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**Article**

## Income inequality and economic growth: An empirical investigation in South Africa

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## DEVELOPMENT ECONOMICS | RESEARCH ARTICLE

# Income inequality and economic growth: An empirical investigation in South Africa

Kholeka Mdingi<sup>1\*</sup> and Sin-Yu Ho<sup>1</sup>

**Abstract:** This study examines the relationship between income inequality and economic growth in South Africa for the period 1989 to 2018. The study is motivated by the high disparity in income inequality and stagnant economic growth that South Africa is experiencing. Using the autoregressive distributed lag (ARDL) bounds testing technique, we established a long-run relationship between economic growth and income inequality. The results revealed that income inequality has a negative impact on economic growth in the long run, and no effect in the short run. These results are robust with an estimation of the ARDL procedure that considers structural breaks. Therefore, policymakers should employ strategies that entail a double effect of growth in national income and consider the distribution of income in the long run. These policies include human capital accumulation, easily accessible education, and reduction in labour market dualism.

**Subjects:** Development Studies; Development Policy; Economics and Development; Finance

**Keywords:** Income inequality; economic growth; ARDL bounds test; South Africa

**Subject:** C22; D63; O15

### ABOUT THE AUTHORS

Kholeka Mdingi is a lecturer at the Department of Economics, University of South Africa. She has an interest in the research field of development economics.

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### PUBLIC INTEREST STATEMENT

South Africa has been ranked highest among the unequal countries globally; it has the highest Gini coefficient compared with other countries. Over the past few decades, it has experienced sluggish economic growth. Motivated by the high disparity in income inequality and stagnant economic growth, we investigate the relationship between income inequality and economic growth in South Africa from 1989–2018. Our findings show that income inequality has a negative impact on economic growth in the long run, but no impact in the short run. Therefore, policymakers should employ strategies that entail a double effect of growth in national income and consider the distribution of income in the long run. These policies include human capital accumulation, easily accessible education, and reduction in labour market dualism.

## 1. Introduction

This study examines the relationship between income inequality and economic growth in South Africa. Income inequality is a challenge for countries across the world. The gap between the rich and the poor continues to increase, irrespective of the level of economic growth and development (Dabla-Norris et al., 2015). Many reasons have been brought forward by researchers in favour of low income inequality. Existing literature has found that economies with high-income inequality have high rates of political and social instability (Barro, 2000; Keefer & Knack, 2000). In the presence of high-income inequality, strikes arise due to the dissatisfaction of the population and the implementation of poor policies that do not serve the interests of the entire population (Barro, 2000; Perotti, 1996). Furthermore, there tends to be corrupt behaviour, where the rich influence the law and distribution policies to increase their wealth at the expense of the poor. This leads to uncertainty that causes low domestic and foreign investor confidence and hence a fall in growth in the long run (Alesina & Perotti, 1996; Barro, 2000; Claessens & Perotti, 2007).

South Africa has the most income inequality in the world, with a Gini coefficient above 50 percent, which is considered a major policy challenge (World Bank, 2018a, 2018b). In South Africa, income inequality is a legacy of apartheid<sup>1</sup> and it has been increasing since the advent of democracy, making it the most unequal country in the world (World Bank, 2019a, 2019b; Ntuli & Kwenda, 2013). As a result, it modelled the development of inequality-perpetuated economic growth causing a long lasting footprint of rising (income) inequality (Leibbrandt et al., 2012; Van der Berg, 2011). This left the country with unequal opportunities among the population, social instability, uncertainty, and undermines the reducing effect of growth on poverty reduction (Keefer and Knack, 2000; World Bank, 2012; World Bank, 2019a; 2019b).

Because of the potential impact of income inequality on economic growth, there has been a growing number of studies, which examined theoretically and empirically the relationship between income inequality and economic growth. Some empirical studies have shown that the effect of income inequality on economic growth can be positive (Forbes, 2000; Hailemariam et al., 2021; Li & Zou, 1998; Majeed, 2016; Partridge, 1997; Shahbaz, 2010), negative (Alesina & Rodrik, 1994; Braun et al., 2019; Perotti, 1996; Persson & Tabellini, 1994; Topuz, 2022), inconclusive (Barro, 2000, Castelló-Climent, 2010; Hailemariam & Dzhumashev, 2020; Ostry et al., 2014) or there can be no impact (Benos & Karagiannis, 2018; Niyimbanira, 2017). Additionally, some studies, such as Aghion et al. (1998), Ahluwalia (1976), Galor and Tsiddon (1997), Helpman (1997), Kuznets (1955), and Robinson (1976), found that income inequality varies along economic development stages and technological advancement.

There are various reasons as to why these studies found mixed results. The main reason is the lack of comparability of the data sets as some studies used expenditure data, while some used gross income data. Expenditure data is more equally distributed than gross income; these differences in the distribution of income may cause mixed findings (Atkinson and Brandolini, 2001; Knowles, 2005). Another reason is the different methodological procedures, which may result in different results. Early studies used cross-sectional data and employed ordinary least squares and two-stage least squares estimation techniques (Alesina & Rodrik, 1994; Perotti, 1996; Persson & Tabellini, 1994). Later studies shifted to the usage of panel data due to its benefit of estimating the effect of a change in a country's level of inequality on growth in a specific country (Barro, 2000; Forbes, 2000; Li & Zou, 1998). However, studies that used panel data employed various estimation techniques such as fixed effects (FE), random effects (RE), and generalised methods of moments (GMM) with varying assumptions (Neves & Silva, 2014). In addition, the use of a panel study may result in the loss of country specific information due to grouping different countries together (Ho, 2018; Hsiao, 2005). Provided that the effect of inequality on growth differs across countries due to various country specific circumstances, the result may differ across the studies.

In this paper, we contribute to the inequality-growth debate by examining this relationship in an individual country, South Africa. We overcome the data limitation challenge by collecting data

from various reliable sources such as Atkinson et al. (2017), Quantec EasyData (2022) and the Standardized World Income Inequality Database (SWIID) 9.2. Our study extends existing literature by using a time series technique that will allow us to examine the relationship at national level, so that we can identify the effects of income inequality on growth in a specific country. The technique allows us to examine both the short and long-run impact of income inequality and economic growth. Our main finding reveals that income inequality has a negative effect on economic growth in the long run, and has no impact in the short run. Our findings are consistent across the main estimation method and robustness check.

The remainder of the paper is arranged as follows: Section 2 provides an overview of development of income inequality and economic growth in South Africa. Section 3 presents a theoretical and empirical literature review on income inequality and economic growth. Sections 4 and 5 provide the methodology and an analysis of the empirical results, while Section 6 concludes.

## 2. Overview of income inequality and economic growth in South Africa

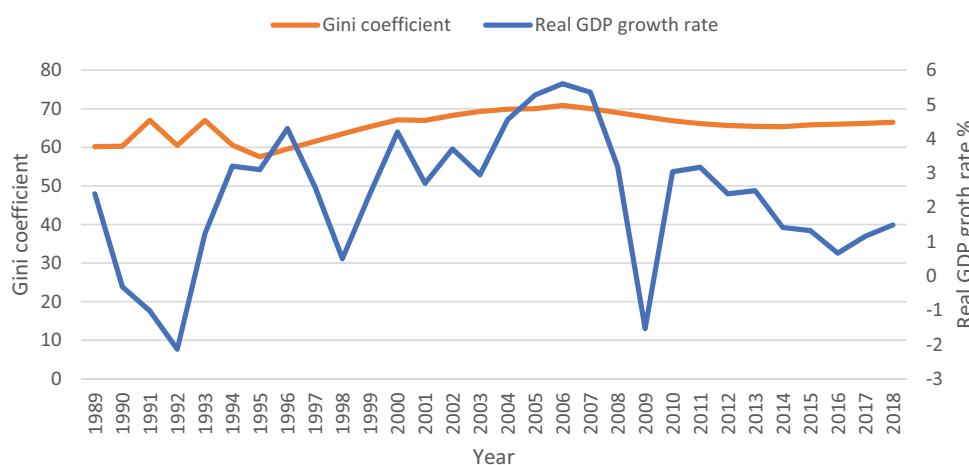
South Africa has been ranked highest among the unequal countries globally; it has the highest Gini coefficient compared to other countries (World Bank, 2019a, 2019b). The roots of inequality have been traced back to racial and wage inequality that characterised the country during the apartheid era, where benefits were distributed and classified according to racial groups. This resulted in economic growth that is not pro-poor and that cannot create sustainable job opportunities (World Bank, 2019a, 2019b; Ntuli & Kwenda, 2013). The existing literature noted that inequality is embedded in the structures of the economy because policies and structures of apartheid modelled a development of inequality perpetuated growth (Leibbrandt et al., 2012; Van der Berg, 2011). Hence, despite the post-apartheid policy interventions by the democratic government to reduce inequality, there is a long-term footprint of continuous rising inequality that is posing a challenge to reverse.

Owing to policy interventions such as the Reconstruction and Development Programme (RDP), Growth, Employment, and Redistribution (GEAR), Accelerated and Shared Growth Initiative for South Africa (ASGISA) and the National Development Plan (NDP) implemented since 1994 to reduce the income inequality gap, inequality has changed its nature (SAHO, 1994a, SAHO, 1994b). Income distribution between races has improved, while income inequality within race groups continues to worsen, especially among the black African population. The literature states that within racial groups, inequality is the root of the persistent increasing income inequality (Leibbrandt et al., 2000, Government Communication and Information System, 2010; Chapman, 2012). The cause of racial income inequality is attributed to the growth in the black middle-income class that is more than what the Black Economic Empowerment (BEE) policies can accommodate and the increasing unemployment within the race (Bhorat et al., 2009; Van der Berg, 2011).

Figure 1 displays the trends of income inequality and economic growth between 1989 and 2018. The data confirm that South Africa has the highest percentage of income inequality and sluggish economic growth. Figure 1 shows that South Africa had more than a decade of increasing income inequality, which started from 1995 to 2005, where it reached a high percentage that exceeded 70 percent and has remained high. The increasing disparity could be attributed to skills mismatch (that results in an unnecessary shortage of skills), the labour market, and high unemployment (Landman et al., 2003; Leibbrandt & Woolard, 2001; Naudé & Coetzee, 2004; Ntuli & Kwenda, 2013). Economic growth, on the other hand, has been in a weak position. As shown in Figure 1, growth drastically fell between 1989 and 1992 reaching a -2.1 percent, after which it had a period of upswings and downswings until 2008 when the financial crisis began. From 2008 to 2018, the country experienced a decade of low and stagnant economic growth due to the economic sectors that were not growing at the same rate, and external and internal economic shocks that destabilised economic performance (World Bank, 2021). The economy of South Africa has faced numerous positive periods of growth and a few periods of low growth, as shown in Figure 1. Existing studies have documented that economic growth in South Africa depends on several sectors:

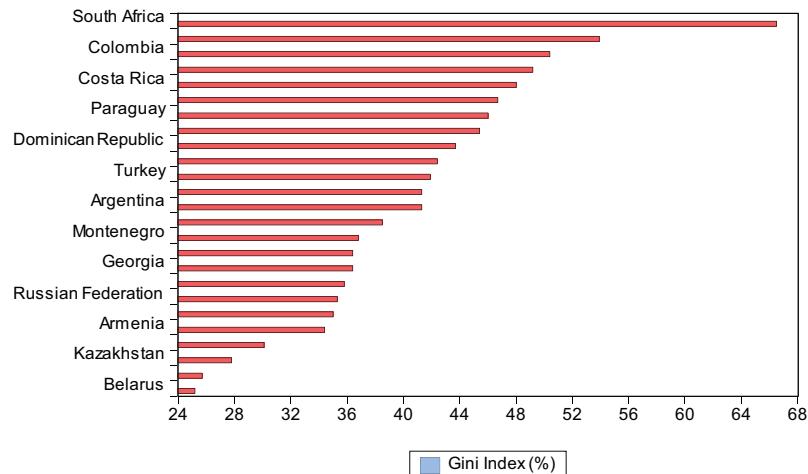
**Figure 1. Gini coefficient and growth rate of real GDP of South Africa for the period 1989 to 2018.**

Source: Authors' own construction using data from Atkinson et al. (2017), Quantec EasyData (2022), SWIID 9.2, and World Bank (2022c).



**Figure 2. Gini index of upper-middle-income countries for 2018.**

Source: Authors' own construction using data from the World Bank (2022a).



finance, government, trade, manufacturing, transport and communication, mining, personal services, construction, electricity and agriculture (South African Embassy in the Netherlands, 2013; Brand South Africa, 2018). These are the sectors that drive the economy of the country. Over the years, South Africa has seen a shift in economic activity and drivers. Historically, South Africa's economy has shifted from being driven by the agricultural sector during the 1990s to being driven by the tertiary sector during the 2000s. Today, it is focused on technological advancement activities (embracing the fourth industrial revolution era), e-commerce, and the financial sector (South African Embassy in the Netherlands, 2013). As shown in Figure 2, South Africa has been ranked the highest and most unequal country among the upper-middle-income countries globally (World Bank, 2022b).

### 3. Literature review of income inequality and economic growth

Various theoretical studies have identified the transmission mechanisms in which income inequality is linked to economic growth. These mechanisms include economic development, technological development, social-political unrest, political economy, imperfection of credit markets, savings, and institutions.

An early study by Kuznets (1955) explored the relationship between income inequality and growth through the level of the development stage of the economy. Kuznets found a differential link between income inequality and economic growth, with a positive impact and a negative impact during the early stages and later stages of economic development, respectively. As labour

moves from the agricultural sector to other economic sectors, the per capita income of those individuals increases, and those left in the agricultural sector earn less income, widening the inequality gap. As the economy develops and individuals continue to move away from the agricultural sector, the low supply of labour will cause those who remain in the agricultural sector to earn a high income, reducing the income inequality.

Ahluwalia (1976), Robinson (1976), and Gupta and Singh (1984) supported the above findings. Some studies have explored the relationship between income inequality and growth through the level of technology in the economy (Aghion et al., 1998; Galor & Tsiddon, 1997; Helpman, 1997). They argue that, at the early stages of technological development, income inequality tends to increase, because new technology requires highly skilled labour, causing an unnecessary shortage of skills by increasing income for those working in the developed sector. As the economy grows and develops, income inequality decreases because more labour moves to the technologically advanced sector. Those who remain in the sector with old technology will earn a high income due to the decrease in the supply of labour in the sector.

Some studies model the income inequality-growth relationship from the social and political perspective. They found that high-income inequality negatively affects growth through social-political unrest. This is because economies with high inequality have high levels of disturbing behaviour, such as criminal activities, strikes and other unproductive activities that lead to wastage of government resources and political instability (Barro, 2000; Benhabib & Rustichini, 1996; Venieris & Gupta, 1986). In contrast, some studies have demonstrated that an increase in social and political unrest can lead to the promotion of fair income distribution. To reduce the number of riots, politicians welcome redistribution—from the rich to the poor—in a transfer of payments. It will restore the people's trust in government, and improve investment, thereby enhancing growth in the long run (Barro, 2000; Benhabib & Rustichini, 1996; Venieris & Gupta, 1986). In the political economy studies, high-income inequality may constrain growth (Alesina & Rodrik, 1994; Barro, 2000; Perotti, 1993). These models show that if the mean income is more than that of the median voter, citizens will engage in riots and other disruptive behaviour demanding redistribution from the rich to the poor. Such disruptive behaviour causes people to lose confidence in the government and its law, and hence lower growth in the long run (Banerjee & Duflo, 2003; Panizza, 2002; Perotti, 1993; Persson & Tabellini, 1994).

From a financial perspective, the models of imperfect credit markets show that high-income inequality adversely affects growth through the credit markets (Aghion & Bolton, 1992; Banerjee & Newman, 1993; Galor & Zeira, 1993; Panizza, 2002; Piketty, 1997). In the presence of credit market imperfection, the problem of asymmetric information will lead to high-income inequality and limit the poor from accessing credit. Laws that protect the borrower make creditors put stricter measures to acquire loans and this will limit access to credit for the poor. Given that investment in human capital (education and skills training) or property depends on the income and assets an individual has, the poor who have limited income cannot afford these investment opportunities. Therefore, high-income inequality limits investment opportunities for some individuals and leads to low economic growth eventually. Additionally, some studies show that savings rates cause income inequality to positively affect economic growth (Aghion et al., 1999; Barro, 2000; Bourguignon, 1981), suggesting that savings are directly proportional to an income. Therefore, with high-income inequality, rich people who earn high incomes save more, as a result, aggregate savings, and capital accumulation increases, which then leads to improved growth rates in the long run (Aghion et al., 1999; Bourguignon, 1981; Mirrlees, 1971; Rebelo, 1991).

Existing studies also showed that income inequality constrains growth through institutions (Chong & Gradstein, 2007; Hoff & Stiglitz, 2004; Sonin, 2003). This is because institutions drive economic growth and development, which enhances the well-being of a country (Smith, 1776; Acemoglu et al., 2005; Weil, 2008). Therefore, the quality of institutions is crucial for redistribution and growth. High-income inequality promotes the existence of poor institutions, which results in

high levels of inefficiency, wastage of resources and funds, social dissatisfaction, and political instability due to the political decisions that favour the rich at the expense of the poor. This will exacerbate income inequality and constrain growth in the long run (Hoff & Stiglitz, 2004; Sonin, 2003). Following this argument, poor quality institutions are associated with high inequality, inefficiency, and low growth, while high quality institutions are associated with low inequality, efficiency, and hence economic growth.

The theoretical literature on the relationship between income inequality and growth proved to be inconclusive. The empirical literature also found diverse results concerning the relationship between these two variables. Many studies found a negative relationship between income inequality and economic growth (Alesina & Rodrik, 1994; Braun et al., 2019; Breunig & Majeed, 2020; Knowles, 2005; Perotti, 1996; Topuz, 2022). In contrast, some scholars such as Partridge (1997), Da Silva (2020), Forbes (2000), Hailemariam et al. (2021), Li and Zou (1998), Majeed (2016), Partridge (1997), and Scholl and Klasen (2019) found a positive relationship.. While some studies found inconclusive results on the relationship (see, for example, Barro, 2000; Brueckner & Lederman, 2018; Deininger & Squire, 1998; Hailemariam & Dzhumashev, 2020), a few studies found no link between income inequality and growth (Benos & Karagiannis, 2018; Niyimbanira, 2017). Table 1 summarises the empirical studies on the relationship between income inequality and economic growth.

#### 4. Methods

##### 4.1. Sources of data

The study uses annual time series data from 1989 to 2018. The length of the study is based on the availability of data. We obtained the data from the World Development Indicators (World Bank) (2022a), Quantec EasyData (2022), Penn World Table 10.0 (2022), Chartbook of Economic Inequality by Atkinson et al. (2017) and Standardized World Income Inequality Database (SWIID) 9.2 by Solt (2019).

##### 4.2. Definition of the variables

###### 4.2.1. Economic growth ( $Y$ )

The study includes the growth rate of real Gross Domestic Product (GDP) (annual percentage) as the dependent variable to denote the year-on-year changes of the GDP. The growth rate of real GDP is used as a proxy for economic growth.

The main explanatory variable is the Gini coefficient. As informed by the literature, we also include other variables such as human capital, labour, capital stock, and government expenditure as control variables.

###### 4.2.2. Gini coefficient (GINI)

This variable measures disparities in the distribution of income. The distribution varies between 0 = perfect equality and 1 = perfect inequality. The Gini coefficient is used as a proxy for income inequality.

###### 4.2.3. Human capital (HC)

This variable documents the skills, knowledge, and experience of individuals and has a significant impact on economic growth (Nelson and Phelps, 1966; Barro, 1991; Castelló and Doménech, 2002). Studies show that human capital improves productivity and competitiveness, thus improving economic growth (Lopez et al., 1998; Fedderke and Simkins, 2009). We use the human capital index to proxy for human capital.

**Table 1. Summary of empirical studies on the relationship between income inequality and economic growth**

Author(s)	Region/country	Measures of income inequality	Method(s) used	Results*
<b>Negative findings</b>				
Alesina and Rodrik (1994)	46 countries, 1960–1985	Gini coefficient	OLS 2SLS	-
Persson and Tabellini (1994)	56 countries, 1960–1985	Share of the fourth quintile	OLS 2SLS	-
Perotti (1996)	67 countries, 1960–1985	Share of the third and fourth quintiles	OLS 2SLS	-
Panizza (2002)	U.S., 1920–1980	Gini index	FE GMM	-
Knowles (2005)	40 countries, 1960–1990	Gini coefficient	OLS	-Rich: 0 Poor: -
Wan et al. (2006)	China, 1987–2001	Regional urban–rural income ratio to measure inequality	3SLS	-
Malinen (2008)	60 countries, 1971–2000	Gini index	Panel dynamic OLS Panel dynamic SUR	-
Cingano (2014)	OECD countries, 1980–2012	Gini index	GMM	-
Iyke and Ho (2017)	Italy, 1967–2012	Gini coefficient	ARDL	-
Besarria et al. (2018)	27 Brazilian states (1994–2014)	Gini coefficient	FE, RE, Instrumental variables	-
Braun et al. (2019)	150 countries, 1978–2012	Gini coefficient	Pooled OLS Dynamic panel IV regressions	-
Royuela et al. (2019)	15 OECD countries, 2003–2013	Gini coefficient	Pooled OLS RE IV	-
Breunig and Majeed (2020)	152 countries, 1956–2011	Gini coefficient	GMM	-
Seo et al. (2020)	43 countries (1991–2014)	Gini coefficient	3 SLS	-
Topolewski (2020)	32 European countries (2001–2018)	Gini coefficient	Dynamic panel models	-
Shen and Zhao (2022)	167 economies (1950–2020)	Gini coefficient of income	2 step system GMM; Dynamic panel threshold	-Low income level: -
Topuz (2022)	143 countries	Gini coefficient	Pooled OLS; FE; RE; 2 SLS	-
<b>Positive findings</b>				
Partridge (1997)	U.S., 1960–1990	Gini coefficient	Open pooled OLS	+
Li and Zou (1998)	46 countries, 1947–1994	Gini coefficient	FE RE	+
Forbes (2000)	45 mid- to high-income countries, 1966–1995	Gini coefficient	First-difference GMM	+
Rangel et al. (2002)	Brazilian minimum comparable areas, 1991–2000	Gini index	Various estimated regressions	+

(Continued)

**Table 1. (Continued)**

<b>Author(s)</b>	<b>Region/country</b>	<b>Measures of income inequality</b>	<b>Method(s) used</b>	<b>Results*</b>
Bhorat and Van der Westhuizen (2008)	South Africa, 1995–2005	Gini coefficient	Distribution-neutral measure	+
Shahbaz (2010)	Pakistan, 1971–2005	Gini coefficient	ARDL	+
Majeed (2016)	Pakistan, 1975–2013	Gini coefficient	ARDL	+
Scholl and Klasen (2019)	122 countries, 1961–2012	Gini coefficient	FE GMM IV	+
Da Silva (2020)	Brazil (1992–2011)	Gini coefficient; Theil index; To 10-bottom 40 income ratio	Panel VAR approach	+
Hailemariam et al. (2021)	OECD countries (1870–2016)	Gini coefficient; the income share of the top 10% of the population	Panel vector auto regression	+
Panzera and Postiglione (2022)	245 European Union NUTS-2 regions (from 22 European countries)	Gini index	Spatial Durbin model (SDM); Lagrange multiplier	Less developed regions: +
<b>Inconclusive findings</b>				
Deininger and Squire (1998)	66/87 countries, 1960–1992	Gini index	OLS	Poor: - Rich: +
Barro (2000)	84 countries, 1965–1995	Gini coefficient	2SLS	Poor: - Rich: +
Voitchovsky (2005)	21 developed countries, 1975–2000	Gini coefficient	System GMM	Lower decile: - Upper decile: +
Castelló-Clement (2010)	102 countries, 1960–2000	Gini coefficient Distribution of education by quintiles	System GMM	Low- and middle-income countries: - High-income countries: +
Fawaz et al. (2014)	111 high- and low-income developing countries, 1960–2010	Gini coefficient	GMM	Low income countries: - High-income countries: +
Halter et al. (2014)	106 countries, 1965–2005	Gini coefficient	System GMM First-difference GMM	Short run: + Long run: -
Ostry et al. (2014)	90 countries, 1960–2010	Gini coefficient	System GMM	Early stage: + Mature stage: -
Brueckner and Lederman (2018)	144 countries, 1970 to 2010	Market Gini coefficient; net Gini coefficient	2SLS GMM	Low income countries: + High-income countries: -
Hailemariam and Dzhumashev (2020)	Broad panel of countries (1965–2014)	Net Gini coefficient; Market Gini coefficient	Dynamic panel models	Non-linear relationship Moderate inequality: + High inequality: -

(Continued)

Author(s)	Region/country	Measures of income inequality	Method(s) used	Results*
<b>No relationship</b>				
Niyimbanira (2017)	Mpumalanga 18 municipalities, 1996–2014	Gini coefficient	FE Pooled regression	0
Benos and Karagiannis (2018)	US state-level data, 1929 to 2013	Gini coefficient	2SLS GMM	0

Source: Mdingi and Ho (2021). Note: - denotes negative, + denotes positive, 0 denotes inconclusive, FE denotes a fixed effect, RE denotes random effect, OLS denotes ordinary least squares, GMM denotes generalised methods of moments, 2SLS denotes two-stage least squares, ARDL denotes autoregressive distributed lag, IV denotes an instrumental variable.

#### 4.2.4. Labour (POP)

Following studies by Temple and Wößmann (2006), Rajan and Zingales (2008), Moral Benito (2012), and Iyke and Ho (2017), this study uses population growth to measure labour. Population growth has a significant impact on economic growth since a faster growth of population relative to national income will burden society and limit the availability of capital per head. It then reduces labour productivity, reducing economic growth in the long run (Mankiw, 2009; Mankiw et al., 1992; Solow, 1956).

#### 4.2.5. Capital stock (K)

Capital stock is used to measure physical capital, which includes the machines, equipment, and other inventories used in production processes. Existing studies indicate that investing in capital is key to achieving growth in per capita output, which enhances growth in the long run (Mankiw et al., 1992; Long and Summers, 1991, 1993).

#### 4.2.6. Government expenditure (GOVT)

Government expenditure is measured by general government final consumption expenditure, which includes expenses by government to meet the needs of the citizens. These include government transfers, the provision of education and health facilities, and safety and security. The literature documents that government spending plays a significant role in stabilising and growing the economy (Keynes, 1936). Furthermore, government spending is a function of national income; however, it adversely affects the economy in the long run (Barro, 2003).

### 4.3. Unit root testing

The study employed the Augmented Dickey Fuller Test (ADF), Perron Test (1997) and Zivot-Andrews Test (1992) for unit root testing. First, the test is conducted to observe the stationary properties of the time series in the presence of structural breaks. Second, it is to see if the variables meet the requirements of the ARDL model, which specify that variables should be integrated of order zero or one, or a mix of both and not be integrated of order two.

### 4.4. The Autoregressive Distributed Lag (ARDL) test for cointegration

Following the stationary test, the study employs the autoregressive distributed lag (ARDL) bounds testing technique proposed by M. H. Pesaran and Shin (1999) and M. H. Pesaran et al. (2001) to investigate the long-run association between income inequality and economic growth in South Africa. The study prefers to use this technique because the ARDL test can be used even if the variables combine the order of integration zero or one. Additionally, the technique can be applied to a small sample size. The ARDL equation is specified as follows:

$$\begin{aligned}\Delta Y_t = & \rho_0 + \sum_{i=1}^n \rho_{1i} \Delta Y_{t-i} + \sum_{i=1}^n \rho_{2i} \Delta \ln GINI_{t-i} + \sum_{i=1}^n \rho_{3i} \Delta \ln HC_{t-i} + \sum_{i=1}^n \rho_{4i} \Delta \ln POP_{t-i} \\ & + \sum_{i=1}^n \rho_{5i} \Delta \ln K_{t-i} + \sum_{i=1}^n \rho_{6i} \Delta \ln GOVT_{t-i} + \alpha_1 Y_{t-1} + \alpha_2 \ln GINI_{t-1} + \alpha_3 \ln HC_{t-1} \\ & + \alpha_4 \ln POP_{t-1} + \alpha_5 \ln K_{t-1} + \alpha_6 \ln GOVT_{t-1} + \mu_t\end{aligned}\quad (1)$$

where  $\ln GINI$ ,  $\ln HC$ ,  $\ln POP$ ,  $\ln K$ ,  $\ln GOVT$  are the logarithms of the variables. For  $Y$ , the study does not take the natural logarithm as a result of the number of negative observations during the study period.  $\rho$ ,  $\alpha$ ,  $n$ ,  $\mu$  are the short-term coefficient, long-run coefficient, number of lags and the error term, respectively. Additionally,  $t$  and  $\Delta$  are the period and difference operator. The study bases the number of optimal lags on the Akaike Information Criterion (AIC).

First, the study tests whether the variables have a long-run relationship. That is, the null hypothesis of no cointegration given by  $H_0 : \alpha = 0$  is tested against the alternative hypothesis of cointegration given by  $H_1 : \alpha \neq 0$ . Second, to accept or reject the null hypothesis, we consider the F-statistic that is compared with the two critical values proposed by M. H. Pesaran et al. (2001), and B. Pesaran and Pesaran (2009). These are assumed to be integrated into either order zero or one. When the F-statistic is less than the lower bound, the null hypothesis cannot be rejected. However, when the F-statistic is higher than the upper bound, the null hypothesis is rejected. If the F-statistic is between the lower and the upper bound, the results are inconclusive.

If the variables are cointegrated, we proceed to estimate the error correction model (ECM) using the following equation:

$$\begin{aligned}\Delta Y_t = & \delta_0 + \sum_{i=1}^n \delta_{1i} \Delta Y_{t-i} + \sum_{i=0}^n \delta_{2i} \Delta \ln GINI_{t-i} + \sum_{i=0}^n \delta_{3i} \Delta \ln HC_{t-i} + \sum_{i=0}^n \delta_{4i} \Delta \ln POP_{t-i} + \sum_{i=0}^n \delta_{5i} \Delta \ln K_{t-i} \\ & + \sum_{i=0}^n \delta_{6i} \Delta \ln GOVT_{t-i} + \varphi EMC_{t-1} + \mu_t\end{aligned}\quad (2)$$

where  $\delta$ ,  $\varphi$  and  $\Delta$  are the short-run coefficients, the coefficient that captures the long-run variations, and the difference operator, respectively. ECM and  $\mu_t$  are the error correction term and the residual error term, respectively. The sign of the  $\varphi$  is expected to be negative. This coefficient measures the speed with which the variables can adjust back to long-run equilibrium.

## 5. Results and analysis

### 5.1. Stationarity test results

The study employed the ADF Test, Perron Test (1997) and Zivot-Andrews Test (1992) to test the stationarity of the observations in the presence of structural breaks. Table 2 presents the results.

Table 2 shows that  $Y$ ,  $\ln HC$  and  $\ln GOVT$  are stationary at the first difference, while  $\ln GINI$  is stationary both at level and at first difference. For  $\ln K$  and  $\ln POP$ , the variables are stationary at level. When provided with the stationarity results—where the variables are integrated of either order zero or one, and a mixture of order zero and one—the ARDL bounds testing technique can be applied.

### 5.2. Findings of Autoregressive Distributed Lag (ARDL): bounds testing approach to cointegration

Having found that the order of integration of the variables is zero and one, we proceed to test for cointegration between the variables using the ARDL bounds technique as proposed by M. H. Pesaran et al. (1996, 2001), and M. H. Pesaran and Shin (1999). Table 3 provides the results of the ARDL bounds test approach for cointegration. The study estimates two equations. First, the study estimates an ARDL equation without structural breaks. Second, the study estimates an ARDL

**Table 2. Stationarity of the variables**

Variables	Augmented Dickey Fuller Test (ADF)				Perron Test				Zivot-Andrews Test			
	Order of integration at level I(0)		Order of integration at the first difference I (1)		Order of integration at level I(0)		Order of integration at the first difference I (1)		Order of integration at level I(0)		Order of integration at the first difference I (1)	
	Trend Intercept	Trend and intercept	Intercept	Trend and intercept	Trend	Intercept	Trend	Intercept	Trend	Intercept	Trend	Trend
Y	-	-5.826***	-5.780***	-	-	-6.287***	-4.913**	-4.260	-4.293*	-4.976**	-4.612**	-4.612**
LNGINI	-5.445***	-5.932***	-3.071**	-	-	-	-7.915***	-4.705*	-	-7.790***	-6.431***	-6.431***
LNHIC	-	-	-2.637*	-2.525	-	-	-9.764***	-3.672	-	-5.061***	-9.894***	-5.061***
LNPOP	-3.401**	-4.780***	-	-	-	-	-	-	-5.141**	-5.010**	-	-
LNK	0.282	-3.374*	-	-	-5.506**	-4.872**	-	-	-5.126**	-5.440***	-	-
LNGOVT	-	-	-5.398***	-5.701***	-	-	-6.559***	-6.133***	-	-	-6.639***	-

Source: Computed by the authors. Notes: \* , \*\* and \*\*\* denote the stationarity of variables at 10%, 5% and 1% levels of significance, respectively; – denotes “not applicable”.

**Table 3. ARDL bounds test for cointegration results without structural breaks**

Country	Dependent variable	Function	F-statistic		Status of cointegration	
South Africa	Y	F (Y   lnGINI, lnHC, lnPOP, lnK, lnGOVT)	9.992***		Cointegrated	
Critical values						
Pesaran et al. (2001: p. 300)	1%		5%		10%	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
	3.41	4.68	2.62	3.79	2.26	3.35

Source: Computed by the authors. Notes: \*\*\* denotes 1% level of significance.

equation with the presence of structural breaks as a robustness check. The equation includes a dummy variable to capture structural breaks in Y.

As shown in Table 3, the F-statistic is 9.992, while the critical values of the lower and upper bounds are 2.26 and 3.79, respectively, at 5% level of significance. These results show that Y, lnGINI, lnHC, lnPOP, lnK and lnGOVT have a long-run relationship. Therefore, the null hypothesis is rejected because the F-statistic is higher than the lower and upper bounds. Now that the long-run relationship is established between the variables, the study proceeds to estimate the regression model using the ARDL technique. The optimal lag lengths for the study as determined by Akaike Information Criterion (AIC) are (3, 2, 2, 2, 2, 2) for Y, lnGINI, lnHC, lnPOP, lnK and lnGOVT, respectively. Table 4 shows the estimation results of the long run and short run.

Table 4 presents estimation results showing that lnGINI, lnPOP, lnK and lnGOVT are statistically significant and negatively affect economic growth in the long run. In contrast, lnHC is statistically significant and positively affects economic growth in the long run. Regarding the Gini coefficient, the results show that as income inequality increases, economic growth falls in the long run, similar to the findings of Alesina and Rodrik (1994), Perotti (1996), Malinen (2008), Iyke and Ho (2017), Royuela et al. (2019), Breunig and Majeed (2020) and Topuz (2022). This is because high-income inequality limits education opportunities for the poor. It results in a lack of investment in education, lack of social mobility, and hinders the development of skills. Furthermore, it increases the number of people who are unable to invest in human capital, and as a result, the productivity of labour becomes lower than expected (Cingano, 2014; Dabla-Norris et al., 2015). Additionally, high-income inequality results in high crime rates, poor health services and political instability. This is because high rates of crime create uncertainty and inefficiency, and affect the competitiveness of businesses. In turn, this lowers domestic and foreign direct investments (FDI) and causes the loss of trust in government leadership, which negatively affects the performance of the economy in the long run (Dabla-Norris et al., 2015; Fajnzlber et al., 2002; Goulas & Zervoyianni, 2013; Keefer & Knack, 2000; Philip et al., 2014).

Furthermore, high-income inequality hinders poverty reduction (Niyimbanira, 2017). It causes the population to be vulnerable and exposed to poverty as the effect of economic growth on poverty reduction is undermined (Van der Berg, 2010; Dabla-Norris et al., 2015; World Bank, 2019a, 2019b). South Africa struggles with extreme income inequality manifested through unfair income distribution, unequal opportunities and disparities across the regions. As a result, the country experiences low economic growth in the long run that is not pro-poor.

Regarding the relationship between human capital and growth, the study confirmed a positive relationship. These finds are in line with existing literature (see, for example, Grossman & Helpman, 1991; Lucas, 1988; Pelinescu, 2015; Romer, 1986, 1990; Seo et al., 2020). The results for physical capital are interesting, yet unexpected, showing a negative impact on economic growth in the case of South Africa. These findings are in contrast to what has been advocated and found by theoretical and empirical

**Table 4. Long-run and short-run estimation results of the model without structural breaks**

**Dependent variable: Y**

**Panel A: The long-run coefficient results**

Regressors	Coefficient	Standard error	t-statistics	Probability
lnGINI	-17.728***	1.801	-9.843	0.000
lnHC	63.501**	19.56388	3.246	0.012
lnPOP	-5.113***	0.980	-5.219	0.001
lnK	-39.177***	10.990	-3.565	0.007
lnGOVT	-18.061***	5.257	-3.435	0.009

**Panel B: The short-run coefficient results**

Regressors	Coefficient	Standard Error	t-statistics	Probability
$\Delta Y (-1)$	0.691***	0.144	4.799	0.001
$\Delta Y (-2)$	0.150	0.097	1.536	0.163
$\Delta \ln GINI$	-7.641	4.276	-1.787	0.112
$\Delta \ln GINI (-1)$	14.958***	4.325	3.458661	0.009
$\Delta \ln HC$	-150.183**	54.660	-2.748	0.025
$\Delta \ln HC (1)$	-101.278	68.768	-1.473	0.179
$\Delta \ln POP$	-77.602***	11.938	-6.500	0.000
$\Delta \ln POP (-1)$	81.778***	10.644	7.683	0.000
$\Delta \ln K$	125.419***	36.938	3.395	0.009
$\Delta \ln K (-1)$	-162.305***	35.730	-4.542	0.002
$\Delta \ln GOVT$	-11.826**	4.202	-2.814	0.023
$\Delta \ln GOVT (1)$	9.191	5.357	1.716	0.125
C	1519.328***	153.918	9.871	0.000
CointEq(-1)*	-2.341***	0.237	-9.870	0.000

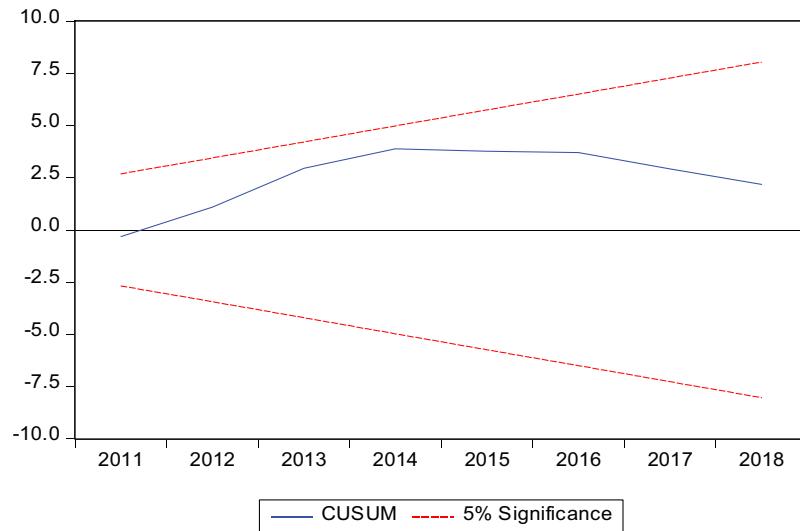
Source: Computed by the authors. Notes: \*, \*\* and \*\*\* denote the stationarity of variables at 10%, 5% and 1% levels of significance, respectively;  $\Delta$  is the first difference operator.

literature by De Long and Summers (1991); De Long and Summers (1993); Mankiw et al. (1992); Mirestean and Tsangarides (2016); and Iyke and Ho (2017), which show that physical capital improves economic growth. In South Africa, we argue that the increase in physical capital must be accompanied by an increased level of the knowledge and skills that equip the labour force with the capabilities to efficiently use this capital. Otherwise, the available capital will be underutilised and, as a consequence, maximum output will not be achieved due to low productivity (Fedderke, 2005). Concerning population growth, the findings showed that the variable negatively affects growth in the long run, consistent with the strand of literature and recent findings (Breunig & Majeed, 2020; Iyke & Ho, 2017; Mankiw, 2009; Mankiw et al., 1992; Solow, 1956). In the case of government expenditure, the results show a negative impact on economic growth in the long run in South Africa. This supports the findings of existing literature and recent studies by Landau (1985), Barro (2003), Bergh and Bjørnskov (2020), and Haini and Loon (2022), which find that government expenditure affects economic growth negatively. This may be plausible because to finance spending, government will impose high taxes on citizens. Second, government might implement projects in which the private sector would be more productive than the public sector, thereby causing low productivity, and hence low economic growth in the long run.

The short-run results document that income inequality does not affect economic growth, while human capital, population growth and government expenditure negatively affect growth. For human capital, it may be because in the short run, the population is still acquiring the necessary skills and knowledge, and its effect on growth will not be seen in the short run. Additionally, physical capital positively affects growth in the short run. Furthermore, the error term coefficient is

**Figure 3. The plot of the cumulative sum of the recursive residuals.**

Source: Author's own compilation. Notes: The straight-line represents critical bounds at 5% significant level.



negative and statistically significant, which implies that when the variables deviate from the equilibrium, they adjust back at a pace of 2.34 percent.

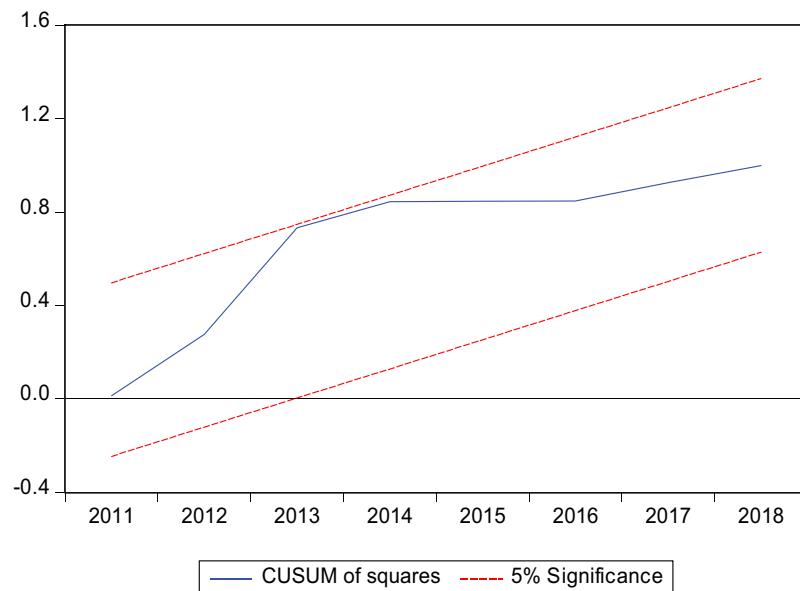
The results show that the data fit the model with an adjusted  $R^2$ -squared of 91 percent. The model passed the diagnostic tests for heteroskedasticity, functionality form and normality. The plots of the estimated cumulative sum of recursive residuals (CUSUM) and the plot of the cumulative sum of squares of recursive residuals (CUSUMSQ) of the model indicate that the long-run coefficients are stable. The CUSUM and CUSUMSQ lines are between the two lines of the 5% level of significance shown in Figures 3 and 4.

### 5.3. Robustness check

In this section, the study explores the impact of income inequality on economic growth, taking into consideration the effect of structural breaks in the model. Given that South Africa is an open economy, it is sensitive to global economic conditions that may affect the economy negatively or positively. Between 1989 and 2018, major structural shifts and economic conditions—such as

**Figure 4. The plot of the cumulative sum of squares of recursive residuals.**

Source: Author's own compilation. Note: The straight lines represent critical bounds at 5% significant level.



**Table 5. Long-run and short-run results with structural breaks**

**Dependent variable: Y**

**Panel A: The long-run coefficient results**

Regressor	Coefficient	Standard error	t-statistics	Probability
lnGINI	-25.594***	5.198	-4.924	0.001
lnHC	72.732**	30.885	2.355	0.040
lnPOP	-5.128***	1.327	-3.865	0.003
lnK	-42.045*	19.267	-2.182	0.054
lnGOVT	-23.546***	7.259	-3.244	0.009

**Panel B: The short-run coefficient results**

Regressor	Coefficient	Standard Error	t-statistics	Probability
ΔY (-1)	0.315**	0.102	3.090	0.011
ΔlnGINI	-3.071	5.053	-0.608	0.557
ΔlnGINI(-1)	16.843***	4.674	3.603	0.005
ΔlnHC	-102.683	60.583	-1.695	0.121
ΔlnHC(-1)	-117.58*	64.754	-1.816	0.010
ΔlnPOP	-50.340***	12.851	-3.917	0.003
ΔlnPOP(-1)	68.992***	11.874	5.810	0.000
ΔlnK	94.752**	37.474	2.528	0.030
ΔlnK(-1)	-218.649***	36.725	-5.954	0.000
ΔlnGOVT	-17.498***	4.667	-3.749	0.004
DUM_Y	0.730	0.510	1.430	0.183
C	1242.878***	109.033	11.399	0.000
CointEq(-1)*	-1.694***	0.149	-11.398	0.000

post-apartheid economic reforms and the global financial crisis—occurred, resulting in shocks to the economy (SAHO, 1994; Bhorat et al., 2020). Having found that the variables are stationary as shown in Table 2, the study estimates the following ARDL equation, which includes a dummy variable (DUM), to capture the presence of structural breaks in Y.

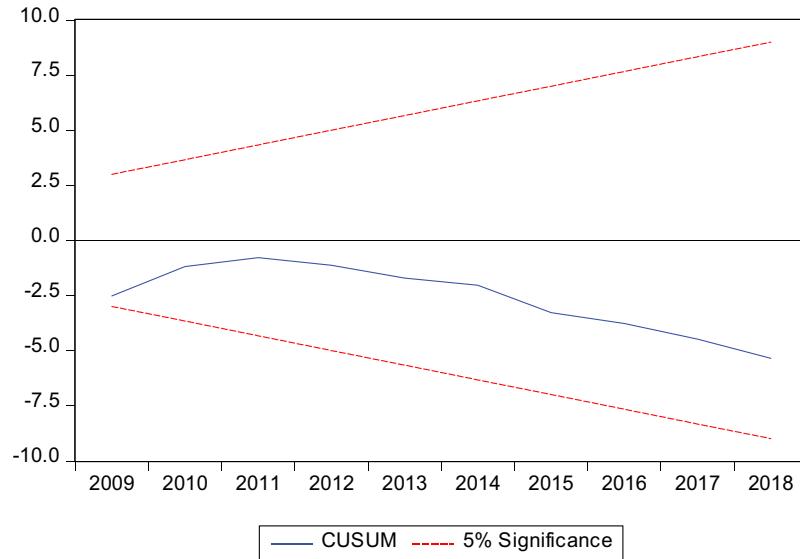
$$\begin{aligned} \Delta Y_t = & \rho_0 + \rho_1 DUM_t + \sum_{i=1}^n \rho_{2i} \Delta Y_{t-i} + \sum_{i=1}^n \rho_{3i} \Delta lnGINI_{t-i} + \sum_{i=1}^n \rho_{4i} \Delta lnHC_{t-i} + \sum_{i=1}^n \rho_{5i} \Delta lnPOP_{t-i} \\ & + \sum_{i=1}^n \rho_{6i} \Delta lnK_{t-i} + \sum_{i=1}^n \rho_{7i} \Delta lnGOVT_{t-i} + \alpha_1 Y_{t-1} + \alpha_2 lnGINI_{t-1} + \alpha_3 lnHC_{t-1} \\ & + \alpha_4 lnPOP_{t-1} + \alpha_5 lnK_{t-1} + \alpha_6 lnGOVT_{t-1} + \mu_t \end{aligned} \quad (3)$$

The Perron Test (1997) and Zivot-Andrews Test (1992) identified the structural breaks in 2005, 2008, 2009 and 2010 for Y. The dummy variable will take one for years with structural breaks and zero for years without structural breaks.

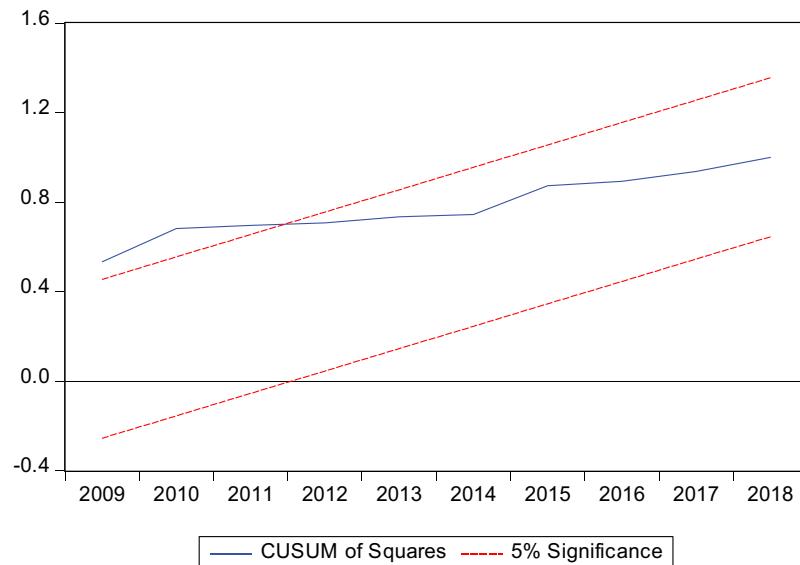
The F-statistics is 14.434, which is significant at 1 percent and higher than the lower and upper bounds reported in Table 3 above. These results show that the variables have a long-run relationship. Then we proceed to estimate the regression model using the ARDL technique. The optimal lag lengths for the study as determined by the AIC are (2, 2, 2, 2, 2, 1) for Y, lnGINI, lnHC, lnPOP, lnK and lnGOVT, respectively. Table 5 presents estimated results of the ARDL model with structural breaks.

Similar to the main findings, Table 5 presents estimation results showing that, in the presence of structural breaks, lnGINI, lnPOP, lnK and lnGOVT are statistically significant and have a negative impact on growth in the long run. In contrast, lnHC is statistically significant and has a positive

**Figure 5. The plot of the cumulative sum of the recursive residuals with structural breaks.**



**Figure 6. The Plot of the cumulative sum of squares of recursive residuals with structural breaks.**



impact on growth in the long run. The short-run results are also similar to the main findings that income inequality has no effect on growth, while population growth, physical capital and government spending negatively affect growth in the short run. The main difference is that human capital has no effect on growth in the short run. The results show that the data fit the model with an adjusted  $R^2$  of 88 percent. The model passed the diagnostic tests for heteroskedasticity, functionality form and normality. The CUSUM line is between the two lines of 5 percent level of significance as shown in Figure 5. The CUSUMSQ showed some instability, however, it returned between the two lines of the 5% level of significance in the long run as shown in Figure 6. Based on the above considerations, it is evident that the main results are reliable compared with the ones that accounted for the structural breaks.

## 6. Conclusion

This study examined the association between income inequality and economic growth in South Africa from 1989 to 2018. Using the ARDL bounds testing technique, we found that an increase in income inequality has a significant negative impact on economic growth in the long run. In the short run income inequality has no effect on economic growth. Additionally, human capital positively affects economic growth, whereas capital stock, population growth, and government consumption inversely affect economic growth. Therefore, we recommend that policymakers pursue the implementation of policies that will not only focus on boosting the economy, but also encourage the distribution of income. According to International Monetary Fund (IMF) (2020), South Africa's income inequality persistently increases through a skewed distribution of income, unequal opportunities, high unemployment and low economic growth. Additionally, due to South Africa being a dual economy, some parts of the country are well developed, while most of the country is underdeveloped. Such development issues perpetuate social and income inequality. Thus, we recommend that social investment policies such as improved quality of health, access to services (water, electricity and sewerage, among others), and easy access to quality education be pursued to support the previously disadvantaged (Organisation for Economic Co-operation and Development (OECD), 2012; IMF 2020).

Moreover, other policies such as good governance, reduced costs of running a business, improved open market competitiveness, compensation of workers for skills and productivity, and improved state-owned enterprise efficiency, may encourage inclusive growth through human capital accumulation and reduce income inequality (OECD, 2012; IMF, 2020). Additionally, the high heterogeneity in the level of education and skills in the labour market increases income inequality. Policies such as educational coaching in the workplace will reduce this heterogeneity, which in turn will reduce income inequality in the labour market. Future studies could empirically investigate the role of the labour market in both income inequality and economic growth.

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### Note

1. Apartheid is a system that discriminated against the population based on race. In South Africa it was introduced in 1948 by the National Party, where the government implemented policies and laws that forced different race groups to live and develop separately, with unequal opportunities in education and employment (South African History Online (SAHO), 1994).

### Disclosure statement

No potential conflict of interest was reported by the author(s).

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## Appendix

**Table A1. Descriptive statistics of economic growth, income inequality, human capital, population growth physical capital, and government expenditure, 1989–2018**

Y	LNGINI	LNHC	LNK	LNPOP	LNGOVT
Mean					
2.312978	4.181506	0.818136	0.478814	14.51313	2.874480
Median					
2.542735	4.192744	0.799235	0.410644	14.44770	2.877240
Maximum					
5.603806	4.260725	1.049997	0.915048	14.86080	2.963809
Minimum					
-2.137057	4.052368	0.643771	0.197015	14.28154	2.763847
Standard deviation.					
1.957419	0.055204	0.131884	0.239916	0.192184	0.062752
Skewness					
-0.440567	-0.713658	0.283156	0.727961	0.472730	-0.115348
Kurtosis					
2.787342	2.556730	1.695318	2.127935	1.788137	1.781813
Jarque-Bera					
1.027028	2.792147	2.528631	3.600260	2.953134	1.921499
Probability					
0.598389	0.247567	0.282433	0.165277	0.228420	0.382606
Sum					
69.38933	125.4452	24.54409	14.36442	435.3940	86.23439
Sum sq. dev.					
111.1132	0.088376	0.504410	1.669234	1.071106	0.114196
Observations					
30	30	30	30	30	30

Source: Authors' computation.