeznikova, 2019). In this study, inequality is measured by the Gini coefficient.

Most of the studies in the literature explored the impact of education and level of income on poverty. In this section, literature on poverty, inequality, and education will be outlined. Due to a dearth of literature on the causality between the variables of interest, studies that examined the impact and causal relationship among the three variables will be reviewed.

Adeleye et al. (2020) carried out a comparative analysis of 58 sub-Saharan African countries and Latin American countries to establish if growth reduces poverty and if the interaction of economic growth and inequality alters its impact on poverty. Using data from 2000 to 2015 and pooled ordinary least squares, fixed effects and system GMM, the study found that the growth of inequality intensified poverty. Inequality was found to reduce the impact of economic growth on poverty, especially in high-income and upper-middle-income countries, but not in lower-middle and low-income countries. Khemili and Belloumi (2018) also examined the relationship between poverty and inequality using 1970 to 2013 data for Tunisia. Using ARDL and Toda and Yamamoto's modification of the Granger causality test, the study found a positive relationship between income inequality and poverty in the long run and a positive relationship between inequality and growth to poverty. In the same study, a unidirectional causality was also confirmed from economic growth to poverty.

Akanbi (2016) analysed the long-run relationship and causality between growth, poverty, and inequality using panel data for nine South African provinces from 1995 to 2012. The study found a long-run relationship between poverty and inequality and a unidirectional causal flow from income poverty to income inequality. In the same spirit, Ogbeide and Agu (2015) examined the causality between poverty and inequality in Nigeria, using the Gini coefficient as a measure of inequality and national poverty lines as a measure of poverty. A study found a bidirectional causality between poverty and inequality, a unidirectional causality from unemployment to inequality, and a unidirectional causality from life expectancy

to inequality. The study found no causality between poverty and unemployment. De Janvry and Sadoulet (1999) used data from 1970 to 1994 for 12 Latin American countries to analyse the role of aggregate income on changes in urban and rural poverty and inequality. The study found income growth to be effective in reducing poverty if educational levels are sufficiently high and the starting poverty levels are not too high. Thus, Latin American countries cannot rely on income growth to eradicate inequality.

Clentine and Garidzirai (2020) investigated the causal relationship between education, poverty, and economic growth using South African data from 1984 to 2015. Employing a trivariate Granger causality analysis, the study found that a 1% change in education minimizes poverty by 0.027%. Afzal et al. (2012) examined the relationship between education, poverty, and economic growth in Pakistan using data from 1971 to 1972 and from 2009 to 2010. Using the ARDL model, the study found that education had a positive impact on economic growth and a bidirectional causality between economic growth and education, poverty and economic growth, and poverty and education, confirming that education leads to poverty reduction; and economic growth is a necessary variable to poverty alleviation. Citak and Duffy (2020) investigated the causal relationship between education and poverty in Turkey. Using the instrumental variable estimation and two-stage least squares (2SLS) regression, the study found that the higher the education of the household head, the higher the income per capita.

Studies that have examined the impact of education on poverty confirm the mitigating effect of education on poverty. Nasution et al. (2015) investigated the impact of social capital on poverty in Indonesia and found education to play an important role in increasing the probability of social participation, which in turn reduces poverty. The same results were found by Chaudhary et al. (2010) and Awan et al. (2011) in a study on Pakistan. Naito and Nishida (2012) examined the effects of inequality on education policy and economic growth. High initial inequality was found to have a negative effect on education expenditure, which consequently reduced economic growth.

3. Estimation Techniques

This study uses the ARDL approach to cointegration and the ECM-based Granger causality test to analyse the causality between poverty, inequality, and education. The ARDL approach was developed by Pesaran and Shin (1999) and further expanded by Pesaran, Shin, and Smith (2001). The ARDL model was selected because of several advantages. The approach allows the analysis of a combination of variables integrated of different orders – variables integrated of order zero [I(0)] or integrated of order one [I(1)] (Pesaran et al., 2001; Odhiambo, 2020). However,

the approach falls away if the order of integration is greater than one. Another advantage of this approach is that the results from this approach are in short- and long-run time frames. These results are formative to policymakers, as guidance is given on short- and long-run policy focuses.

The study employs two models. Model 1 captures poverty measured by household consumption expenditure, and Model 2 captures poverty measured by infant mortality rate.

4. Variables

Poverty is captured by household consumption expenditure (HCE) and infant mortality rate (INFT), which are used as proxies for poverty capturing income poverty and health poverty respectively. Household consumption expenditure has been used in several studies as a proxy for poverty (see Musakwa and Odhiambo, 2022; Magombeyi and Odhiambo, 2017, 2018a; Kaidi et al., 2018; Rehman and Shahbaz, 2014; Ravallion, 2001). Infant mortality rate has been used in several studies to capture health poverty. Some of the studies that used infant mortality rate as a proxy for poverty include Musakwa and Odhiambo (2020), Magombeyi and Odhiambo (2018b), Abosedra et al. (2016), Van Multzahn and Durrheim (2008). Education (EDU) is captured by gross secondary enrolment, following the findings by Citak and Duffy (2020) that higher education is more important in poverty alleviation and inequality. The Gini coefficient is used to capture inequality in this study. The study added one intermittent variable, namely unemployment, to form a multivariate causality framework. *Table 2* reports variable description.

Table 2. *Variable description*

Variable	Description	Notation	Source
Poverty	Household consumption expenditure as a percentage of GDP	HCE	World Development Indicators
	Infant mortality rate	INFT	World Development Indicators
Income inequality	Gini Coefficient	INEQ	Worldwide Inequality Database
Education	Secondary school gross enrolment	EDU	World Development Indicators
Unemployment	Unemployment measured by strict unemployment definition	UNE	World Development Indicators

The study is divided into two models, where Model 1 captures household consumption expenditure as a proxy for poverty while other variables remain the same, and Model 2 captures infant mortality rate as a proxy for poverty and the rest of the variables remain unchanged.

ARDL model specification for the multicausality model is given in equations (1)–(4).

Cointegration Model (POV, EDU, INEQ, UNE):

$$\Delta POV_{mt} = \varphi_0 + \sum_{i=1}^{n} \varphi_{1i} \Delta POV_{mt-i} + \sum_{i=0}^{n} \varphi_{2i} \Delta EDU_{t-i} + \sum_{i=0}^{n} \varphi_{3i} \Delta INEQ_{t-i} + \sum_{i=0}^{n} \varphi_{4i} \Delta UNE_{t-i}$$
$$+ \beta_1 POV_{mt-1} + \beta_2 EDU_{t-1} + \beta_3 INEQ + \beta_4 UNE_{t-1} + \mu_{1t} \tag{1}$$

$$\Delta EDU_t = \varphi_0 + \sum_{i=0}^{n} \varphi_{1i} \Delta POV_{mt-i} + \sum_{i=1}^{n} \varphi_{2i} \Delta EDU_{t-i} + \sum_{i=0}^{n} \varphi_{3i} \Delta INEQ_{t-i} + \sum_{i=0}^{n} \varphi_{4i} \Delta UNE_{t-i} + \beta_1 POV_{mt-1}$$
$$+ \beta_2 EDU_{t-1} + \beta_3 INEQ + \beta_4 UNE_{t-1} + \mu_{2t} \tag{2}$$

$$\Delta INEQ_t = \varphi_0 + \sum_{i=0}^{n} \varphi_{1i} \Delta POV_{mt-i} + \sum_{i=0}^{n} \varphi_{2i} \Delta EDU_{t-i} + \sum_{i=1}^{n} \varphi_{3i} \Delta INEQ_{t-i} + \sum_{i=0}^{n} \varphi_{4i} \Delta UNEu_{t-i} + \beta_1 POV_{mt}$$
$$+ \beta_2 EDU_{t-1} + \beta_3 INEQ + \beta_4 UNE_{t-1} + \mu_{3t} \tag{3}$$

$$UNE_t = \varphi_0 + \sum_{i=0}^{n} \varphi_{1i} \Delta POV_{mt-i} + \sum_{i=0}^{n} \varphi_{2i} \Delta EDU_{t-i} + \sum_{i=0}^{n} \varphi_{3i} \Delta INEQ_{t-i} + \sum_{i=1}^{n} \varphi_{4i} \Delta UNEu_{t-i} + \beta_1 POV_{mt-1}$$
$$+ \beta_2 EDU_{t-1} + \beta_3 INEQ + \beta_4 UNE_{t-1} + \mu_{5t} \tag{4}$$

POV_m is measured by household consumption expenditure (HCE) in Model 1 and infant mortality rate per 1,000 live births (INFT) in Model 2; the rest of the variables remain the same in each model; EDU = education measured by gross secondary school enrolment; INEQ = inequality measured by the Gini coefficient; UNE = unemployment measured by the strict definition of unemployment; φ_0 is a constant; $\varphi_1 - \varphi_4$; $\beta_1 - \beta_4$ are coefficients; $\mu_1 - \mu_4$ are error terms.

The cointegration test determines if variables included in a model have a long-run relationship. Each variable enters the equation as a dependent variable. For those equations where cointegration is confirmed, long-run causality is captured by the error correction term, while short-run causality is captured by the F-statistics in each equation. For those models where long-run relationships could not be confirmed, only the F-statistic is used to determine short-run causality. The Granger causality models for Equations (1)–(4) are specified in Equations (5)–(8) as follows:

$$POV_{mt} = \varphi_0 + \sum_{i=1}^{n} \varphi_{1i} \Delta POV_{mt-i} + \sum_{i=1}^{n} \varphi_{2i} \Delta EDU_{t-i} + \sum_{i=1}^{n} \varphi_{3i} \Delta INEQ_{t-i} + \sum_{i=1}^{n} \varphi_{4i} \Delta UNE_{t-i} + \vartheta_1 ECM_{t-1}$$
$$+ \mu_{1t} \tag{5}$$

$$EDU_t = \varphi_0 + \sum_{i=1}^{n} \varphi_{1i} \Delta POV_{mt-i} + \sum_{i=1}^{n} \varphi_{2i} \Delta EDU_{t-i} + \sum_{i=1}^{n} \varphi_{3i} \Delta INEQ_{t-i} + \sum_{i=1}^{n} \varphi_{4i} \Delta UNE_{t-i} + \vartheta_2 ECM_{t-1}$$
$$+ \mu_{2t} \tag{6}$$

$$INEQ_t = \varphi_0 + \sum_{i=1}^{n} \varphi_{1i} \Delta POV_{mt-i} + \sum_{i=1}^{n} \varphi_{2i} \Delta EDU_{t-i} + \sum_{i=1}^{n} \varphi_{3i} \Delta INEQ_{t-i} + \sum_{i=1}^{n} \varphi_{4i} \Delta UNE_{t-i} + \vartheta_3 ECM_{t-1}$$
$$+ \mu_{3t} \tag{7}$$

$$UNE_t = \varphi_0 + \sum_{i=1}^{n} \varphi_{1i} \Delta POV_{mt-i} + \sum_{i=1}^{n} \varphi_{2i} \Delta EDU_{t-i} + \sum_{i=1}^{n} \varphi_{3i} \Delta INEQ_{t-i} + \sum_{i=1}^{n} \varphi_{4i} \Delta UNE_{t-i} + \vartheta_4 ECM_{t-1}$$
$$+ \mu_{5t} \tag{8}$$

5. Data Sources

The study used annual time series data from 1990 to 2020 to examine the causality between poverty, education, and inequality in South Africa. Data on education (EDU), poverty (POV) proxied by household consumption expenditure per capita (HCE), infant mortality rate (INFT), and unemployment (UNE) were obtained from the World Development Indicators database. The Gini coefficient was retrieved from the Worldwide Inequality Database.

6. Empirical Results

A test for unit roots was done on all the variables in Model 1 and Model 2 to avoid spurious regression associated with non-stationary variables. Stationarity is when the mean, covariance, and variance of variables specified in a model remain constant over time. It is also important to confirm the stationarity of the variables when using the ARDL approach, although it is not essential. If any of the variables are integrated of order two or higher, the ARDL approach falls away. However, a combination of variables integrated with order 0 and order 1 are acceptable when using this approach. Unit root results are reported in *Table 3*.

Table 3. *Stationarity results*

Variable	Dickey–Fuller Generalized Least Square (DF-GLS)				Phillips and Perron (PP) Root Test			
	Variables in Levels		Variables in First Difference		Variables in Levels		Variables in First Difference	
	Without Trend	With Trend	Without Trend	With Trend	Without Trend	With Trend	Without Trend	With Trend
HCE	-0.523	-1.781	-2.748**	-3.123*	-0.660	-1.350	-3.621**	-3.504*
INFT	-0.623	-1.881	-2.746**	-2.895*	-0.660	-1.350	-3.621**	-3.504*
INEQ	0,3669	-2.504	-4.215***	-4.808***	-0.431	-2.380	-5.090***	-4.829***
EDU	-0.4735	-2.320	-4.825***	-5.094***	-1.554	-2.205	-4.978***	-4.960***
UNE	-1.276	-1.939	-4.192***	-4.232***	-1.445	-1.472	-4.063***	-4.022**

Notes: *, **, and *** denote stationarity at 10%, 5%, and 1% significance levels respectively.

Results presented in *Table 3* show that all the variables in Model 1 and Model 2 are stationary in first difference. The next step is to check for the long-run relationship among the variables in Model 1 and Model 2. Cointegration results are presented in *Table 4*.

Table 4. *Cointegration results*

Dependent Variable	Function	F-Statistic	Cointegration Status
	Panel A: Model 1		
HEC	F(HCE|INEQ,UNE,EDU)	9,2170***	Cointegrated
INEQ	F(INEQ|HCE,UNE,EDU)	3.5138	Not Cointegrated
EDU	F(EDU|HCE,UNE,INEQ)	1,3195	Not cointegrated
UNE	F(UNE|INEQ,HCE,EDU)	4.3216**	Cointegrated
	Panel B: Model 2		
INFT	F(INFT|INEQ,UNE,EDU)	4.961**	Cointegrated
INEQ	F(INEQ|INFT,UNE,EDU)	2.601	Not Cointegrated
EDU	F(EDU|INFT,UNE,INEQ)	2.408	Not cointegrated
UNE	F(UNE|INEQ,INFT,EDU)	1.126	Not Cointegrated
	Asymptotic Critical Values (unrestricted intercept and no trend)		
Critical Values	1%	5%	10%
	I (0)　　　　I (1)	I (0)　　　　I (1)	I (0)　　　　I (1)
	3.74　　　　5.06	2.86　　　　4.01	2.45　　　　3.52

Notes: *, **, and *** denote stationarity at 10%, 5%, and 1% significance levels respectively.

Results reported in *Table 4* confirm cointegration in some of the functions in Models 1 and 2. For Model 1, the HEC and UNE functions were found to be cointegrated at 1% and 5% level of significance, respectively, while in Model 2 the INFT function was found to be cointegrated at 5% level of significance. To proceed with the analysis, long-run and short causality relationships are tested

for those functions where cointegration was confirmed. In those functions where no cointegration was confirmed, only the short-run causality is tested. Causality results are reported in *Table 5*.

Table 5. *ECM-based causality results for models 1 and 2*

Panel 1	Model 1: Household Consumption Expenditure as a Measure of Poverty				
	ECM t-statistics				ECM (t-stat)
	ΔHCE	ΔINEQ	ΔEDU	ΔUNE	
ΔHCE	-	2.451 [0.108]	0.133 [0.719]	2.616* [0.095]	-0.589** [-2.748]
ΔINEQ	10.507*** [0.002]	-	1.514 [0.230]	7.195** [0.013]	-
ΔEDU	3.878* [0.077]	5.432** [0.042]	-	2.404 [0.141]	-
ΔUNE	9.570*** [0.002]	8.660*** [0.007]	0.356 [0.556]	-	-0.393*** [-4.866]
Panel 2	Model 2: Infant Mortality Rate as a Measure of Poverty				
	ΔINFT	ΔINEQ	ΔEDU	ΔUNE	ECM (t-stat)
ΔINFT	-	6.187* [0.020]	6.482** [0.018]	5.568** [0.095]	-0.091*** [-5.396]
ΔINEQ	0.541 [0.469]	-	5.114** [0.026]	0.377 [0.545]	-
ΔEDU	4.351* [0.049]	5.309** [0.042]	-	0.215 [0.648]	-

Notes: *, **, and *** denote stationarity at 10%, 5%, and 1% significance levels respectively.

The results reported in *Table 5*, Panel 1, where household consumption expenditure was used as a poverty measure, a unidirectional causal flow from poverty to education was confirmed in the short run at 5% level of significance. Results confirmed the importance of household consumption expenditure on the level of education. The higher the household consumption expenditure, the higher the access to education. In other words, the lower the poverty levels, the more likely households can invest in human capital, which is important in getting better-paying jobs (Cingano, 2014; Keeton, 2014; Van der Berg, 2010). A distinct unidirectional causal flow from household consumption expenditure to inequality was confirmed in the short run at 1% level of significance. This finding confirms the importance of the level of household consumption expenditure on the inequality gap. Lower household consumption expenditure fosters the widening of the income gap, while the opposite is true with high household consumption expenditure. Thus, a low

household consumption expenditure worsens inequality, as more households lack the capability to access social services that can change their living standards. The study also found a unidirectional causal flow from inequality to education in the short run. The study confirmed the importance of the negative influence inequality has on education level and quality. It is not surprising that South Africa sits with high structural unemployment and a mismatch between what is covered in the education curriculum and what the market requires.

When poverty was measured by infant mortality rate, a bidirectional causality was found between poverty and education in the short run and a unidirectional causality from education to inequality in the long run. According to the findings of the study, poverty causes lower education, which in turn worsens poverty. This finding is consistent with the phenomenon that poor people in South Africa are trapped in a vicious cycle of poverty because the lack of education that reduces chances of getting better-paying jobs. Afzal et al. (2012) found the same results in a study on Pakistan. The study also found a unidirectional causal flow from inequality to poverty in both the long run and the short run. Results confirm the challenge that South Africa is facing due to high inequality and consequently high poverty levels. The government needs to solve high poverty levels by also focusing on closing the inequality gap, where the poor get poorer, and the rich get richer. Another bidirectional causality was found between inequality and education in the short run at 1% level of significance. Accordingly, poor families have no access to quality education, as they are unable to pay for the service, thus trapping generations in deprivation and poverty. These results are not unique to South Africa alone, as Akanbi (2016) and Ogbeide and Agu (2015) found the same results in separate studies on the South African provinces and Nigeria respectively.

Other results reported in *Table 5*, Panel 1, where household consumption expenditure was used as a measure of poverty, confirmed: i) a bidirectional causality between unemployment and inequality in the short run and a unidirectional causal flow from income inequality to unemployment in the long run; ii) a bidirectional causality between poverty and unemployment in the short run and the long run; iii) no causality between unemployment and education. Results reported in *Table 5*, Panel 2, where infant mortality rate was used as a measure of poverty confirm: i) a unidirectional causal flow from inequality to unemployment in the short run; ii) a bidirectional causality between unemployment and poverty in the short run and a unidirectional causal flow from unemployment to poverty in the long run; iii) a unidirectional causal flow from education to unemployment. This finding emphasizes the importance of education in lifting most South African population from poverty and dependence on government, where secure, better-paying jobs imply high income to cater for social services or opening businesses.

The government needs a three-pronged policy that tackles education, poverty, and inequality to reduce poverty and inequality levels in South Africa. This

intervention provides a permanent solution to poverty and helps to eradicate the main cause of poverty and not just its symptoms.

7. Conclusions

This study investigated the nexus between poverty, inequality, and education in South Africa, using annual data from 1990 to 2020. Using two proxies of poverty, the household consumption expenditure and infant mortality rate, it succeeded in capturing income and health poverty respectively. The study used the ARDL approach and the ECM-based Granger causality test. The findings of the study revealed that when household consumption expenditure was used as a proxy, 1) a unidirectional causal flow was found to prevail from poverty to education in the short run, 2) a unidirectional causality from poverty to inequality was found in the short run, and 3) a unidirectional causal flow from inequality to education was found to predominate in the short run.

The results confirmed the importance of poverty in access to education and closing the inequality gap. When infant mortality rate was used as a poverty proxy, the study found: 1) a bidirectional causality between education and inequality in the short run and a unidirectional causal flow from education to poverty in the long run; 2) a unidirectional causal flow from inequality to poverty in the short and long run; 3) a bidirectional causality between inequality and education in the short run. Based on the findings of this study, it can be concluded that there is a close causal relationship between inequality, poverty, and education. This suggests a coordinated policy approach from all fronts to ensure that the challenge of poverty and inequality is eliminated. The National Development Plan pointed out poverty and inequality as challenges among the triple challenges, for which a concoction of policies was formulated. However, according to the findings of the study, a coordination of policies across poverty, inequality, and education will allow South Africa to enjoy the mutually beneficial effect of each variable individually and as a group. It is therefore recommended that the government should continue to strengthen policies on education, poverty, and inequality with a view to benefiting from the reinforcing effects among the policies. It is also recommended that a continuous review of the policies and desired outcomes is done to ensure that policies serve the purpose they were designed for and take new developments at a national and global level into account.

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