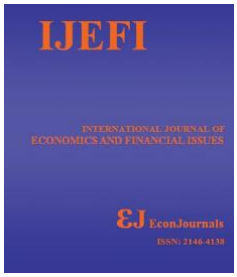

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Poverty-Inequality-GDP Nexus and Social Grants: Implications for SDGs in South Africa

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ABSTRACT

The policy framework in many emerging economies is based on the triangular concerns of poverty, inequality, and economic growth. In this case, social protection and grants serve as efficient means of providing welfare packages to the public. Nonetheless, South Africa still has one of the most unequal socioeconomic structures in the world, despite the social grant system. This study focuses on the dynamic trend of poverty, inequality, and GDP, which is crucial to the attainment of SDG objectives in South Africa. The instrument of estimation is the ARIMA principle using data spanning 1990 - 2020 for prognosis. The study forecasts that between the present and 2050, poverty and inequality would rise, but more slowly. The policy implication is that a concerted effort through policy re-appraisal and review that will change the nature of rural and township life and allow people to move from a high level of poverty and inequality to a better life-changing status is recommended.

Keywords: Economic, Growth, Inequality, Poverty, Social
JEL Classifications: I32, D63, E62, H53

1. INTRODUCTION

The Stainable Development Goals (SDGs) were based on three major pillars namely the economic, social, and environmental with deep reference to human, peace, and health facilities (Cerf, 2018). In SDG 1 (no poverty) and 5 (inequality) of 2030, as further adopted in 2050, greater emphasis was placed on the need to get rid of inequality and poverty especially in developing countries so as to get the citizens out of chronic abject poverty and extreme inequality. Poverty and inequality are intertwined such that any policy aimed at solving one must also be designed at targeting the other. Poverty as a challenge to economic growth is capable of disempowering individuals, groups of people, and even a nation and thus widens inequality (Remenyi, 2004). As in many developing economies, the trilemma of poverty, inequality, and economic growth had been the basis upon which policies are targeted to the extent that social protection/grants are means of effective delivery of welfare packages to the citizenry (Osabuohien et al., 2020). As opined by Gumede (2021), the social structure of South Africa is still among the most unequal in the world. In the 2015 SDGs pact of the United Nations also, poverty reduction and equality of life were identified as major channels through which the 2030 sustainable development goals could be achieved (United Nations, 2016).

Inequality and poverty are indirectly linked to employment growth. According to Kuznet's hypothesis, inequality and growth have an inverse U-shaped connection. In times of economic boom, those with substantial inequality are regarded as living in poverty. Growth has a negative influence on inequality and raises the value of poverty, but the relationship between inequality and poverty benefits people and economies. The relationship between poverty and GDP has been well documented in the literature (Sachs et al., 2019; Fransman and Yu, 2019; Yameogo and Omojolaibi, 2020). So also, the impact of inequality (in whatever form), GDP, and poverty have been examined as major issues to contend with in developing and underdeveloped countries of the world (Sulla and Zikhali, 2018; Sachs et al., 2019; Mhlanga, 2020; Osabohien et

al., 2020). To the World Bank (2020), poverty was identified as one of the major global challenges that could mar the achievement of Sustainable Development Goals soon. Accordingly, social grants remain one of the succors towards poverty alleviation and inequality management (Cerf, 2018; and Osabohien et al., 2020). Within this context, the need to juxtapose the dynamics of the relationship between poverty and inequality for a better understanding of these concepts and policy requirements cannot be ignored.

Although little is known about how poverty, inequality, GDP, and social grants relate to the SDGs, it is critical to evaluate their dynamics and drawbacks in emerging nations like South Africa. There aren't many studies on the connections between these factors and social grants, and none of them have used a social theory that takes these factors into account. Incorporating government handouts into the context of GDP, inequality, and poverty could expose policy reversals in South Africa's 2030 SDG goals. Examining the relationship and trajectory between poverty, inequality, and GDP in relation to social grants in South Africa is the major goal of this study. Therefore, the study heavily relied on the Autoregressive Integrated Moving Average (ARIMA) approach to accomplish this goal. Additionally, it is believed that the use of ARIMA in this study is appropriate because it is well-established in the literature (Rajkumari and Gayithri 2017; Wadi et al., 2018) that the technique is most useful for trend analysis and forecasting-related studies.

1.1. Theoretical Perceptions to Poverty, Inequality and Social Welfarism

According to Osabohien et al. (2020), social theories, such as grants, are crucial for reducing poverty and inequality. Traditional welfare theory holds that people should strive hard to overcome poverty, while Neo-Classicalists see poverty and inequality as the result of people's economic and social activity, with the poor being excluded from social advantages. Both theorists place a strong emphasis on the financial side, with little personal accountability for the state. Without aid from the government, developing and less developed nations may have to deal with issues including population growth, insecurity, and exchange rate imbalances. This philosophy promotes increased economic engagement rather than placing all the burden on the government. Keynesians believe that low aggregate demand, debt, rapid inflation, and asset bubbles are what lead to poverty. Another significant factor that necessitates government action is unemployment. Equal income distribution can increase economic involvement and enable the poor to engage in previously underprivileged pursuits. Government engagement in monetary-based social amenities is emphasized in Keynes's ideology. Marxist thinkers contend that because of class divisions within capitalism, government involvement alone is insufficient to address poverty. They contend that an economic system where the wealthy control production places the poor at a disadvantage, such as when peasant farmers are punished for environmental damage.

The social exclusion theory was also founded on a deficient social welfare system, according to Osabohien et al. (2020). This line of thinking contends that social infrastructure, like education, is essential for reducing inequality and poverty. For them, being poor means not being able to make use of and benefit from social services (Asongu et al., 2019). As a result, grants are necessary to provide emerging nations with the social and capital goods that are essential to welfare capitalism. Our projection in this study is based on the social exclusion theory, which, according to Osabohien et al. (2020), is one method for African countries to provide social security while also reducing poverty and inequality.

2. LITERATURE REVIEW

2.1. Social Investment, Poverty, Inequality, and Economic Growth

According to Kouadio and Gakpa (2022), one major cause of poverty is inequality, or the unequal distribution of wealth and income, which is a major result of capitalism. Poverty is inescapable in any society marked with inequality (Aziz, 2022). In other words, a society that accepts inequality is more likely to experience poverty. Sociologists who accept the relative definition of poverty believe that to eradicate poverty, all income inequality must be eliminated first (Francia and Webster, 2019). Poverty and income inequality are theoretically inseparable, so the presence of one indicates the presence of the other (Agyemang-Badu et al., 2018; and Francis and Webster, 2019). In the presence of equitable income distribution, the lowest income group can exit poverty. There could be a direct or indirect link between inequality and poverty. Under the direct link, unequal distribution of income and wealth in the economy restricts the people who are negatively impacted, such that they will have less than enough to provide for necessities of life, as well as their children's education and healthcare, and as a result, they will be poor. The result of the comparative analysis of 58 sub-Saharan African and Latin American countries investigated by Adeleye et al. (2020) concluded that inequality in income is a major determining factor of poverty in developing economies. The findings of the system GMM further pointed to the fact that inequality also aggravates the impact of growth on poverty.

Using an SEM approach, More and Aye (2017) investigated the impact of social infrastructure on economic growth and inequality in South Africa. While trying to control production factors, urbanization, and globalization, they used growth as a moderating effect. The findings reveal a positive and significant link between education spending and economic growth. However, there is a small but significant negative correlation between health spending and growth. Furthermore, the findings show a weak but significant link between education and inequality, as well as a strong negative link between health and inequality. They discovered a positive and significant relationship between growth and inequality in South Africa, which is consistent with Kuznets's theory {Kuznets, 1955}. 58 nations in Sub-Saharan Africa and Latin America were subjected to an extensive analysis from 2000 to 2015 by Adeleye et al. (2020) and Osabohien et al. (2020). The study sought to ascertain if economic expansion lessens poverty and whether its interaction with income disparity enhances or modifies that influence. According to the findings, there are differences in the growth-poverty-inequality trilemma across income levels and regional samples. According to the study, economic growth and income disparity have a negative influence on inclusivity and a

favorable impact on the incidence of poverty. A major component in determining poverty is income inequality.

In Nigeria from 1980 to 2010, Ogbeide and Agu (2015) discovered a bidirectional causal relationship between poverty and income disparity. They advise putting policies in place that lessen inequality along with those that lessen poverty, making sure they are not carried out in isolation. According to Doumbia and Kinda (2019), when infrastructure and social protection are prioritized over defense investment, there is a reduction in economic inequality. However, there is little proof that reducing defense budget raises conflict risks and wealth inequality under institutions with weak governance. By diverting funds from infrastructure and social protection to other sectors, income disparity often increases. The Johansen co-integration test was used by Ajibola et al. (2018) to analyze poverty and inequality in Nigeria from 1980 to 2013 and discover long-run co-integration. They discovered that as the economy expands, government healthcare spending raises inequality and lowers poverty. Inequality [PCI] is negatively impacted by expenditure on health [GEXPED] while poverty [POV] is positively impacted.

The impact of institutional quality and economic growth on reducing inequality and poverty in West Africa was empirically examined by Kouadio and Gakpa (2022). The findings, which were based on information from the World Development Indicators (WDI), the International Country Risk Guide (ICRG), and the Standardized World Income Inequality Database (SWIID), demonstrated that economic growth remains a prerequisite for eradicating poverty as well as the significant long-term benefits of an overall increase in the quality of institutions. The role that social protection policies and programs can play in poverty and inequality reduction in Africa was examined by Osabohien et al. (2020), using 38 African countries. The study uses fixed and random effects models with data from the World Development Indicators, Gini Index, and Country Policy Institutional Assessment for the years 2000-2017. The study's striking finding, among others, is that a 1% increase in social protection will reduce inequality and poverty by 58% and 26%, respectively. Therefore, the existence of social safety programs as a means of reducing poverty and inequality in Africa was justified by the study. On the other hand, Ogujiuba and Mngometulu (2022) observed a no-cointegration between social investment, poverty, inequality, and economic growth in South Africa. This shows that while the insignificant effect of social grants on poverty and inequality might not be well pronounced in a panel data study, the reverse might be the case under a time series investigation.

In Eastern Indonesia, Erlando et al. (2020) discovered a significant relationship between income distribution, poverty, and economic growth. Financial inclusion is positively impacted by socioeconomic growth while being negatively impacted by poverty. Financial inclusion's positive effect on inequality emphasizes the widespread nature of income disparity. Mhlanga and Moloi (2021) saw COVID-19 as another major hindrance to the achievement of Sustainable Development Goals (SDG) in South Africa and Zimbabwe in a study that investigated the impact of this pandemic on SDG in both countries. This was based on the premise that the pandemic will have untold hardship on low-income earners and those who are already in the poverty bracket and therefore making some of the SDG's objectives, especially in poverty reduction, difficult to accomplish. As a way out, the study advised developing countries to avail themselves of grants for the poor and low-income earners. Satumba et al. (2017) examined the relationship between social grants and poverty reduction in South Africa using the income decomposition approach based on race, gender, household, and province. It was discovered that social grants have mitigating effects on the black race more than any other racial group in South Africa. It was further affirmed that the rural dwellers as well as female-headed households benefited from social grants more than other contemporaries. Similarly, Rogan (2015) measured the gender poverty gap in South Africa using the multidimensional poverty index and considered how investment in healthcare services delivery especially in the rural areas could enhance gender equality. Cerf (2018) conceptualized sustainable development goals viz-a-viz economic and health landscape in Africa and submitted that inequality and poverty are pervasive in Africa and therefore, hinder the gains from sustainable development policies.

In terms of poverty, inequality, foreign direct investment, and sustainable development goals, South Africa ranked poorly according to Aust et al. (2019). Moreover, Gumede (2021) looked at the connection between inequality, human development, and poverty in South Africa and discovered that poverty was most common among African and Black people. The proportion of people who live in poverty has remained stable since the end of apartheid, according to the Multidimensional Poverty Index.

3. DATA AND METHODS

Secondary annual data for the study is sourced from StatsSA OECD World Economic Development and SASSA for the period 1990-2020. The SPSS software was used to analyze the data. For the model estimation, the ARIMA model was used for prognosis.

3.1. ARIMA Model: [Forecasting Inequality and Poverty from 2022 to 2050]

An autoregressive integrated moving average, [ARIMA], is a statistical analysis model that uses time series data to either better understand the data set or to predict future trends. A statistical model is autoregressive if it predicts future values based on past values. Our Model (ARIMA) makes use of lagged moving averages to smooth time series data. Autoregressive models implicitly assume that the future will resemble the past. Therefore, they can prove inaccurate under certain market conditions such as financial crises or periods of rapid technological change.

The ARIMA model has the following components:

- Autoregression (AR): refers to a model that shows a changing variable that regresses on its own lagged, or prior, values
- Integrated (I): represents the differencing of raw observations to allow for the time series to become stationary (i.e., data values are replaced by the difference between the data values and the previous values)

- Moving Average (MA): incorporates the dependency between an observation and a residual error from a moving average model applied to lagged observations.

For the ARIMA model, a standard notation would be ARIMA with p, d, and q, where integer values substitute for the parameters to indicate the type of ARIMA model used. The parameters can be defined as:

- p: the number of lag observations in the model; also known as the lag order
- d: the number of times that the raw observations are differenced; also known as the degree of differencing
- q: the size of the moving average window; also known as the order of the moving average.

Because ARIMA models are complicated and work best on very large data sets, computer algorithms and machine learning techniques are used for computation.

3.2. Autoregressive Integrated Moving Average (ARIMA) and Stationarity

In an autoregressive integrated moving average model, the data are differenced to make it stationary. A model that shows stationarity is one that shows there is constancy to the data over time. Most economic and market data show trends, so the purpose of differencing is to remove any trends or seasonal structures. ARIMA forecasting is achieved by plugging in time series data for the variable of interest. SPSS software identified the appropriate number of lags or amount of differencing to be applied to the data and check for stationarity. In a multiple regression model, we forecast the variable of interest using a linear combination of predictors. In an autoregression model, we forecast the variable of interest using a linear combination of *past values of the variable*. The term autoregression indicates that it is a regression of the variable against itself.

Thus, an autoregressive model of order pp can be written as:

$$y_t = c+\phi_1 y_{t-1}+\phi 2 y_{t-2}+\cdots+\phi p y_{t-p})+\varepsilon_t \quad (1)$$

Where y_t is the value of the tine at time t, c is the constant term, ϕ_1, $\phi_{2,\ldots}$ ϕ_p are the autoregressive coefficients. ε_t is the error term at time t

This is like a multiple regression but with lagged values of y_t as predictors. We refer to this as an AR(pp) model, an autoregressive model of order pp.

Point forecasts from the ARIMA model were calculated using the following three steps.

1. Expanded the ARIMA equation so that y_t is on the left-hand side and all other terms are on the right.

$$y_t = \left(1+\hat{\phi}_1\right)y_{t-1}-\left(\hat{\phi}_1-\hat{\phi}_2\right)y_{t-2}-\left(\hat{\phi}_2-\hat{\phi}_3\right)y_{t-3}-\hat{\phi}_3 y_{t-4} +\varepsilon_t+\hat{\theta}_1\varepsilon_{t-1} \quad (2)$$

2. Rewrite the equation by replacing t with $T+h$;

$$y_{T+h} = \left(1+\hat{\phi}_1\right)y_{T+h-1}-\left(\hat{\phi}_1-\hat{\phi}_2\right)y_{T+h-2}-\left(\hat{\phi}_2-\hat{\phi}_3\right)y_{T+h-3} -\hat{\phi}_3 y_{T+h-4}+\varepsilon_{T+h}+\hat{\theta}_1\varepsilon_{T+h-1} \quad (3)$$

When for $h=1$;

$$\hat{y}_{T+1} = \left(1+\hat{\phi}_1\right)\hat{y}_T-\left(\hat{\phi}_1-\hat{\phi}_2\right)\hat{y}_{T-1}-\left(\hat{\phi}_2-\hat{\phi}_3\right)\hat{y}_{T-2}-\hat{\phi}_3\hat{y}_{T-3} +\varepsilon_{T+1}+\hat{\theta}_1\varepsilon_T \quad (4)$$

3. On the right-hand side of the equation, replace future observations with their forecasts, future errors with zero, and past errors with the corresponding residuals

$$\hat{y}_{T+1} = \left(1+\hat{\phi}_1\right)\hat{y}_T-\left(\hat{\phi}_1-\hat{\phi}_2\right)\hat{y}_{T-1}-\left(\hat{\phi}_2-\hat{\phi}_3\right)\hat{y}_{T-2}-\hat{\phi}_3\hat{y}_{T-3}+0+0 \quad (5)$$

Therefore, the equation is as follows:

$$\hat{y}_{T+1} = \left(1+\hat{\phi}_1\right)\hat{y}_T-\left(\hat{\phi}_1-\hat{\phi}_2\right)\hat{y}_{T-1}-\left(\hat{\phi}_2-\hat{\phi}_3\right)\hat{y}_{T-2}-\hat{\phi}_3\hat{y}_{T-3} \quad (6)$$

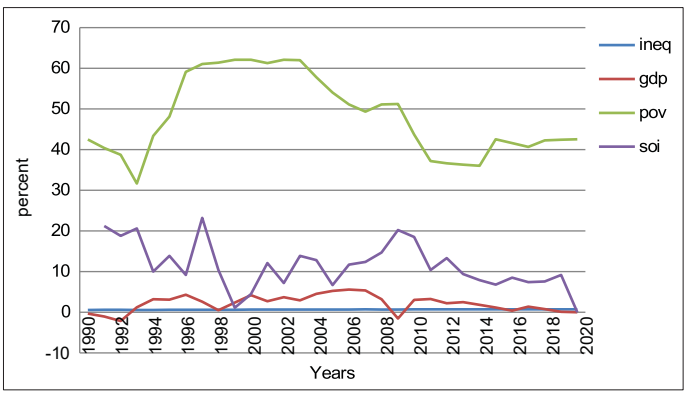
4. FINDINGS AND DISCUSSION

4.1. Trend Analysis of Variables

Table 1 shows years between 1990 and 2020 variations in macro-social indicators related to poverty, inequality, and development policy in South Africa. It illustrates that GDP growth was inconsistent, displaying negative growth during times of recession (such as in 1992, 2009, and particularly in 2020 with -6.96%) followed by moderate recovery periods. Inequality, represented by the Gini coefficient (INEQ), stayed consistently higher, increasing gradually from 0.59 in 1990 to 0.75 by 2012, and levelling off afterwards. Poverty headcount ratios (POV) exhibited a non-linear pattern, decreasing during times of economic expansion, yet increasing again after 2008 despite ongoing social grant payments.

Significantly, indicators of human development like education (EDU) and health spending (HEAL) showed slight improvements over the thirty years, indicating steady but modest investment in social areas. The social grant ratio (SOGR) is only accessible from 2007 onwards, illustrating steady growth up to 2020. This strengthens

Figure 1: Movement of variables



the argument that fiscal transfers have served a stabilizing function in protecting household welfare amid macroeconomic declines.

Figure 1 illustrates the trends in social investment, inequality, poverty, and economic growth during the past years. The graph demonstrates that, while inequality has not changed significantly over the past few decades, social investment and GDP have been shifting. On the other hand, as seen in the graph, poverty has been increasing at a much higher rate than all the other variables. Over the years, the GDP per capita has fluctuated both upward and downward. A rising GDP is a sign of economic expansion and tends to imply rising productivity. The figure further shows that between 1990 and 1993, 2009 and 2010 GDP was negative. This might have been due to the global financial crisis and other factors within the economy.

On the other hand, social investment has fluctuated significantly over the years, rising and falling. Although there were upswings and downswings after the country gained democracy in 1994, there was a noticeable decline in social spending between 1997 and 1999. An increase in government spending on South African people's social assistance would be responsible for the improvement in social investment. Education, health, and social grants were all included in the enhanced budget for spending. Nevertheless, over time, inequality has been gradually shifting. Even if laws have been put in place to combat poverty and inequality, the inequality figure shows that there hasn't been much progress in that area over the years.

Table 1: Variables dynamics

Year	INEQ	GDP	POV	EDU	HEAL	SOGR	SOI
1990	.59	-0.32	42.48	17.7	8.9	–	–
1991	.61	-1.02	40.38	19.1	9.3	–	21.2
1992	.60	-2.14	38.74	20.3	9.8	–	18.8
1993	.58	1.23	31.63	20.8	9.4	–	20.6
1994	.59	3.20	43.35	18.3	8.9	–	10.0
1995	.60	3.10	48.11	20.4	9.1	–	13.9
1996	.61	4.30	59.07	21.2	9.5	–	9.2
1997	.62	2.60	61.04	22.0	9.9	–	23.2
1998	.63	.50	61.34	21.3	10.3	–	10.4
1999	.64	2.40	62.06	20.6	10.1	–	1.1
2000	.65	4.20	62.08	20.3	9.7	–	4.5
2001	.66	2.70	61.26	20.4	10.3	–	12.1
2002	.67	3.70	62.07	20.1	9.5	–	7.2
2003	.67	2.95	61.96	19.6	9.5	–	13.9
2004	.67	4.55	57.79	19.5	9.4	–	12.8
2005	.68	5.28	53.99	18.3	9.3	–	6.7
2006	.69	5.60	51.10	18.4	9.7	–	11.7
2007	.71	5.36	49.31	18.1	9.9	3.40	12.4
2008	.70	3.19	51.08	18.1	10.3	5.22	14.7
2009	.69	-1.54	51.18	18.3	10.4	7.54	20.2
2010	.71	3.04	43.70	19.6	11.5	6.25	18.5
2011	.72	3.28	37.20	20.1	11.8	4.42	10.4
2012	.75	2.21	36.62	19.9	11.7	3.27	13.3
2013	.75	2.49	36.28	19.4	11.5	-1.08	9.4
2014	.75	1.85	36.00	19.3	11.3	4.46	7.9
2015	.75	1.19	42.53	19.3	11.4	2.10	6.8
2016	.75	.40	41.57	18.8	11.4	1.23	8.5
2017	.75	1.41	40.66	19.2	11.6	1.80	7.4
2018	.75	.79	42.25	19.3	11.8	1.72	7.6
2019	.75	.15	42.40	20.1	12.1	2.69	9.2
2020	.75	-6.96	42.55	21.4	12.9	–	11.4

N/b: Variables are shown in Growth Rates

4.2. ARIMA model results

Table 2 presents the outcomes of two distinct ARIMA models (Model_1 and Model_2) investigating the relationships among poverty (POV), inequality (INEQ), and GDP in South Africa. Furthermore, it examines the potential influence of social grants on these variables in relation to achieving the Sustainable Development Goals (SDGs).

4.2.1. Prediction intervals

The first prediction interval is easy to calculate.

If σ is the standard deviation of the residuals, then a 95% prediction interval is given by:

$$\hat{y}_{T+1|T} \pm 1.96\sigma \tag{7}$$

This result is true for all ARIMA models regardless of their parameters and orders. Multi-step prediction intervals for ARIMA (0,0, q) models are relatively easy to calculate. We can write the model as

$$Y_t = \varepsilon_t + \sum_{i=1}^{q} \theta_i \varepsilon_{t-i} \tag{8}$$

Then, the estimated forecast variance can be written as

$$\sigma_h = \sigma^2[1 + \sum_{i=1}^{h-1} \theta_i^2 \quad \text{for h= 2,3,} \tag{9}$$

Table 2: Model description

Model ID	Model Name	Model type
INEQ-Model_1	INEQ	ARIMA (0,1,0)
POV-Model_2	POV	ARIMA (0,1,0)

Model fit											
Fit Statistic	Mean	SE	Minimum	Maximum	5	10	25	50	75	90	95
Stationary R-squared	1.665E-16	2.355E-16	0.000	3.331E-16	0.000	0.000	0.000	1.665E-16	3.331E-16	3.331E-16	3.331E-16
R-squared	0.887	0.114	0.807	0.968	0.807	0.807	0.807	0.887	0.968	0.968	0.968
RMSE	2.164	3.045	0.010	4.317	0.010	0.010	0.010	2.164	4.317	4.317	4.317
MAPE	3.770	3.572	1.244	6.296	1.244	1.244	1.244	3.770	6.296	6.296	6.296
MaxAPE	15.475	15.816	4.292	26.658	4.292	4.292	4.292	15.475	26.658	26.658	26.658
MAE	1.415	1.989	0.008	2.821	0.008	0.008	0.008	1.415	2.821	2.821	2.821
MaxAE	5.791	8.154	0.025	11.556	0.025	0.025	0.025	5.791	11.556	11.556	11.556
Normalized BIC	−2.986	8.520	−9.011	3.039	−9.011	−9.011	−9.011	−2.986	3.039	3.039	3.039

and a 95% prediction interval is given by:

$$\hat{y}_{T+1|T} \pm 1.96\sqrt{\sigma_h} \quad (10)$$

Figure 2 illustrates the relationship between inequality and poverty over the past few years. The curve illustrates the relationship between changes in inequality levels and variations in poverty rates, highlighting the significant correlation between these two variables.

Table 3 displays the fit statistics and Ljung-Box Q-test results for the ARIMA models (INEQ-Model_1 and POV-Model_2 for poverty) introduced in Table 2. These statistics mainly examine the presence of serial correlation (autocorrelation) in the residuals of the model. This is an important assumption for accurately fitting ARIMA models.

4.3. Post-test: Ljung Box Test

The Ljung-Box test, named after statisticians Greta M. Ljung and George E.P. Box, is a statistical test that checks if autocorrelation exists in a time series. The Ljung-Box test is used widely in econometrics and in other fields in which time series data are common.

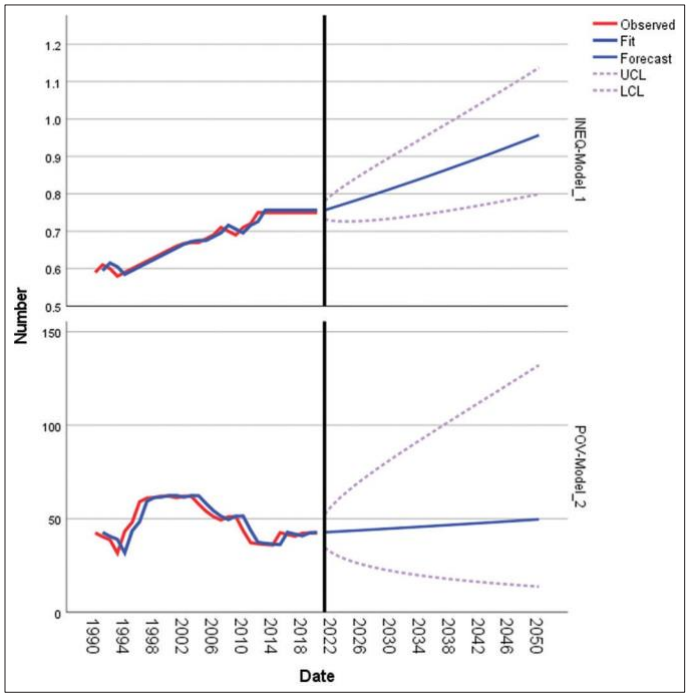
4.3.1. Hypotheses

The Ljung-Box test uses the following hypotheses:

H_0: The residuals are independently distributed.

H_A: The residuals are not independently distributed; they exhibit serial correlation.

Figure 2: Inequality and poverty curve



Ideally, we would like to fail to reject the null hypothesis. That is, we would like to see the p-value of the test be greater than 0.05 because this means the residuals for our time series model are independent, which is often an assumption we make when creating a model.

4.3.2. Test statistic

The test statistic for the Ljung-Box test is as follows:

$$Q = n(n+2)\sum p_k^2/(n-k)$$

where:

n = sample size

Σ = a fancy symbol that means "sum" and is taken as the sum of 1 to *h*, where *h* is the number of lags being tested.

p_K = sample autocorrelation at lag k

4.3.3. Rejection region

The test statistic Q follows a chi-square distribution with h degrees of freedom; that is, $Q \sim X^2(h)$. We reject the null hypothesis and say that the residuals of the model are not independently distributed if $Q > X^2_{1-a,h}$. In the above instance, we accept the null hypothesis because the p-values are not significant and >0.05.

Table 4 presents anticipated figures for inequality, poverty, and GDP from 2021 to 2050. The data set contains the projected values for each year, as well as the corresponding lower (InqL, PoL, GL) and upper bounds (InqU, PoU, GU). The forecasts highlight expected patterns and uncertainties in inequality and poverty rates, as well as GDP growth over the upcoming three decades. These projections are critical for understanding long-term economic and social changes and planning policy interventions aimed at achieving the Sustainable Development Goals (SDGs) in South Africa.

4.3.3.1. Inequality

A closer look at Figure 2 above revealed that the inequality trend in South Africa is expected to increase during the period 2021 to 2050. Between the first 5 years (2021 and 2025), inequality was projected to increase from.76 to.78, which represents 0.02 growth in the rate of inequality. In another 10 years to this period, that is years 2026 to 2035, the table projected additional 0.05 growth to the existing 0.02, which suggests that by the end of the year 2035, growth in the rate of inequality in South Africa would be 0.09 to the existing number of unequal persons. From the year 2026 to 2050, the inequality growth rate prognosis was put at.07%, because of the projected increase from 0.78 to 0.83, suggesting that, if necessary, measures are not put in place, inequality would continue to rise even though with the marginal trend. Cumulatively, the percentage change in the rate of inequality in South Africa in the next 30 years beginning from the year 2020 to 2050 is expected to

Table 3: Model statistics

Model	Number of predictors	Model fit statistics		Ljung-box Q (18)			Number of outliers
		Stationary R-squared	R-squared	Statistics	DF	Sig.	
INEQ-Model_1	0	0.000	0.968	20.509	18	0.305	0
POV-Model_2	0	3.331E-16	0.807	13.165	18	0.782	0

Table 4: Inequality and poverty rate prognosis (2020-2050)

Year	Inequality [Predicted]	InqL	InqU	Poverty [Predicted]	PoL	PoU	GDP [Predicted]	GL	GU
2021	0.76	0.73	0.78	42.55	33.76	51.34	0.17	−3.48	3.81
2022	0.76	0.73	0.79	42.55	30.12	54.99	0.18	−4.98	5.34
2023	0.77	0.73	0.80	42.56	27.33	57.78	0.20	−6.12	6.52
2024	0.77	0.73	0.81	42.56	24.98	60.14	0.21	−7.08	7.51
2025	0.78	0.73	0.82	42.56	22.90	62.22	0.23	−7.93	8.39
2026	0.78	0.73	0.83	42.56	21.03	64.10	0.24	−8.69	9.18
2027	0.79	0.73	0.84	42.57	19.31	65.83	0.26	−9.39	9.91
2028	0.79	0.73	0.85	42.57	17.70	67.43	0.28	−10.04	10.59
2029	0.80	0.73	0.86	42.57	16.20	68.95	0.29	−10.65	11.24
2030	0.80	0.74	0.87	14.77	42.57	70.37	0.31	−11.23	11.84
2031	0.81	0.74	088	42.58	13.42	71.73	0.32	−11.78	12.42
2032	0.81	0.74	0.89	42.58	12.12	73.03	0.34	−12.30	12.98
2033	0.82	0.74	0.90	42.58	10.88	74.28	0.35	−12.80	13.51
2034	0. 82	0.75	0.90	42.58	9.69	75.48	0.37	−13.28	14.02
2035	0.83	0.75	0.91	42.58	8.54	76.63	0.38	−13.74	14.51
2036	0.84	0.75	0.92	42.59	7.42	77.75	0.40	−14.19	14.99
2037	0.84	0.75	0.93	42.59	6.34	78.84	0.42	−14.62	15.46
2038	0.85	0.76	0.94	42.59	5.29	79.89	0.43	−15.05	15.91
2039	0.85	0.76	0.94	42.59	4.27	80.92	0.45	−15.45	16.35
2040	0.86	0.76	0.95	42.60	3.28	81.91	0.46	−15.85	16.78
2041	0.86	0.77	0.96	42.60	2.31	82.89	0.48	−16.24	17.20
2042	0.87	0.77	0.97	42.60	1.37	83.84	0.49	−16.62	17.61
2043	0.87	0.77	0.97	42.60	0.44	84.77	0.51	−16.98	18.01
2044	0.88	0.77	0.98	42.61	−0.46	85.68	0.53	−17.35	18.40
2045	0.88	0.78	0.99	42.61	−1.35	86.57	0.54	−17.70	18.78
2046	0.89	0.78	1.00	42.61	−2.22	87.44	0.56	−18.04	19.16
2047	0.89	0.78	1.00	42.61	−3.07	88.29	0.57	−18.38	19.53
2048	0.90	0.79	1.01	42.62	−3.90	89.14	0.59	−18.71	19.89
2049	0.90	0.79	1.02	42.62	−4.73	89.96	0.60	−19.04	20.25
2050	0.91	0.79	1.03	42.62	−5.53	90.77	0.62	−19.36	20.60

InqL: Inequality lower bound, InqU: Inequality upper bound, Pol: Poverty lower bound, PoU: Poverty upper bound, GL: GDP Lower bound, GU: GDP Upper bound

be 0.15. In view of this, the attainment of articles 1 and 5 of 2030 and 2050 sustainable development goals that bother on poverty and inequality reduction may be fully achieved by South Africa.

4.3.3.2. Poverty

According to the table's depiction of poverty increase, it is estimated that in the 10 years starting from 2021, South Africa's poverty rate will rise by a very slight 0.02%, from 42.55 in 2021 to 2029. The rate of poverty is anticipated to decrease to 14.77 in 2030 from 42.57 in 2029. The macroeconomic policy managers of the government have displayed excellent performance in this instance. Notably, Vision 2030 came to an end in the year 2030, and the government's focus moved to determine the degree to which the goals of Vision 2030 might be achieved. After this year (2030), poverty management in the nation is anticipated to be effectively controlled, with the growth in the poverty rate estimated to be 0.04% between 2031 and 2050, rising from 42.58 to 42.62 over this time. There is hope for poverty management in South Africa if there is political will on the part of the government, even though Cerf (2018) confirmed that African countries are moving slowly toward reducing poverty and inequality. The cumulative rate of poverty growth between 2021 and 2050 was estimated at 0.07%. According to studies like Aust et al. (2019) and Gumede (2021), South Africa performed poorly in terms of reducing poverty.

4.3.3.3. GDP

Despite the seeming increase in inequality and poverty indices between 2021 and 2050 as enunciated above, GDP during this period is expected to be impressive in terms of growth percentage changes. Between the years 2021 and 2030, the growth rate in the GDP was put at 0.14%, increasing from 0.17% in 2021 to 0.31% in 2031. In another 10 years again (2031 to 2040), the increase in GDP is expected to be 0.15%, which points to the fact that 20 years from 2020, the GDP growth rate of South Africa is expected to be over 0.30%. Also, in the last 10 years beginning from 2041 to 2050, the expected growth in GDP rate is expected at 0.14%. In all, the projected increase in GDP growth rate for 30 years commencing from 2021 to 2050 was put at 0.45%. Again, this projection is achievable provided there is political will on the part of policymakers and implementors in formulating and implementing pro-growth macroeconomic policies for the country. In Niyimbanira (2017), it was demonstrated that economic growth caused poverty to reduce in South Africa.

The conclusions drawn from the analysis are that, although at a modest and steady marginal rate, inequality, and poverty rates are predicted to rise between the years 2020 and 2050. This is in line with the United Nations (2016) report that lack of sufficient economic opportunities and inadequate social insurance systems are to blame for Africa's slow progress in reducing poverty and inequality. While it was estimated that the growth rates of inequality and poverty would increase cumulatively by 0.15% and 0.07% in 2020 and 2050, respectively, it was predicted that GDP would expand by 0.45% over that time. Inequality and poverty are the two main interconnected issues that African countries must deal with, claims. (Cerf, 2018)

Additionally, poverty and inequality were specifically mentioned as issues for underdeveloped nations in sections 1 and 5 of the 2030 SDGs (which were also repeated in the 2060 version). Although our study suggests that the predicted increase in GDP growth rate is excellent, it also demonstrates that the impacts of this increase may not be sufficient to address South Africa's problems with inequality and poverty. This poses a significant obstacle to the fulfillment of the SDGs. This is scarcely surprising considering that, as noted by Gumede (2021) and supported by Fagbemi (2021), despite the proven development in the GDP of the majority of developing African countries, this has not been fully reflected in the residents' standard of life. There is a need to address the pathologies of corruptive wealth accumulation, the spending habits of the people, and greater access to health facilities, education, and other basic human necessities of the people in order to reduce the difficulties of cyclical inequality and poverty to the bare minimum. According to Olamide and Maredza (2021), corruption continues to be a significant obstacle to the fulfillment of macroeconomic goals in South Africa. This finding advised a more comprehensive assessment and strategy for the country's ongoing fight against corruption.

5. CONCLUDING REMARKS AND POLICY RECOMMENDATIONS

This study examined the nexus between poverty, inequality, and economic growth in relation to government social grants in South Africa as a projection to SDGs. The major instrument of estimation was the ARIMA which according to available literature was considered appropriate for a study on trend analysis and forecasting. It was discovered that despite the continuous spending by the government and the increase in her GDP, poverty and inequality are expected to be on the increase in the next decades. South Africa is one of the developing countries with a high rate of inequality and poverty while on the other hand, it is regarded as one of the top rich countries in natural resources and infrastructural development. The main cause of the expected rise, but at a slow rate in poverty and inequality in the country, is the severe lack of human capital or skills arising from a lack of proper education and health especially in the rural areas where most of the blacks reside.

5.1. Policy Recommendations

1. Improving the infrastructure in rural areas can enhance the growth of the economy which can then reduce poverty and inequality
2. South Africa's macroeconomic policies, which appear to be more urban-focused, must be changed and channelled to all-inclusive policies as outlined in the National Development Programme (NDP); with strict regulations in place to ensure proper implementation. This approach will aid in changing the nature of rural and township life and allow people to move from a high level of poverty and inequality to a better and positive life-changing status
3. Empirical evidence about the relationship between poverty, inequality, and GDP is needed in formulating policies and programs that can address the hindrances that keep people within the poverty and inequality brackets in developing countries. Not only that, the role of social grants and the need to prioritize their applications in developing countries need to be re-emphasized for the purpose of prognosis and policy objective achievement.

REFERENCES

Adeleye, B.N., Gershon, O., Ogundipe, A., Owolabi, O., Ogunrinola, I., Adediran, O. (2020), Comparative investigation of the growth-poverty-inequality trilemma in Sub-Saharan Africa and Latin American and Caribbean Countries. Heliyon, 6(12), 1-11.

Agyemang-Badu, A.A., Agyei, K., Duah, E.K. (2018), Financial inclusion, poverty and income inequality: Evidence from Africa. Spiritan International Journal of Poverty Studies, 2(2). Available from: https://ssrn.com/abstract=3167200

Ajibola, A.A., Loto, M.A., Enilolobo, O.S. (2018), Poverty and inequality in Nigeria: Implications for inclusive growth. Nile Journal of Business and Economics, 9, 30-51.

Asongu, S.A., Efobi, U.R., Tanakem, B.V., Osabuohien, E. (2019), Globalisation and female economic participation in sub-Saharan Africa. Gender Issues, 37(1), 61-89.

Aust, V., Morais, A., Pinto, I. (2019), How does foreign direct investment contribute to Sustainable Development Goals? Evidence from African countries. Journal of Cleaner Production, 245, 118823.

Aziz, S., Basit, A., Sultana, S., Homer, C. S., and Vogel, J. P. (2022), Inequalities in women's utilization of postnatal care services in Bangladesh from 2004 to 2017. Scientific reports, 12(1), 2747

Cerf, M.E. (2018), The Sustainable development goals: Contextualizing Africa's economic and health landscape. Global Challenges, 2, 1800014.

Doumbia, D., Kinda, T. (2019), Reallocating Public Spending to Reduce Income Inequality: Can It Work? IMF Working Paper WP/19/188.

Erlando, A., Riyanto, F.D., Masakazu, S. (2020), Financial inclusion, economic growth, and poverty alleviation: evidence from eastern Indonesia. Heliyon, 6(10), e05235.

Fagbemi, F. (2021), COVID-19 and sustainable development goals (SDGs): An appraisal of the emanating effects in Nigeria. Research in Globalization, 3, 100047.

Francis, D., Webster, E. (2019), Poverty and inequality in South Africa: Critical reflections. Development Southern Africa, 36(6), 1-15.

Francis, D., Webster, E. (2019), Poverty and inequality in South Africa: Critical reflections. Development Southern Africa, 36(6), 788-802.

Fransman, T., Yu, D. (2019), Multidimensional poverty in South Africa in 2001-16. Development Southern Africa, 36(1), 50-79.

Gumede, V. (2021), Revisiting poverty, human development and inequality in democratic South Africa. Indian Journal of Human Development, 15(2), 183-199.

Kouadio, H. K., Gakpa, L. L. (2022), Do economic growth and institutional quality reduce poverty and inequality in West Africa?. Journal of Policy Modeling, 44(1), 41-63

Kuznets, S. (1955), Economic growth and income inequality. American Economic Review, 45, 1-28.

Mhlanga, D. (2020), Financial Inclusion and Poverty Reduction: Evidence from Small Scale Agricultural Sector in Manicaland Province of Zimbabwe. Available from: http://repository.nwu.ac.za/handle/10394/34615

Mhlanga, D., Moloi, T. (2021), COVID-19, and sustainable development goals: A comparative analysis of Zimbabwe and South Africa. African Renaissance, 18(1), 247-269

More, I., Aye, G.C. (2017), Effect of social infrastructure investment on

economic growth and inequality in South Africa: A SEM approach. International Journal of Economics and Business Research, 13(2), 95-109.
Ogbeide, E.N.O., Agu, D.O. (2015), Poverty and income inequality in Nigeria: Any causality? Asian Economic and Financial Review, 5(3), 439-452.
Ogujiuba, K., Mngometulu, N. (2022), Does social investment influence poverty and economic growth in South Africa: A cointegration analysis? Economies, 10, 226.
Olamide, E.G., Maredza, A. (2021), Pre-COVID-19 evaluation of external debt, corruption and economic growth in South Africa. Review of Economics and Political Science, 8(1), 19-36.
Osabohien, R., Matthew, O., Ohalete, P., Osabuohien, E. (2020), Population-poverty-inequality nexus and social protection in Africa. Social Indicators Research: An International and Interdisciplinary Journal for Quality-of-Life Measurement, 151(2), 575-598.
Osabohien, R., Osuagwu, E., Osabuohien, E., Ekhator-Mobayode, U.E., Matthew, O., Gershon, O. (2020), Household access to agricultural credit and agricultural production in Nigeria: A propensity score matching model. South African Journal of Economic and Management Sciences, 23(1), a2688.
Osabuohien, E., Odularu, G., Ufua, D., Augustine, D., Osabohien, R. (2022), Socioeconomic shocks, inequality and food systems in the Global South: an introduction. Contemporary Social Science, 17(2), 77-83.
Rajkumari, L., Gayithri, K. (2017), Electricity Consumption and Economic Growth in Karnataka. Working Paper No. 384 of the Institute for Social and Economic Change, Bangalore.
Rogan, M. (2015), Gender and multidimensional poverty in South Africa: Applying the global multidimensional poverty index (MPI), Social Indicators Research, 126(3), 987-1006.
Remenyi, J. (2004), Poverty and development: The struggle to empower the poor. Key issues in development, 190-220.
Sachs, J.D., Schmidt-Traub, G., Mazzucato, M., Messner, D., Nakicenovic, N., Rockström, J. (2019), Six transformations to achieve the sustainable development goals. Nature Sustainability, 2(9), 805-814.
Satumba, T., Bayat, A., Mohamed, S. (2017), The impact of social grants on poverty reduction in South Africa. Journal of Economics, 8(1), 33-49.
Sulla, V., Zikhali, P. (2018), Overcoming Poverty and Inequality in South Africa: An Assessment of Drivers, Constraints, and Opportunities. Available from: http://documents.worldbank.org/curated/en/530481521735906534/overcoming-poverty-and-inequality-in-south-africa-anassessment-of-drivers-constraints-and-opportunities [Last accessed on 2022 Jan 10].
United Nations. (2016), Sustainable Development Goals: 17 Goals to Transform Our World 2016. Available from: https://www.un.org/sustainabledevelopment/sustainable-development-goals [Last accessed on 2018 Aug 14].
Wadi, S.A., Almasarweh, M., Alsaraireh, A.A. (2018), Predicting closed price time series data using ARIMA model. Modern Applied Science, 12(11), 181.
World Bank. (2020), Poverty Overview 2020. Available from: https://www.worldbank.org/en/topic/poverty/overview
Yameogo, C. E., Omojolaibi, J. A. (2022), Regional economic integration and its impact on income distribution and the poverty level: The case of the WAEMU zone. Quaestiones Geographicae, 41(2), 21-35