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-RESEARCH ARTICLE-

THE NEXUS BETWEEN CORRUPTION, INCOME INEQUALITY AND POVERTY IN SOUTH AFRICA

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—Abstract—

To achieve United Nations Sustainable Development Goal 3 and 10, which focus on ending poverty in all its forms everywhere and reducing inequality within and among countries, there is a need to examine the relationship between corruption, income inequality, and poverty within the South African context. This examination aims to recommend policies that will help achieve these goals. Therefore, this study investigates corruption-income inequality-poverty nexus for South Africa spanning from 1996 to 2020. This research contributes to the existing literature by utilizing advanced econometric techniques, including Autoregressive Distributed Lags and Fully Modified Ordinary Least Squares, to comprehensively investigate the complex interplay between corruption, income inequality, and poverty in South Africa. By employing these methods, the study offers a more nuanced understanding of the dynamic relationships over time, providing policymakers with valuable insights for designing targeted interventions to address these pressing socio-economic issues in South Africa. Autoregressive Distributed Lags and Fully Modified Ordinary Least Squares were employed to achieve the study's objectives. There is a long run relationship among the variables of interested in this study. However, in the short run corruption significantly

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impact income inequality. Addressing corruption in South Africa is crucial to mitigate income inequality and poverty in the long run. Immediate measures should focus on reducing corruption's short-term impact on income inequality. Long-term strategies should include effective anti-corruption measures to create a more equitable society, thereby reducing poverty and enhancing overall economic development.

Keywords: Corruption, Income inequality, Poverty, South Africa

JEL Classification: G3, D63, I3

INTRODUCTION

Corruption is a global issue that exerts influence on poverty, income inequality, and income growth rates (Moges, 2013). For over 300 years, a corrupt authority structure adversely affected South Africans, allowing a privileged few to profit at the expense of the majority (Ikejiaku, 2009). In 1975, a public servant traded an acre of land for R125,000, which was 62 times the asking price of R2,000 just two years earlier (Van Vuuren, 2006). Public sector corruption is defined as 'the use of public office for private gains' (Bardhan, 1997). In the post-apartheid era, it was the black population that came into power and was exposed to significant financial and resource opportunities.

Increased corruption reduces financial investment, distorts markets, hampers competition, fosters inefficiencies by elevating operating costs, and widens income disparities (Chetwynd et al., 2003). Poverty becomes more severe when these critical economic factors are undermined. As they assumed power and gained access to abundant resources for the first time, it fuelled greed and the temptation to abuse their authority. They began to exhibit avarice and misuse government resources. Corruption is a daily occurrence in South Africa. Allegations of dishonesty against cabinet members engaged in dubious practices have been widespread (Hyslop, 2005). Ace Magashule, the Secretary-General of the African National Congress (ANC), was instructed to step down after facing charges from public prosecutors in November in connection with an allegedly fraudulent $18 million project aimed at removing asbestos from homes in disadvantaged communities in the Free State province (Vyas-Doorgapersad, 2022).

Poverty is closely linked to corruption, as public servants divert resources intended to assist the disadvantaged for personal gain, leaving them with nothing, thereby exacerbating their plight. Analysing the impact of corruption on poverty is essential, as it poses challenges to economic and social factors in African countries (Ahmed & Mustafa, 2016). Income inequality is one of the most pressing issues. According to the World Inequality Database (2021), the wealthiest 10% earn over 60 times more than the bottom 50% of working individuals, who earn approximately R12,300 annually.

Economists typically differentiate between two fundamental measures of income distribution for analytical and quantitative purposes: personal income distribution and the functional factor share distribution (Francese & Mulas-Granados, 2015).

In essence, income inequality refers to the uneven allocation of total national income among households, both rich and poor. South Africa is currently grappling with high levels of corruption, income inequality, and poverty. Extreme income inequality results in economic inefficiency (Francese & Mulas-Granados, 2015). For instance, with greater inequality, fewer people are eligible for loans, given the average income. The lack of collateral defines relative poverty, making it difficult for impoverished individuals to secure loans for child education or business ventures. Consequently, high inequality is likely to depress savings rates in the economy, with the middle class exhibiting the highest marginal savings rates (Francese & Mulas-Granados, 2015).

De Graaf (2007) enumerates various reasons or causes of corruption, including:

- Extensive poverty and low levels of public sector wages
- Opportunities stemming from weak governance and public servants' incompetence
- Lack of whistle-blowers, among others.

The nexus between corruption, income inequality, and poverty is a complex and multifaceted issue that has been extensively explored in academic literature. Several theoretical perspectives shed light on the interconnections among these variables, firstly, the institutional theorists argue that corruption thrives in environments with weak institutions and inadequate governance mechanisms. Corruption undermines the rule of law, distorts economic incentives, and exacerbates income inequality by favoring the wealthy and powerful at the expense of the poor (Chetwynd et al., 2003; Robinson & Acemoglu, 2012). As a result, unequal access to resources and opportunities perpetuates inequality and poverty (North & Alt, 1990). Secondly, rent-seeking behaviour refers to the pursuit of wealth through activities that do not create new wealth but merely redistribute it. Corruption is often driven by rent-seeking incentives, where individuals or groups seek to extract economic rents from public resources or regulations.

This behaviour leads to inefficient allocation of resources, impedes economic growth, and widens income disparities (Krueger, 1974). Thirdly, elite capture theory occurs when powerful groups or individuals manipulate political and economic systems to serve their interests, thereby perpetuating income inequality and exacerbating poverty (Khan, 2006). Corruption serves as a tool for elites to maintain their privileged position by capturing state resources, distorting markets, and excluding marginalized groups from the benefits of economic development (Khan, 2006).

Fourthly, the poverty trap hypothesis suggests that corruption can trap individuals and communities in cycles of poverty by impeding their ability to access essential services, invest in human capital, or engage in productive activities (Collier, 2008). In corrupt systems, resources intended for poverty alleviation programs or public services are often diverted or misallocated, perpetuating the conditions of deprivation (Collier, 2008). Lastly, the social capital theory refers to the networks, norms, and trust that facilitate cooperation and collective action within society. Corruption erodes social capital by undermining trust in institutions and weakening social cohesion (Leonardi et al., 2001). In societies with low social capital, individuals may be less inclined to invest in public goods or participate in community development initiatives, exacerbating poverty and widening income disparities (Leonardi et al., 2001).

The genesis of poverty and income inequality has attracted numerous researchers to South Africa. There is scant research on the nexus between corruption, income inequality, and poverty. Chotia and Rao (2017) study provides evidence that both rural and urban income inequality exacerbates poverty in BRICS economies, while Gyimah-Brempong (2002) investigates the consequences of corruption on economic growth and income distribution in African countries. Gupta et al. (1998), Gupta et al. (2000), and Gyimah-Brempong (2002) contend that corruption contributes to income inequality through various channels. First, corruption reduces economic growth, thereby increasing income inequality and poverty.

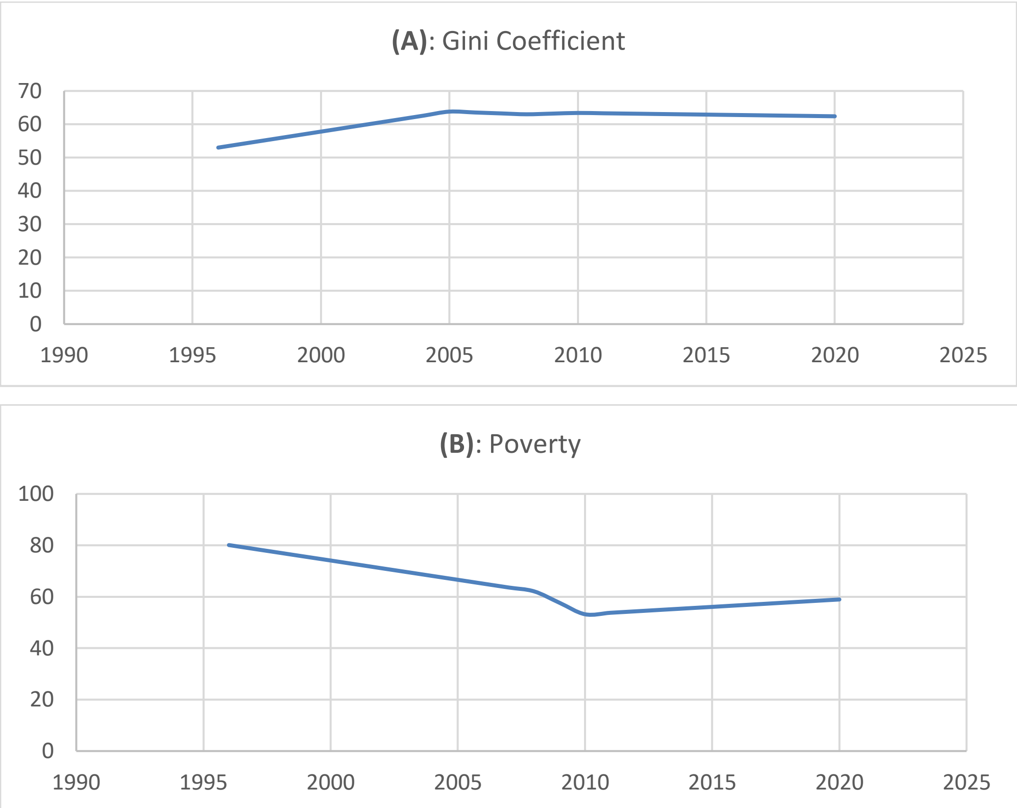
A second channel is that corruption leads to a regressive tax system (Capasso et al., 2022), where the tax burden falls disproportionately on the poor. Corruption allows the rich to evade their tax obligations. Gyimah-Brempong (2002) found evidence that corruption correlates with increased income inequality. Africa is continent rich in minerals and resources but remains one of the poorest. Poverty-alleviation programs are underutilized as funds often end up in the hands of corrupt individuals (Addae-Korankye, 2014). Corruption may not directly increase poverty, but its consequences can exacerbate the economic factors contributing to poverty (Chetwynd et al., 2003). According to Keneck-Massil et al. (2021), there is a negative relationship between income inequality and corruption.

Gyimah-Brempong (2002), Gupta et al. (1998), and Gupta et al. (2000) argue that corruption and income inequality are positively related, while (Keneck-Massil et al., 2021) suggest a negative relationship. Given the contradictory findings in the previous empirical studies, therefore, this study contributes to understanding the nexus between corruption, income inequality, and poverty by investigating the effect of corruption on income inequality and poverty, utilizing recent data and applying Autoregressive Distributed Lag (ARDL) and Fully Modified Ordinary Least Squares (FMOLS) methods. Previous studies have primarily focused on the impact of income inequality on poverty or how corruption influences income inequality. To the best of our

Vol: 16 **No:** 01 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 224-251) **Doi:** 10.34109/ijefs.202416110

knowledge, no study has investigated the interplay between corruption, income inequality, and poverty within the South African context, along with the econometric approach employed in this study. Filling this research gap is vital as it addresses a critical aspect of South Africa's economic and social challenges.

Understanding how corruption, income inequality, and poverty interact within this unique context can provide invaluable insights for policymakers and scholars. Moreover, the use of novel econometric methods can offer fresh perspectives and robust analysis, contributing to a more comprehensive understanding of these complex issues, aiding in the development of effective policies and strategies to tackle them. Furthermore, below, Figure 1 displays a graphical representation of the temporal trajectories for the key variables of interest in this study, specifically for South Africa. The initial analysis provided by the visual graph indicates that the three variables exhibited distinct temporal patterns during the study period. This finding highlights the necessity of exploring the interconnections among the variables illustrated in Figure 1. Filling this gap in the literature is important because it will facilitate the formulation of policies aimed at achieving United Nations Sustainable Development Goal 3 and 10, which are dedicated to ending poverty in all its forms worldwide and reducing inequality within and among countries.



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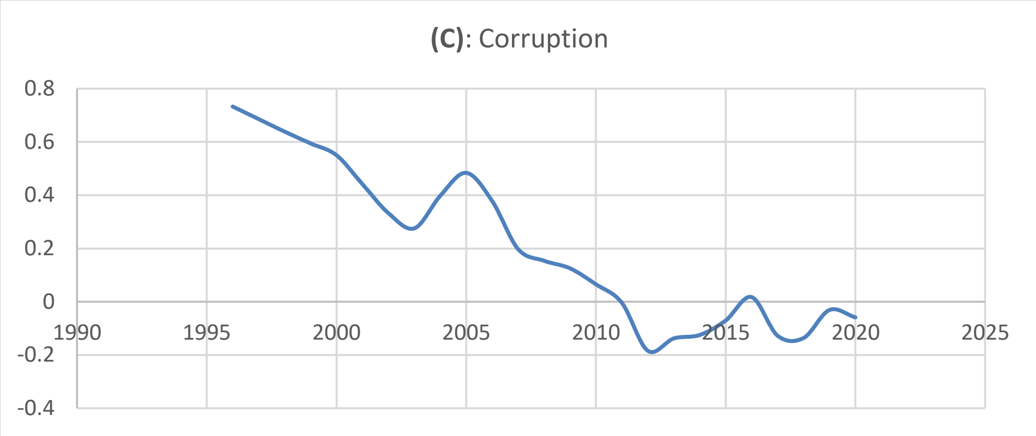

Figure 1: (**A**): Trends in the Gini Coefficient (proxy for inequality) for (Africa, 1996-2020); (**B**): Trends in poverty for (Africa, 1996-2020); (**C**): Trends in corruption in (Africa, 1996-2020).

The data for corruption, income inequality, and poverty are sourced from the World Bank's governance indicators. The selected period spans from 1996 to 2020. This study draws inspiration from Gyimah-Brempong (2002), who used OLS, IV, and LIML estimation methods to analyse corruption and income inequality, yielding a negative relationship significantly different from zero. According to Ahmed and Mustafa (2016), the model employed was FEM (fixed effects model) and REM (random effects model), revealing a positive relationship between poverty and corruption. This academic work will utilize Autoregressive Distributed Lag (ARDL) and FMOLS (Fully Modified Ordinary Least Squares) estimation methods.

The significance of the study lies in its exploration of the intricate relationships between corruption, income inequality, and poverty, particularly within the context of South Africa. Previous research has primarily focused on individual aspects of these phenomena, but this study takes a comprehensive approach to understand their interconnectedness. This study delves into pressing socio-economic challenges faced by South Africa, including high levels of corruption, income inequality, and poverty. By examining the interplay between these factors, the study sheds light on the complex dynamics that contribute to economic disparity and social exclusion. By utilizing advanced econometric methods such as Autoregressive Distributed Lag (ARDL) and Fully Modified Ordinary Least Squares (FMOLS), the study offers methodological innovation. These techniques provide robust analysis and insights into the long-term dynamics of corruption, income inequality, and poverty, enhancing the credibility and depth of the findings. The findings of the study have significant policy implications for addressing poverty and inequality in South Africa. By understanding how corruption influences income distribution and exacerbates poverty, policymakers can formulate targeted interventions to tackle these issues effectively. Moreover, the study aligns with

Vol: 16 **No:** 01 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 224-251) **Doi:** 10.34109/ijefs.202416110

the United Nations Sustainable Development Goals (SDGs), particularly Goal 1 (ending poverty) and Goal 10 (reducing inequality), by providing empirical evidence and insights for policy formulation, implementation, evaluation and review. This study fills a critical research gap by exploring the nexus between our variables of interest within the South African context as mentioned earlier. While previous studies have examined similar issues, the unique focus on South Africa and the application of specific econometric methods contribute to advancing scholarly knowledge in this area.

The literature review relevant to this study follows this section. The subsequent sections present and discuss the methodology and data in chronological order, provide the study's results, and then present the conclusion and recommendations.

LITERATURE REVIEW

Previous Literature

Government corruption is driven by the availability of state resources for personal gain by government officials (Shleifer & Vishny, 1993). For instance, government officials accept bribes from other individuals if they seek to break the law. Typically, these bribes take the form of money, promises of employment or contracts, or fully funded trips. Poverty arises when one or more individuals fall below a minimum standard of economic and social support, which is considered a reasonable basic standard, whether in an absolute sense or according to the norms of a particular community (Lipton & Ravallion, 1995). Income inequality is characterized by the disproportionate distribution of total income among households (Francese & Mulas-Granados, 2015).

Keneck-Massil et al. (2021) study investigates the nature of political power classification using subsequent linear panel data (SLPD) estimation. They divide 172 countries into 95 developed countries with high income and 77 developing economies with low income for the period from 1975 to 2017. Their study indicates that when corruption decreases, income inequality widens in developing countries, while the relationship is reversed in developed countries. In contrast to Keneck-Massil et al. (2021) study, Sulemana and Kpienbaareh (2018) study focuses on the link between corruption and income inequality, with corruption as the dependent variable and income inequality as the independent variable. The study spans from 1996 to 2016, with a focus on 48 countries in Sub-Saharan Africa. The economic model used to obtain results is the two-stage least estimation (2SLS) due to the limitations of OLS, which may produce biased results, measurement errors, or fail to address reverse causality problems. The results suggest that high levels of income inequality are associated with increased corruption.

Andres and Ramlogan-Dobson (2011) provide new evidence on the relationship between corruption and income inequality. They employ panel data from 1982 to 2002

Vol: 16 **No:** 01 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 224-251) **Doi:** 10.34109/ijefs.202416110

for 19 Latin American countries. Their findings indicate that in Latin America, reduced corruption is linked to reduced income inequality. Unlike other empirical studies, this result makes sense in the Latin American context. Apergis et al. (2010) investigates the causality between corruption and income inequality using panel data from 1980 to 2004 from all 50 U.S. states within a multivariate framework. They employ fully modified OLS to estimate the regression of the long run cointegrating correlation. Their results show a positive relationship between corruption and income inequality. Essentially, corruption can lead to poverty without intervention, and income inequality can also lead to poverty, and vice versa.

Regarding findings in the United States, Dincer and Gunalp (2008) examine the impact of corruption on income inequality and poverty. Their study aims to understand the relationship using four different approaches. Firstly, they employ an objective measure of abuse of power: the number of public officials convicted in a state for corruption-related crimes. Secondly, they use poverty and income inequality, which are commonly used in other studies. Thirdly, they address potential data incompatibility issues by examining variations in income inequality and poverty across U.S. states. Lastly, they analyse time series and cross-sectional data from the period 1981 to 1991 for 50 states. They employ OLS to estimate the relationship between both corruption and income inequality, finding a significant positive relationship, meaning that an increase in corruption results in an increase in income inequality, and the same applies to corruption and poverty.

As impoverished individuals often rely on government assistance, they are more susceptible to manipulation by street-level officials. The study analysed data from 18 African countries based on micro-level survey data from Afro-barometer. The results suggest that poor people are considerably more vulnerable to bribes from government officials. Country fixed and region fixed effects models were employed to assess the relationship between poverty and corruption. The survey was conducted between 2005 and 2006 (Justesen & Bjørnskov, 2014). Gupta et al. (2002) explores several ways in which corruption can impact poverty. They examine data from various countries from 1980 to 1997. Their results indicate that high levels of corruption are associated with slower earnings growth for poor people.

Conceptual Framework

The corruption-income inequality-poverty nexus is complex and multifaceted, supported by both empirical evidence and theoretical perspectives. The conceptual framework of this study integrates insights from empirical literature and theoretical perspectives on the relationships among these variables, as well as theoretical frameworks that elucidate the underlying mechanisms. Numerous studies have established a significant relationship between corruption and both income inequality and poverty (Mauro, 1995; Wei, 2001). According to empirical literature, corruption

Vol: 16 **No:** 01 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 224-251) **Doi:** 10.34109/ijefs.202416110

undermines economic development, distorts resource allocation, and exacerbates income disparities (Gupta et al., 2002; Svensson, 2005). Empirical studies have shown that corruption exacerbates income inequality and poverty by diverting resources from public services and social programs (Gupta et al., 2002). Institutional theory suggests that corruption flourishes in environments with weak governance structures and ineffective regulatory mechanisms (Kaufmann et al., 2009). Rent-seeking theory posits that corruption arises when individuals or groups seek to extract economic rents through illicit means (Krueger, 1974).

Income inequality has been widely documented in South Africa, with historical legacies of apartheid contributing to persistent disparities (Leibbrandt et al., 2010). Empirical studies have highlighted the role of corruption in exacerbating income inequality through unequal access to resources and opportunities (Glaeser & Saks, 2006). The dual economy model suggests that income inequality arises from the coexistence of a modern, high-income sector and a traditional, low-income sector (Lewis, 1954). For example, Gyimah-Brempong (2002) examines the impact of corruption on economic growth and income distribution in African countries. The study finds that corruption negatively affects economic growth and contributes to higher income inequality. Jong-Sung and Khagram (2005) explores the relationship between corruption and income inequality across different countries. The authors conclude that higher levels of corruption are associated with greater income inequality.

Poverty remains a significant challenge in South Africa, with high levels of deprivation and limited access to basic services (Africa, 2020). Empirical research has linked corruption and income inequality to increased poverty rates (Hoeffler & Outram, 2011; Sachs, 2005). Sachs (2005) discusses the poverty trap and emphasizes the need for targeted interventions to break the cycle of poverty, highlighting the role of corruption in hindering these efforts. The poverty trap hypothesis suggests that individuals and communities can become trapped in cycles of poverty due to factors such as limited access to education, healthcare, and economic opportunities (Sachs, 2005). The capability approach emphasizes the importance of enhancing individuals' capabilities to overcome poverty (Sen, 2014). Figure 2 below illustrates the graphical representation of the conceptual framework described above.

A prevalent gap in the current literature is the absence of a thorough examination of the link between corruption, poverty, and income inequality. While certain empirical studies rely on surveys, which can produce varying results, others focus on the correlation between corruption and income inequality, employing the International Perception Index to gauge corruption. It is for these reasons, among others, that we explore the interplay between corruption, income inequality, and poverty in South Africa. This research employs World Governance Indicator data, with corruption as the dependent variable, covering the period from 1996 to 2020.

Vol: 16 **No:** 01 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 224-251) **Doi:** 10.34109/ijefs.202416110

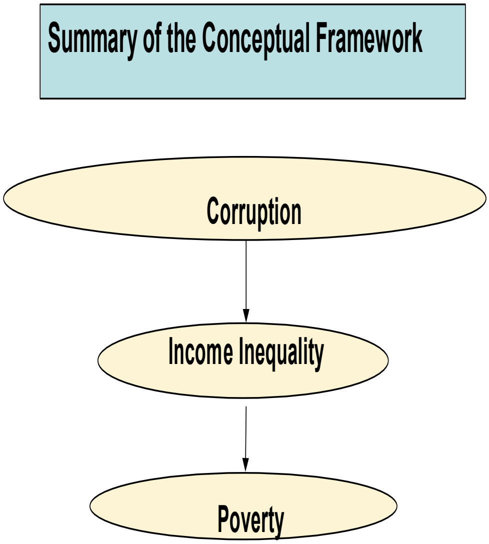

Figure 2: Summary of the Diagram Explaining the Conceptual Framework on the Nexus between Corruption, Income, Inequality and Poverty

METHODOLOGY

Estimation Techniques

We initiate our analysis by conducting a unit root test on the time series data. This test encompasses both the Augmented Dickey-Fuller (ADF) test (Dickey & Fuller, 1981) and the Phillips-Perron (PP) test (Phillips, 1988). The primary objective of this unit root test is to prevent spurious regression, which can yield misleading conclusions. We opt for the ADF test because it incorporates the lag-dependent variable, effectively mitigating autocorrelation (Asteriou & Hall, 2021). The PP test is a relatively recent addition, acknowledged for its unbiased and lenient assumptions regarding error distribution.

Once the unit root test is completed, we proceed to examine the cointegration between the variables using the Johansen-Fisher Cointegration test. Prior to cointegration testing, we will determine the optimal lag length based on two criteria: the Schwartz Information Criteria and the Akaike Information Criteria. The Johansen-Fisher test is employed to assess cointegration between the dependent and independent variables. Additionally, our study will incorporate a correlation matrix and diagnostic statistics. We also utilized the Autoregressive Distributed Lag (ARDL) bound test and the Fully Modified Ordinary Least Squares (FMOLS) to accomplish the objective of this study,

Vol: 16 **No:** 01 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 224-251) **Doi:** 10.34109/ijefs.202416110

building on previous research such as that conducted by (Adams & Klobodu. 2018; Igwegbe & Amaka, 2021; Merlin & Chen, 2021; Muhammad et al., 2022)

ARDL bound test was applied to the time series data because it offers a flexible modeling framework that can handle variables with diverse integration properties. This is important in economic analysis where variables may exhibit different levels of persistence and long-run behavior. By accommodating both stationary and non-stationary variables, ARDL provides a robust approach for estimating long-run relationships while addressing issues of spurious regression and ensuring the validity of inference (Adams & Klobodu, 2018; Igwegbe & Amaka, 2021; Merlin & Chen, 2021; Muhammad et al., 2022). FMOLS method was used in this study to: (i) estimate the long-run parameters in the cointegrating regression model; (ii) address the endogeneity and serial correlation issues commonly encountered in time series data by applying a correction procedure to the OLS estimator; and (iii) provide consistent estimates even when the regressors are endogenous and exhibit serial correlation, making it suitable for modelling relationships between variables of the study over time (Adams & Klobodu, 2018; Igwegbe & Amaka, 2021; Merlin & Chen, 2021; Muhammad et al., 2022).

Theoretical Framework and Model Specification

This study examines six theories of poverty: Conservative, Liberal Reformists, Radical Marxists, Social Exclusion Theory, and Feedback Theory, also known as the Poverty Cycle. Conservative theories place blame on the poor for their circumstances, attributing an individual's or household's inability to escape poverty to their inefficiency (Nwankwo, 2013). It is not surprising, then, that many African political theorists attribute the issue of political corruption to the legacy of British colonialism (Ekeh, 1975). In Africa, a one-unit increase in the corruption index aligns with a seven-point rise in the Gini coefficient of income inequality (Policardo et al., 2019). Dincer and Gunalp (2008) found that corruption significantly increases income inequality, estimated poverty without controlling for income inequality, and concluded that corruption contributes to poverty. This study centres on distribution theory, which seeks to explain functional distribution - the share of total national income received by each factor of production - and the size of income distribution or personal distribution (Kakwani, 1980).

We are particularly interested in determining whether corruption impacts income inequality and poverty in this study. Corruption can manifest at different levels, including street-level corruption, which occurs in citizens' day-to-day interactions with public servants, corporate corruption, which occurs among businesses of all sizes, often involving comparable public servants, and top-level corruption, which involves significant sums of money and influences political power in finance, civil service, and administration (David, 2012).

Vol: 16 **No:** 01 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 224-251) **Doi:** 10.34109/ijefs.202416110

$$corrupt_t = f(gini, poverty) \tag{1}$$
$$lncorrupt_t = \alpha_0 + \beta_0 lngini_t + \beta_1 lnpov_t + \beta_2 x_t + u_t \tag{2}$$

Equation (1) is interpreted as a corruption function of the Gini coefficient proxy for income inequality, and headcount proxy for poverty.

Equation (2) is the intercept of the model, β are the coefficient to be estimated, is a set of control variables and is the error term. Stands for time to be used in this model. Dependent variable used is corruption which the proxy is control of corruption. Our variables are in logarithm form to minimize heteroscedasticity problems. The control variables used in this study include income inequality, poverty, GDP per capita, net inflows of direct foreign investment, gross capita formation, unemployment and government expenditure (Negin et al., 2010; Sulemana & Kpienbaareh, 2018).

ARDL Bound Test

This research is designed to use ARDL to check the long-term relationship between variables. The advantage of using ARDL is that it is efficient for small sample data. The ARDL must demonstrate the presence of a solid relationship (Wang, 2022).

$Model\ 1.$

$$\Delta lncorrupt_t = y_0 + \textstyle\sum_{i=1}^{n} y_0\, \Delta lncorrupti_t + \sum_{i=1}^{n} y_0 \Delta lngini_t + \sum_{i=1}^{n} y_0 \Delta lnpov_t + \sum_{i=1}^{n} y_0 \Delta lngdp_t + \sum_{i=1}^{n} y_0 \Delta lnfdi_t + \sum_{i=1}^{n} y_0\, \Delta lngovexp_t + \sum_{i=1}^{n} y_0\, \Delta lngcf_t + \sum_{i=1}^{n} y_0\, \Delta lnunempl_t + \delta_1\, lncorrupt_t + \delta_2 lngini_t + \delta_3 lnpov_t + \delta_4 lnfdi_t + \delta_5 lngovexp_t + \delta_6 lngdp_t + \delta_7 lnunempl_t + \delta_8 lngcf_t + \varepsilon_t \tag{3}$$

$Model\ 2.$

$$\Delta lngini_t = y_0 + \textstyle\sum_{i=1}^{n} y_0 \Delta lngini_t + \sum_{i=1}^{n} y_0 \Delta lncorrupt_t + \sum_{i=1}^{n} y_0 \Delta lnpov_t + \sum_{i=1}^{n} y_0 \Delta lngdp_t + \sum_{i=1}^{n} y_0 \Delta lnfdi_t + \sum_{i=1}^{n} y_0 \Delta lngovexp_t + \sum_{i=1}^{n} y_0\, \Delta lngcf_t + \sum_{i=1}^{n} y_0\, \Delta lnunempl_t + \delta_1 lncorrupt_t + \delta_2 lngini_t + \delta_3 lnpov_t + \delta_4 lnfdi_t + \delta_5 lngovexp_t + \delta_6 lngdp_t + \delta_7 lnunempl_t + \delta_8 lngcf_t + \varepsilon_t \tag{4}$$

$Model\ 3.$

$$\Delta lnpov_t = y_0 + \textstyle\sum_{i=1}^{n} y_0\, \Delta lnpov_t + \sum_{i=1}^{n} y_0 \Delta lngini_t + \sum_{i=1}^{n} y_0 \Delta lncorrupt_t + \sum_{i=1}^{n} y_0 \Delta lngdp_t + \sum_{i=1}^{n} y_0 \Delta lnfdi_t + \sum_{i=1}^{n} y_0 \Delta lngovexp_t + \sum_{i=1}^{n} y_0\, \Delta lnunempl_t + \sum_{i=1}^{n} y_0\, \Delta lngcf_t + \delta_1 lncorrupt_t + \delta_2 lngini_t + \delta_3 lnpov_t + \delta_4 lnfdi_t + \delta_5 lngovexp_t + \delta_6 lngdp_t + \delta_7 lnunempl_t + \delta_8 lngcf_t + \varepsilon_t \tag{5}$$

$\varepsilon_t and\ \Delta$, denotes the white noise and the first difference terms. δ_1, δ_2 and δ_3 constitutes for short term correlation between the coefficients. The maximum lag order is measured by Akaike Information Criteria and Schwarts Bayesian Criterion. Based on equation (3), (H_0: $\delta_1 = \delta_2 = \delta_3 = 0$) *is* the null hypothesis with peculiar alternative hypothesis

Vol: 16 **No:** 01 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 224-251) **Doi:** 10.34109/ijefs.202416110

(H_1:$\delta_1 \neq \delta_2 \neq \delta_3 \neq 0$). Assuming that there is no cointegration existing, the short run is represented as:

$$\Delta lncorrupt_t = y_0 + \sum_{i=1}^{n} y_0 \, \Delta lncorrupti_t + \delta ECM_t + u_t \tag{6}$$

ECM is the error correction model, and it is addressed as follows:

$Model$ 1.

$$\Delta lncorrupt_t = y_0 + \sum_{i=1}^{n} \delta_1 lncorrupt_t + \sum_{i=1}^{n} \delta_2 lngini_t + \sum_{i=1}^{n} \delta_3 lnpov_t + ECM_t + u_t \tag{7}$$

$Model$ 2.

$$\Delta lngini_t = y_0 + \sum_{i=1}^{n} \delta_1 lngini_t + \sum_{i=1}^{n} \delta_2 lncorrupt_t + \sum_{i=1}^{n} \delta_3 lnpov_t + ECM_t + u_t \tag{8}$$

$Model$ 3.

$$\Delta lnpov_t = y_0 + \sum_{i=1}^{n} \delta_1 lnpov_t + \sum_{i=1}^{n} \delta_2 lngini_t + \sum_{i=1}^{n} \delta_3 lncorrupt_t + ECM_t + u_t \tag{9}$$

For the long run model, the specified function is represented as:

$Model$ 1.

$$\Delta lncorrupt_t = y_0 + \delta_1 lncorrupt_t + \delta_2 lngini_t + \delta_3 lnpov_t + u_t \tag{10}$$

$Model$ 2.

$$\Delta lngini_t = y_0 + \delta_1 lngini_t + \delta_2 lncorrupt_t + \delta_3 lnpov_t + u_t \tag{11}$$

$Model$ 3.

$$\Delta lnpov_t = y_0 + \delta_1 \ln pov_t + \delta_2 lncorrupt_t + \delta_3 lngini_t + u_t \tag{12}$$

Data Description

We utilized time series data from South Africa spanning the years 1996 to 2020. This research employs a quantitative approach, including an econometric model. The data on corruption was sourced from the World Governance Indicator database. Income inequality refers to a significant disparity in income among different groups, populations, and social classes. (Keneck-Massil et al., 2021) employed the Gini coefficient as a proxy for measuring income inequality; hence, this study follows a similar approach. All other variables were extracted from the World Bank database. Poverty is assessed using the poverty headcount ratio at the national poverty line, as per (Asongu & Odhiambo, 2023). Missing data for certain variables will be addressed through interpolation and extrapolation. Alnasaa et al. (2022) used control of corruption as a proxy for their study. We chose the period 1996-2020 for the study due to its significance in South Africa's history. This period marks the post-apartheid era, characterized by significant political, social, and economic changes in South Africa. It

Vol: 16 **No:** 01 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 224-251) **Doi:** 10.34109/ijefs.202416110

represents a critical phase for examining the impact of policy changes and governance on corruption, income inequality, and poverty. Additionally, this timeframe allows for the analysis of long-term trends and the evaluation of the effectiveness of various initiatives aimed at addressing these issues. By studying this period, we offer insights into the progress made and the challenges that persist in South Africa's socio-economic landscape. The choice of the period was also influenced by the availability of consistent and reliable data for the variables of interest (corruption, income inequality, and poverty) to conduct a robust analysis.

EMPIRICAL RESULTS AND DISCUSSION

Descriptive Statistics

Table 1: Descriptive statistics results

	corrpti	ginico	pov	govex	fdi	gdp	unempl	gcf
Mean	0.275	61.150	63.951	40183.56	3.81E+09	5723.197	7.596	17.097
Median	0.211	62.700	62.100	28075.00	3.70E+09	6259.840	7.470	16.831
Maximum	0.732	63.800	80.100	111793.0	9.90E+09	8810.930	14.580	21.287
Minimum	-0.115	53.000	53.200	8839.000	5.50E+08	2797.090	0.410	12.745
Std. Dev	0.277	3.208	8.737	29712.62	2.78E+09	1749.809	3.707	1.874
Skewness	0.270	-1.403	0.449	0.898	0.480	-0.198	0.258	-0.002
Kurtosis	1.665	3.565	1.788	2.717	2.083	1.961	2.607	3.021
Jacque Bera	2.160	8.543	2.369	3.446	1.838	1.287	0.438	0.000
Prob	0.339	0.013	0.305	0.178	0.398	0.525	0.803	0.999

Source: Author’s computation

Table 1 presents the descriptive statistics for the variables. There is a mean value of 0.275, with a maximum value of 0.732, a minimum value of -0.115, and a standard deviation of 0.277. The variable exhibits a positively skewed distribution, with a kurtosis of 1.665, indicating leptokurtosis. GiniCo, with a mean value of 61.156, ranges from a maximum of 63.800 to a minimum of 53.000, with a standard deviation of 3.208.

Table 2 presents the correlations between the variables. A positive and significant relationship is observed between corruption and poverty, indicating that when corruption increases, poverty also increases at a 5% level of significance. On the other hand, there is a negative and significant relationship between corruption, govex, GDP, unemployment, GCF, and FDI. This suggests that as corruption increases, govex, GDP, unemployment, GCF, and FDI all decrease at a 10% level of significance.

Vol: 16 **No:** 01 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 224-251) **Doi:** 10.34109/ijefs.202416110

Table 2: Correlation matrix results

Correlation Probability	corrpti	Fdi	gdp	ginico	govex	pov	Gcf	Unempl
corrpti	1.000 ------							
FDI	-0.391 0.053**	1.000 -----						
GDP	-0.785 0.000**	0.425 0.033	1.000 -----					
Ginico	-0.763 0.000**	0.399 0.048	0.758 0.000	1.000 ----				
Govex	-0.783 0.000**	0.163 0.435	0.524 0.007	0.515 0.008	1.000 ----			
POV	0.942 0.000**	-0.403 0.045	-0.892 0.000	-0.861 0.000	-0.718 0.000	1.000 ----		
GCF	-0.355 0.081***	0.476 0.016	0.626 0.000	0.427 0.003	-0.101 0.630	-0.445 0.025	1.000 ----	
Unempl	-0.770 0.000**	0.158 0.450	0.370 0.068	0.534 0.005	0.894 0.000	-6.665 0.003	-0.210 0.313	1.000 ----

Note: *,**, *** 1%, 5% and 10% level of significance.
Source: Author's computation

GiniCo displays a negatively skewed distribution. In terms of POV, the mean value is 63.951, with maximum and minimum values of 80.100 and 53.200, respectively. This variable has a positively skewed distribution with a well-defined peak. Govex has an average of 40,183.56, with maximum and minimum values of 111,793.0 and 8,839.00. The standard deviation for Govex is 29,712.62, and it has a positively skewed distribution. FDI has a mean of 3.81E+09, with a maximum of 9.90E+09 and a minimum of 5.50E+08. The standard deviation is 2.78E+09, and it also exhibits a positively skewed distribution. Lastly, unemployment has a mean of 7.596, with maximum and minimum values of 14.580 and 0.410, respectively. It is positively skewed and has a standard deviation of 3.707. Additionally, GCF has an average value of 17.097, with a maximum value of 16.831 and a minimum value of 21.287, indicating a negatively skewed distribution.

Unit Root Test, Cointegration, ARDL and FMOLS Analysis

The unit root test helps determine results that are not spurious. Testing the stationarity of variables is crucial to avoid false regression. Therefore, the Augmented Dickey Fuller (ADF) and Phillips and Perron tests are employed to assess stationarity. The results of the ADF and PP tests are displayed in Table 3. The null hypothesis, which suggests the presence of a unit root, is rejected for FDI and GiniCo at 10% and 5% significance levels, respectively. Table 3 clearly indicates that Govex, corrpti, GDP, GCF,

Vol: 16 **No:** 01 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 224-251) **Doi:** 10.34109/ijefs.202416110

unemployment, and POV are integrated at the first order. However, the variables used in this study are not all integrated at the same order. To test for cointegration, the Johansen-Fisher cointegration test will be employed.

Table 3: Stationarity test results

LEVELS	ADF		PP	
	t-stat	Prop	t-stat	Prop
corrpti	-1.538	0.5047	-1.5633	0.4852
lnGDP	-1.639	0.4472	-1.340	0.5936
lnPOV	-1.796	0.3727	-2.081	0.3475
lnGovex	-3.671	0.6710	2.2125	0.9676
lnFDI	-4.339	0.0002**	-4.338	0.0025**
lnGiniCo	-2.8572	0.0661	-4.6686	0.0012**
1st DIFFERENCE				
Corrpti	-1.538	0.5047	-1.5633	0.4852
lnGDP	-1.639	0.4472	-1.340	0.5936
lnPOV	-2.011	0.044***	-1.928	0.053
lngovex	-3.484	0.018**	-3.583	0.014**
lnunempl	-6.928	0.000**	-6.928	0.000**
lngcf	-2.720	0.008***	-2.720	0.008***

Note: Reject null hypothesis at *, ** and *** indicating 1%, 5% and 10%.
Source: Author's computation

To determine the optimal lag length, we employ the Akaike Information Criterion (AIC) after confirming the stationarity of the variable quantity. We chose this criterion due to the stringent penalties it imposes, resulting in more consistent and reliable results when compared to other lag length criteria, as demonstrated in Table 4 below.

Table 4: Optimal lag length results

Lag	LogL	LR	FPE	AIC	SC	HQ
0	117.164	NA	1.63e-13	-9.579	-9.233	-9.492
1	283.257	216.642	7.63e-18	-19.761	-16.996	-19.066
2	438.815	108.214*	3.45e-21*	-29.027*	-23.843*	-27.723*

FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion and HQ: Hannan-Quinn information criterion.
Source: Author's computation

Below is Table 5 displaying the results of the cointegration test for the variables? In multivariate frameworks, the Johansen-Fisher cointegration test is applied. At the 5% significance level, both the unrestricted cointegration test for trace and maximum eigenvalue indicate the presence of five cointegrating equations. Consequently, there exists a long-run equilibrium relationship between the variables.

Vol: 16 **No:** 01 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 224-251) **Doi:** 10.34109/ijefs.202416110

Table 5: Johansen-Fisher Cointegration test results

Hypothesized No. of CE(s)	Eigenvalue	Trace statistic	0.05 critical value	Probability **
Unrestricted cointegration rank test (trace)				
None*	0.956	154.365	95.753	0.000
At most 1*	0.795	82.088	69.818	0.003
At most 2	0.637	45.637	47.856	0.079
At most 3	0.500	22.312	29.797	0.281
At most 4	0.237	6.345	15.494	0.654
At most 5	0.004	0.106	3.841	0.743
Unrestricted cointegration rank test (maximum eigenvalue)				
None*	0.956	72.277	40.077	0.000
At most 1*	0.795	36.450	33.876	0.024
At most 2	0.637	23.325	27.584	0.160
At most 3	0.500	15.966	21.131	0.226
At most 4	0.237	6.238	14.264	0.582
At most 5	0.004	0.106	3.841	0.743
Trace test indicates 2 cointegrating eqns at 0.05 level				
Max eigenvalue test indicates 2 cointegrating eqns at 0.05 level				
* Denotes rejection of the hypothesis at 0.05 level				
** Mackinnon- Haung- Michelis (1999) p values				

Source: Author’s computation

The results presented in Table 6 stem from the long-run analysis conducted using the Fully Modified Ordinary Least Squares (FMOLS) method. This approach yields reliable estimates, especially for small sample sizes, and ensures the robustness of the results. As indicated in Table 6, when corruption is considered the dependent variable, poverty has an influence on corruption, signified by its significant coefficient. Interestingly, this coefficient assumes a positive value, suggesting that a 1% increase in poverty leads to a 1.78% increase in corruption. On the other hand, the Gini coefficient is not significant and displays a positive coefficient.

Conversely, when poverty is the dependent variable, corruption impact poverty significantly at the 1% level. This implies that a 1% increase in corruption results in a 0.41% increase in poverty. The Gini coefficient is significant and has a positive coefficient when poverty is the dependent variable, indicating that a 1% increase in income inequality leads to a 1.39% increase in poverty. Likewise, when the Gini coefficient is the dependent variable, poverty is significant and assumes a positive value. Statistically, when poverty increases by 1%, the Gini coefficient increases by 0.54%. In the case of the relationship between the Gini coefficient and corruption, the coefficient is not significant and is negative. It is worth noting that the residuals are normally distributed in all the analyses.

Table 6: Fully Modified Ordinary Least Squares (FMOLS) results

Dependent variable: lnpov	**Coefficient**	**Probability**
lnfdi	0.017	0.218
lnginico	1.391	0.000*
corrpti	0.412	0.003**
lngcf	0.052	0.756
lnunempl	-0.112	0.122
lngovex	0.104	0.074***
lngdp	-0.187	0.015***
R squared	0.946	
Adj R squared	0.923	
Jacque bera	0.289	0.865
Dependent variable: corrpti		
Lnfdi	-0.016	0.366
lnginico	0.632	0.285
lnpov	1.782	0.000**
lngcf	-0.339	0.098***
lngdp	0.270	0.129
lnunempl	0.010	0.908
lngovex	-0.158	0.037***
c	-9.113	0.019**
R squared	0.928	
Adj R squared	0.896	
Diagnostic tests:		
Jacque bera	0.744	0.689
Dependent variable: lnginico		
lnfdi	-0.002	0.715
corrpti	-0.095	0.212
lngcf	0.065	0.410
lnunempl	0.052	0.073***
lnpov	0.543	0.000*
lngovex	-0.000	0.212
lngdp	0.193	0.000*
R squared	0.542	
Adj R squared	0.386	
Diagnostic test:		
Jacque Bera	0.095	0.953

Note: *, ** and *** are 1%, 5% and 10% level of significance.
Source: Author's computation

Vol: 16 **No:** 01 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 224-251) **Doi:** 10.34109/ijefs.202416110

Table 7: ARDL results

Dependent variable: corrpti Model 1	**Coefficient**	**Probability**
Corrpti	0.052	0.311
lnfdi	-0.286	0.023**
lngcf	1.010	0.006*
lngdp	0.164	0.150
lnginico	16.358	0.000**
lnpov	2.055	0.005*
lngovex	0.312	0.238
lnunempl	0.013	0.847
c	-11.541	0.000
R squared	0.967	
Adj R squared	0.975	
$\Delta lngovex$	-0.083	0.570
$\Delta lnginico$	16.358	0.000**
$\Delta lnpov$	-0.002	0.992
ECT(-1)	-0.947	0.000**
R squared	0.907	
Adj R squared	0.886	
Dependent: lnginico Model 2		
lnginico	0.943	0.000
corrpti	-0.036	0.004**
lnfdi	-0.001	0.066***
lngcf	-0.028	0.028***
lngovex	-0.030	0.085***
lnunempl	0.006	0.218
lnpov	0.049	0.060***
c	0.297	0.129
R squared	0.996	
Adj R squared	0.994	
$\Delta lngovex$	0.010	0.330
$\Delta corrpti$	-0.002	0.698
c	0.297	0.000
ECT(-1)	-0.056	0.000**
R squared	0.957	
Adj R squared	0.950	
Dependent: lnpov Model 3		
lnpov	0.781	0.000
corrpti	-0.007	0.891
lnfdi	-0.008	0.081***
lngcf	0.280	0.002**
lngdp	-0.083	0.038***
lnunempl	-0.013	0.506
lnginico	-0.398	0.016**
c	2.888	0.004
R squared	0.994	
Adj R squared	0.989	

Vol: 16 **No:** 01 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 224-251) **Doi:** 10.34109/ijefs.202416110

$\Delta lnfdi$	-0.004	0.023***
$\Delta lngcf$	0.062	0.132
$\Delta lngdp$	-0.046	0.023***
ECT(-1)	-0.342	0.000**
R squared	0.862	
Adj R squared	0.831	

Note:*,**,*** depicts 1%,5% and 10% respectively.

Source: Author's computation

Table 7 presents the results of the ARDL analysis, and the model's goodness of fit is represented by the R^2 (0.90) and Adj R^2 (0.88). These values explain that 90% and 88% of the variation in corruption can be accounted for by poverty, income inequality, government expenditure, GDP, FDI, and gross capital formation, while the remaining percentage is attributed to error. In Model 1, where corruption is the dependent variable in the long run, it is evident that both poverty and the Gini coefficient are positive and significant at the 5% level of significance. A 1% increase in poverty leads to a 2.05% increase in corruption, and a 1% increase in the Gini coefficient results in a substantial 16.35% increase in corruption. However, in the short run, the Gini coefficient is negative and significant, indicating that an increase in income inequality leads to a 0.002% decrease in corruption. Model 2 reveals results when the Gini coefficient is the dependent variable. In this case, poverty and corruption are significant at the 10% level of significance. This suggests that a 1% increase in poverty leads to a 0.04% increase in income inequality, and when corruption increases by 1%, income inequality decreases by 0.03%. Additionally, lnFDI, lnGCF, and lngovex are statistically significant and negative at the 10% significance level.

Diagnostic Test Result

The diagnostic tests conducted in this study cover autocorrelation, heteroscedasticity, normality, and omitted variable bias. *Firstly*, autocorrelation, which assesses the similarity between a time series and a lagged version of itself across successive time intervals, is employed with the null hypothesis suggesting the presence of autocorrelation. *Secondly*, heteroscedasticity describes situations where the variability of errors (residuals) in a regression model varies across different levels of independent variables. The null hypothesis in this case is the presence of heteroscedasticity. Thirdly, the normality test determines whether the dataset follows a normal distribution, with the null hypothesis assuming that the distribution of residuals is not normal (Gujarati, 2022). Lastly, the Ramsey RESET test in the examines model misspecification, specifically identifying omitted variables, incorrect functional forms, or both. It evaluates whether additional powers or transformations of the fitted values can significantly explain the dependent variable, indicating potential omission of important explanatory variables or incorrect specification of the relationship between variables. If

Vol: 16 **No:** 01 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 224-251) **Doi:** 10.34109/ijefs.202416110

the test statistic is significant, it suggests that the model may need to be re-specified to adequately capture the underlying relationship between the variables.

Table 8: Diagnostic results

	Tests	Type of Test	F-Statistic	p-value
Model 1	Auto Correlation	Breusch-Godfrey Serial Correlation LM Test	2.8020	0.1163
	Heteroscedasticity	Breusch-Pagan Godfrey	0.3074	0.9597
	Normality	Jarque-Bera	0.6550	0.7207
		Ramsey RESET Test	0.1197	0.7345
Model 2	Auto Correlation	Breusch-Godfrey Serial Correlation LM Test	4.529530	0.2341
	Heteroscedasticity	Breusch-Pagan Godfrey	2.6798	0.9883
	Normality	Jarque-Bera	0.7797	0.7790
		Ramsey RESET Test	0.001	0.9779
Model 3	Auto Correlation	Breusch-Godfrey Serial Correlation LM Test	6.1515	0.2325
	Heteroscedasticity	Breusch-Pagan Godfrey	1.2104	0.3873
	Normality	Jarque-Bera	1.3575	0.5072
		Ramsey RESET Test	0.3958	0.5434

Since the probability values for all tests exceeded the 10% significance level, this indicates that the specified and estimated models are free from defects. Consequently, the robustness of the results in this section enhances the reliability and validity of the model's results, instilling confidence in the study's findings, conclusion and policy recommendations.

For the stability test, it is evident from the CUSUM squares graphs below that the models are stable. Since the CUSUM of squares plot stays within the critical bounds, it suggests that the coefficients of the models are stable; (see Figure 3 to 5).

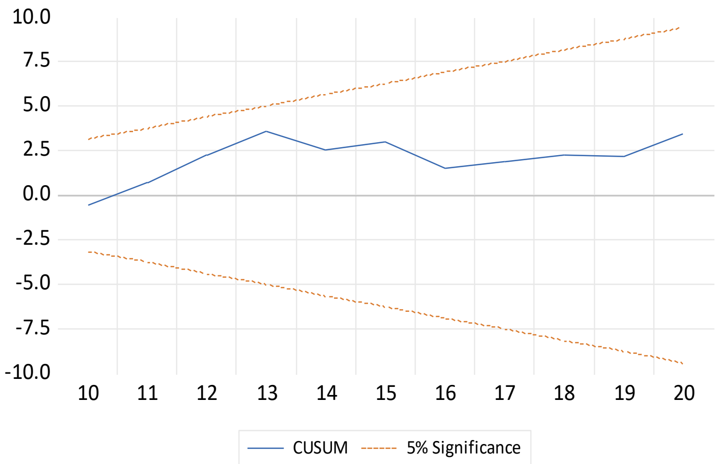

Figure 3: CUSUM squares for model 1

Vol: 16 **No:** 01 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 224-251) **Doi:** 10.34109/ijefs.202416110

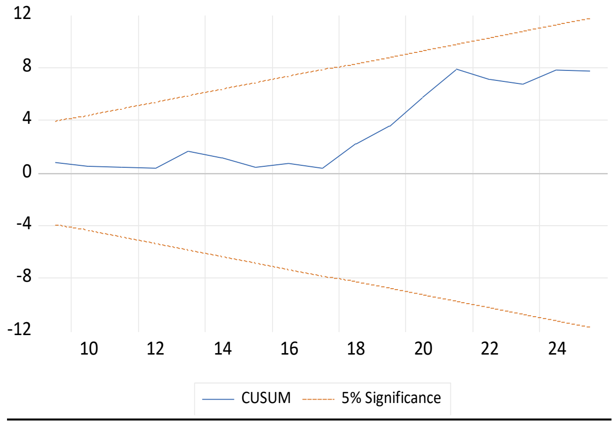

Figure 4: CUSUM squares for model 2

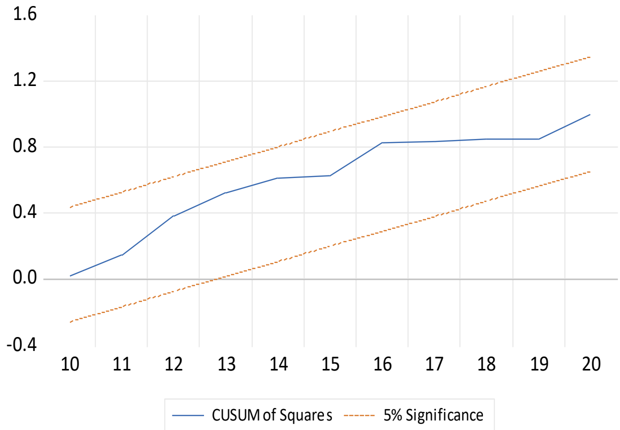

Figure 5: CUSUM squares for model 3

DISCUSSIONS

When corruption is considered the dependent variable, foreign direct investment is found to be negative and significant, as indicated by (Zangina & Hassan, 2020). This implies that corruption discourages foreign investment in the country. However, poverty, gross capital formation, and income inequality are positive and significant, aligning with the findings of (Onakoya, 2020). In this context, a 1% increase in poverty, gross capital formation, and income inequality leads to respective increases of 2.05%, 1.01%, and 16.35% in South African corruption.

In the short run, government expenditure and poverty are positive but insignificant, while income inequality is statistically significant and positive. This indicates that when income inequality increases by 1%, South African corruption increases by 16.35%. Unemployment, government expenditure, and gross domestic product are positive but insignificant in the long run. The estimated short run relationship between government

Vol: 16 **No:** 01 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 224-251) **Doi:** 10.34109/ijefs.202416110

expenditure and corruption is also insignificant when the Gini coefficient is the dependent variable, which contrasts with the findings of (Jong-Sung & Khagram, 2005). However, in the long run, poverty is positive and significant, signifying that a 1% increase in corruption increases income inequality by 0.04% in South Africa. Furthermore, government expenditure, gross capital formation, foreign direct investment, and corruption are negative and statistically significant in the long run.

When poverty is the dependent variable, gross domestic product, income inequality, and foreign direct investment are negative and significant in the long run. These results differ from those of Hichem (2016), suggesting that when these variables increase by 1%, poverty decreases by 0.083%, 0.398%, and 0.008%. In the short run, foreign direct investment and gross domestic product are negative and significant.

The analysis supports a long run relationship between corruption and income inequality, consistent with (Iskandar & Saragih, 2018). Corruption impacts poverty by diverting public funds that could have been used to improve the conditions of the poor, limiting their access to essential services like health, education, infrastructure, and security from shocks. This finding aligns with previous studies that have shown a positive short run relationship between corruption and poverty, as observed in the results of (Keneck-Massil et al., 2021).

CONCLUSION

The study delves into the interconnectedness of corruption, income inequality, and poverty in South Africa, utilizing data from 1996 to 2020. Its primary objective is to ascertain the relationship between poverty and income inequality when corruption is the dependent variable. Understanding these relationships is essential for South Africa's pursuit of the Sustainable Development Goals, particularly the critical goal of reducing poverty and inequality, a global endeavour (Undp, 2014).

The study employed stationary and cointegration analyses to explore the connections between corruption, income inequality, and poverty. ARDL and FMOLS were the analytical methods employed. Notably, the study revealed the existence of a long-term relationship among poverty, income inequality, and corruption.

To address poverty effectively, the South African government should consider implementing robust social targeting programs and establishing rigorous fiscal management practices. This study contributes to the existing literature by examining the interplay between these variables. Future research could further investigate the impact of corruption during the apartheid era, providing deeper insights into this critical issue. Addressing corruption in South Africa is crucial to mitigate income inequality and poverty in the long run. Immediate measures should focus on reducing corruption's short-term impact on income inequality. Long-term strategies should include effective

Vol: 16 **No:** 01 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 224-251) **Doi:** 10.34109/ijefs.202416110

anti-corruption measures to create a more equitable society, thereby reducing poverty and enhancing overall economic development.

CONFLICT OF INTEREST:

The author(s) declared no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

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