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Corruption and Economic Development in the SADC Region: A Nonlinear Panel ARDL Approach

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ABSTRACT

Many African nations, particularly those within the Southern African Development Community (SADC), face significant challenges due to pervasive corruption. The impact of corruption on economic wellbeing has been scrutinised for years, with its impact ranging from economic growth and development, foreign direct investment, its impact on living standards, service delivery, and poverty levels. The existing literature presents two contrasting views: the "sand the wheels" hypothesis, which posits that corruption hampers economic development, and the "grease the wheels" hypothesis, which argues the opposite. This study seeks to determine the asymmetric impact of corruption on economic development and to model a corruption threshold that has a non-detrimental impact on economic development. Employing a nonlinear panel autoregressive distributed lag model and a panel threshold model. The study reveals that changes in corruption levels have influence on economic development, with reductions in corruption being particularly more beneficial. The findings suggest that corruption impedes development, especially when corruption levels are below a threshold of 0.64, measured by control of corruption indicators, and 41 on the corruption perception index. The results underscore the necessity of concerted efforts to combat corruption to foster improved economic development in SADC countries. This study outlines several policies for eradicating corruption.

Keywords: Corruption, Economic Development, NARDL, Panel Threshold Model
JEL Classifications: O10, O11, D72

1. INTRODUCTION

Corruption is a major problem that is prevalent all around the world and affects the economic and social wellbeing of many countries, including those in Sub-Saharan Africa and SADC in particular. According to UNODC (2023), corruption touches every part of the world, including countries belonging to the Southern African Development Community. It hinders sustainable development, and it diverts resources meant for the most vulnerable, posing a significant threat to the stability and security of the SADC region. Corruption does not only threaten security in the SADC region, but also drives organised crimes, corrodes economies, crushes opportunity for development, and continues to trap people in cycles of poverty and inequality (UNODC, 2023).

Despite decades of addressing and implementing measures to combat it, fighting corruption in this region continues to be a challenging task. Corruption continues to increase in many of SADC countries while economic development remains stagnated. These countries have failed to effectively reduce corruption and to also economically develop and transition to high-income countries. Statistics from Transparency International (2023) show that around 81.25% or rather 13 out of 16 SADC countries have high levels of corruption. It continues to undermine transparency, accountability, and rule of law (SADC, 2023). Despite having abundant natural resources and minerals which can be used, not only to enhance economic growth, but to also promote sustainable economic development, most of the SADC countries have been experiencing stagnated economic development in the last two decades (UNDP, 2024; Transparency International, 2024).

The SADC organisation has been in operation for more than four decades with the primary goals of achieving sustainable economic development, promoting peace, security, and economic growth, eradicating poverty, and improving citizens' living standards in member countries. However, the region continues to fall short of these objectives. Many SADC member countries are locked in a stagnant economic development cycle, unable to move from low- or middle-income to high-income countries and enhance the living conditions of most the citizens. According to statistics from UNDP (2024), between 2000 and 2022, economic development in the SADC region averaged at 0.55, placing the region under low human development category. Out of 16 of the SADC countries, Seychelles is the only country which managed to reduce corruption by more than 30% while economic development changed by more than 3%.

Moruti (2022) emphasises that the negative impact of corruption on economic wellbeing in SADC countries persists despite decades of addressing the consequences of corruption on the functioning of SADC member states' economies. Bonga (2019) further adds that the journey to harness corruption in the region remains a challenge even after many years of preaching the ramifications of corruption on economic and social wellbeing.

The World Bank Vice President for Integrity, Mouhamodou Diagne, and the World Bank Vice President for Western and Central Africa, Ousmane Diagana and Diagne (2023), highlights that corruption harms the poor and vulnerable the most as it reduces access to basic services and increases inequality (World Bank, 2023). Mabeba (2021) and Spyromitros and Panagiodtidis (2022) emphasize that corruption hampers service delivery for citizens, affects economic development in terms of economic efficiency and growth as it prevents equitable distribution of resources and reduces innovative strategies, and discourages foreign direct investment.

Given the elevated levels of corruption and stagnated economic development in the SADC region, there is a debate among scholars mostly theorists whether corruption is all bad or not. The debate is around the grease the wheels hypothesis and sand the wheels hypothesis. Therefore, the purpose of this study is to determine the asymmetric impact of corruption on economic development and to also model a threshold level of corruption which is non-detrimental to economic development in the SADC region.

2. REVIEW OF THEORIES AND PREVIOUS EMPIRICAL STUDIES

2.1. About Hypotheses on Corruption and Economic Development

While it is often argued in most cases that corruption has a negative impact on economic wellbeing, it is sometimes argued that corruption, under various economic conditions can have a positive impact on economic wellbeing. One theory that contends that corruption improves economic wellbeing is the grease the wheels hypothesis, which holds that corruption can be a form of coercion bargaining that improves the efficiency of ineffective institutions (Mayo, 2016). Such theory emphasizes that, in an environment with weak governance and inefficient regulatory rules and laws, corruption can encourage economic activities, resulting in increased economic growth and development (Cooray and Schneider, 2018). Caiado (2020) highlights that corruption, in an environment with dysfunctional regulatory policies and weak institutions, can serve as an efficiency-enhancing catalyst, a solution for the "malfunctioning part of the system." Gillanders (2023) and Leff and Heidenheimer (2017) argue that bribery and other forms of corruption can benefit entrepreneurs and organisations by lowering operating expenses, navigating cumbersome regulatory hurdles, thus accelerating economic progress. This demonstrates that corruption may be a lubricant that stimulates economic activities and improves economic efficiency, greasing the wheels of commerce and promoting growth and development.

Opposing this view, the sand the wheels hypothesis sees corruption as an obstacle for economic growth and development for several reasons. Grundler and Protflake (2019) argue that corruption hampers economic growth and development as it prevents efficient production and innovation. It often leads to the misallocation of resources, increases income inequality, and elevates poverty levels. While the revisionists believe that corruption can "grease the wheels of commerce," resulting in increased economic growth and development, Enste and Heldman (2017) highlight that there are some elements which are overlooked. Example of such elements include cases whereby an official is bribed with the aim to circumvent bureaucratic procedures can actually result in delays in company operations as the official might postpone the process for such reasons. This, in turn, may lead to reduced economic activities and efficiency, resulting in poor economic performance.

While these theories have opposing views about the impact of corruption on economic growth and development, it is important for such theories to be empirically tested and to check whether such theories are applicable in the real world. As highlighted by Pavlik (2016) the impact of corruption on economic wellbeing is determined by several factors such as economic uncertainties and economic conditions such as countries' income levels, with low-income countries most negatively affected by corruption. For years, the impact of corruption on economic wellbeing has been scrutinized and several scholars have conducted empirical studies to test the applicability of the grease the wheels and sand the wheels hypotheses in different economies.

2.2. Previous Empirical Studies

While the grease the wheels hypothesis argue that corruption has a positive impact on economic wellbeing under certain conditions, Akkoyunly and Ramela (2017) conducted a panel study to determine the impact of corruption on economic development in 143 countries. Findings from the study not only reveal a negative relationship between corruption and economic development, but also highlight that corruption negatively impact innovation and productivity. Another study by Feruna et al. (2020) involving the Western Balkan and EU countries also shows a negative relationship between corruption and economic development. Xhindi and Gjika (2022) conducted a similar study in Western Balkan countries and also found a negative relationship between corruption and economic development. While the Western Balkan comprises of mostly high-income countries such as Albania, Serbia and North Macedonia, this differs Pavlik (2016)'s view that low-income countries are the ones mostly affected negatively by corruption.

A panel study by Hoinaru et al. (2022) which include a combination of low-income and high-income countries show a strong negative relationship between corruption and sustainable economic development in the case of high-income countries and a weak negative relationship between corruption and sustainable economic development in the case of low-income countries, showing that a country's income level does not necessarily determine the extent to which corruption affects its economic wellbeing. Studies by Obono (2019) and Nageri et al. (2013), which were conducted in Nigeria to determine the impact of corruption on the country's economic development, show that corruption hinders the country's economic development. A study by Abidin et al. (2023) which was conducted to determine the impact of corruption, economic freedom, and brain drain on Malaysia's economic development also shows a negative relationship between corruption and economic development. Other studies conducted in various countries by several scholars such as Syaifudin et al. (2021), Pulok and Ahmed (2017), Murshed and Mredula (2017), and Lucic et al. (2016) also show a negative relationship between corruption and economic development. Thus, it is evident that regardless of the country's economic conditions, corruption has a negative impact on economic wellbeing in most countries.

A study by Niyimbanira et al. (2024) was conducted on corruption and economic growth in the emerging markets. They used the heterogenous dynamic autoregressive distributed lags (ARDL) panel data approach for the period of 1995-2019. Their findings indicate a statistically significant inverse relationship between corruption and economic growth. Their results confirm that a unit increase in the corruption perception index increases the growth rate of GDP by 0.97% in the long-run while in the short-run a unit increase in the corruption perception index increases the GDP growth rate by approximately 0.41%. Therefore, lowering corruption or the eradication of corruption can be expected that most emerging markets will achieve more in terms of economic growth. Instead of directly determining the impact that corruption has on economic development, several scholars rather determine the impact that corruption has on economic factors which are direct measurements of economic development. These factors include living standards, education, and health. A study by Morais et al. (2017) which determines the impact of corruption on all three indicators for economic development (health, education, and living standards), shows a strong negative relationship between corruption and all these indicators. A study by Oana-Ramona et al. (2022) which covers the UE countries, shows a negative relationship between corruption and life expectancy at birth, which is one of the measures for health outcomes. Studies such as the one by Obono (2019) show a negative relationship between corruption, access to education, health, and living standards.

While it is argued and found by many scholars such as the ones mentioned previously that corruption negatively impact economic development and economic development indicators, supporting the sand the wheels hypothesis, there is limited evidence that supports the grease the wheels hypothesis. Contrarily to Niyimbanira et al. (2024), Shittu et al. (2018) find evidence which supports the grease the wheels hypothesis and highlights that corruption promotes economic growth, which is an important factor for economic development. However, Cragg (2016:2) argues that claims made by studies that corruption promote economic growth and development are a "mistake" and that "the real value of these studies is their potential contribution to shaping effective policies designed to control corruption in different economic settings." Such claim implies that findings by scholars which claim that corruption can in fact grease the wheels of commerce and promote economic growth and development are actually not true and they are made to promote policies in favour of their own gain (Cragg, 2016).

Although it is strongly indicated that corruption has a negative impact on economic development, it is also often argued that economic development itself has a direct impact on the level of corruption in a country. Several studies such as those by Lucic et al. (2016) and Nurudeen and Marcin (2015) have been conducted to determine the causal relationship between corruption and economic development. Results from these studies show that there is indeed a causal relationship between corruption and economic development, highlighting that while corruption impact economic development either positively or negative, economic development itself has an influence on the level of corruption in a country. Hence with such reach literature evidence, a question to ask is to what extent does corruption have an impact on economic development and what is the asymmetric relationship between corruption and economic development in the SADC region?

3. DATA AND RESEARCH METHODOLOGY

3.1. Data Sources

This study examines 14 Southern African Development Community countries, analysing economic development as measured by the Human Development Index (HDI) and its relationship with corruption, proxied by the Control of Corruption (COC) and Corruption Perception Index (Corr). Data sources include the UNDP for HDI, the World Bank for COC and unemployment, and Transparency International for Corr. Additionally, Gross Fixed Capital Formation (GFCF) serves as a proxy for capital investment. This study employs two models to analyse the impact of corruption on economic development, utilising the Control of Corruption index annual data from 2002 to 2022 giving 260 observations and the Corruption Perception Index from 2007 to 2022 giving 195 observations. Economic development is given as a function of corruption, unemployment rate, and capital investment as specified below for model one and model two, respectively:

$$HDI_{1it} = \alpha_0 + \beta_1 COC_{it} + \beta_2 GFCF_{it} + \beta_3 UNE_{it} + \varepsilon_{it} \quad (1)$$

$$HDI_{2it} = \alpha_1 + \beta_4 Corr_{it} + \beta_5 GFCF_{it} + \beta_6 UNE_{it} + \varepsilon_{it} \quad (2)$$

β_1 to β_6 denote estimate parameters while the epsilon (ε) denotes the error term which accounts for the excluded variable with a potential impact on the dependent variable. *t* denotes the time, while *i* denotes the country.

3.2. Cross-Sectional Dependency

Prior to estimating model results, pre-estimation techniques, particularly cross-sectional dependency tests, are essential for panel data analysis. Such tests guide the selection of appropriate unit root and cointegration tests, as cross-sectional dependency, stemming from unobservable common factors, can significantly impact interconnected economies (Azam et al., 2021; Magweva and Sibanda, 2020). In this study of SADC countries, acknowledging this dependency is vital to ensure reliable estimation outcomes. Unit root tests in panel regression are categorized into first and second generations based on cross-sectional dependency. First generation tests, such as Choi (2001), Breitung (2000), Levin-Lin-Chu (2002), and Maddala and Wu (1999), are applicable when cross-sectional variables are uncorrelated, while second generation tests, including Pedroni (1999) and Im-Pesaran-Shin (2003), account for correlated cross-sectional variables (Tugcu, 2018). The following tests are used in this study to test for cross-sectional dependency:

3.2.1. Pesaran CD test

The Pesaran CD test for cross-sectional dependence test is employed under a null hypothesis of cross-sectional independency and such test can be used even when the sample size in a dataset is relatively small (Simeonescu et al., 2021). This test is reliable and applicable for this study as the sample size is not large nor small. The Pesaran CD test can be specified as follows:

$$CD = \sqrt{\frac{2T}{N\left(N-1\right)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}\right) \qquad (3)$$

3.2.2. Breusch-Pagan LM test

The cross-sectional dependence test by Breusch and Pagan (1980) is a test which tests the null hypothesis of zero dependency across the panel variables and is relevant to a range of panel data with large time period (*t*) and a small number of cross-sections (*n*) (Shamar and Shamar, 2020; Arshad et al., 2020). The number of cross-sectional dimensions (*n*) in this study are 13 for both models while the time dimensions (*t*) is 20 for model 1 and 15 for model 2, meaning that $t > n$. This makes the Breusch-Pagan LM test for cross-sectional dependency applicable in this study.

3.3. Panel unit root test

3.3.1. Im-Pesaran-Shin (2003)

The Im-Pesaran-Shin (IPS) unit root test effectively analyses correlated cross-sectional units in panel datasets, accounting for residual heterogeneity and serial correlation (Shaari et al., 2020; Zardoub, 2020; Sikder et al., 2022). This makes such a test suitable for this study's assessment of variable stationarity. The Im-Pesaran-Shin unit root test used is adopted from a study by Bidirici and Bohur (2015) and Asghar et al. (2015), and it is demonstrated as follows by equation 4:

$$\Delta y_{i,t} = \mu_i + \beta_i t + \rho_i y_{i,t-1} + \sum_{j=1}^{p}\phi_{ij}\Delta y_{i,t-1} + \varepsilon_{i,t} \qquad (4)$$

3.3.2. Pesaran cross-sectional augmented Dickey-Fuller test (PESCADF)

The Pesaran Cross-Sectional Augmented Dickey-Fuller test (PESCADF), developed by Pesaran (2007), is a relevant unit root test used in case of the existence of cross-sectional dependency in panel data (Attard, 2019). Equation 5 is a representation of the Cross-Sectional Augmented Dickey-Fuller test, adopted from a study by Bulut and Bayraktar (2023):

$$\Delta y_{it} = \alpha_i + \rho_i \bar{y}_{i,t-1} + d_0 \bar{y}_{t-1} + d_1 \bar{y}_t + \mu_{it} \qquad (5)$$

Pesaran's (2007) equation (eq. 5) mitigates cross-sectional dependency among variables by incorporating the cross-sectional mean of lagged values and first differences in the Augmented Dickey-Fuller regression (Bulut and Bayarkatar, 2023).

3.4. Panel cointegration test

3.4.1. Pedroni cointegration test

The Pedroni (1999) cointegration, which is the most popular panel cointegration test, is used to test whether there is a long-run or short-run relationship between panel variables. Such a test allows for heterogeneity among individual panel variables, emphasizing the differences in characteristics that each of the cross-sectional units possess. The Pedroni cointegration test can be specified as follows by equation 6, adopted from a study by Bidirici and Bohur (2015):

$$Y_{it} = \alpha_i + \delta_t + \beta_{1i} X_{it} + \varepsilon_{it} \qquad (6)$$

$i = 1$., N for each country, $t = 1$…T for each period, α_i and δ_t are country and time fixed effects while β is the coefficient for a respective cross-sectional unit X_{it} observed in a specific time period. According to Cetin and Ecevit (2015), the Pedroni cointegration test is residual based. To apply the cointegration test, the residual for each cross-sectional unit can be derived from the above equation (eq.6) as follows:

$$\varepsilon_{it} = \rho_i \varepsilon_{it-1} + \mu_{it} \qquad (7)$$

The null hypothesis for the Pedroni cointegration test proposes the absence of cointegration in which the residuals (ε_{it}) will be integrated of I (1), therefore proposing that the residuals are nonstationary and contain a unit root.

3.4.2. Kao cointegration test

Similar to the Pedroni (1999) cointegration test, Kao (1999) cointegration test acknowledges the heterogeneity between cointegrating vectors both the long-run and short-run (Heriqbaldi & Mufiidah, 2023). The null hypothesis for this test is that there exists no long-run relationship between the cross-sectional variables while the alternative hypothesis holds otherwise. Adopted from a study by Heriqbaldi and Mufiidah (2023), Cetin and Ecevit (2015), and Bulut and Bayraktar (2023), the Kao cointegration test can be specified as follows:

$$y_{it} = \alpha_i + \beta x_{it} + e_{it} \qquad (8)$$

$$y_{it} = y_{it-1} + \mu_{it} \quad (9)$$

$$x_{it} = x_{it-1} + \varepsilon_{it} \quad (10)$$

α_i is the fixed effect, which varies across each cross-sectional observation, β is the slope parameter, y_{it} and x_{it} are random walk independent variables for each observation i whereby μ_{it} and ε_{it} are the estimated residuals. Furthermore, the estimated residuals are expanded as follows:

$$\hat{e}_{it} = \rho\hat{e}_{it-1} + \sum_{j=1}^{p}\varphi_j \Delta\hat{e}_{it-j} + v_{itp} \quad (11)$$

3.4.3. Westerlund cointegration test

The Westerlund (2007) is another panel cointegration which, according to Spatariu (2019), offers an advantage of taking into account the presence of cross-sectional dependency in a dataset or model by using a bootstrap approach. Similar to the Pedroni and Kao cointegration tests, Westerlund test also takes the cross-sectional units' heterogeneity into account (Bayar and Yener, 2018). With such benefits, the test is also used in this study to test whether there is a long-run relationship between economic development, corruption, unemployment rate, and capital investment.

3.5. Nonlinear Panel Autoregressive Distributed Lag Model

This study aims to determine the asymmetric impact of corruption on economic development in the SADC region. Equation 12 and 13present the nonlinear autoregressive distributed lag model, adopted from a study by Sadik-Zada et al. (2022) with adjustments made on the model by incorporating the error-correction term:

$$\begin{aligned}\Delta HDI_{1it} =& \alpha_{it} + \beta_{1i}HDI_{i,t-1} + \beta_{2i}^{+}COC_{t-1} + \beta_{3i}^{-}COC_{t-1} \\ &+ \beta_{4i}^{+}UNE_{t-1} + \beta_{5i}^{-}UNE_{t-1} + \beta_{6i}^{+}GFCF_{t-1} + \beta_{7i}^{-}GFCF_{t-1} + \\ &\sum_{j=0}^{N}\delta_{1ij}\Delta HDI_{i,t-j} + \sum_{j=0}^{N}(\gamma_{1ij}^{+}COC_{t-j}^{+} + \gamma_{1ij}^{-}COC_{t-j}^{-}) \\ &+ \sum_{j=0}^{N}(\mu_{1ij}^{+}UNE_{t-j}^{+} + \mu_{1ij}^{-}UNE_{t-j}^{-}) + \sum_{j=0}^{N}(\sigma_{1ij}^{+}GFCF_{t-j}^{+} \\ &+ \sigma_{1it}^{-}GFCF_{t-j}^{-}) + \sum_{i=1}^{N}\varphi_{1i}\Delta ECM_{t-1} + \varepsilon_{1it} \end{aligned} \quad (12)$$

$$\begin{aligned}\Delta HDI_{2it} =& \alpha_{2it} + \beta_{8i}HDI_{i,t-1} + \beta_{9i}^{+}Corr_{t-1} + \beta_{10i}^{-}Corr_{t-1} \\ &+ \beta_{11i}^{+}UNE_{t-1} + \beta_{12i}^{-}UNE_{t-1} + \beta_{13i}^{+}GFCF_{t-1} + \beta_{14i}^{-}GFCF_{t-1} \\ &+ \sum_{j=0}^{N}\delta_{2ij}\Delta HDI_{i,t-j} + \sum_{j=0}^{N}(\gamma_{2ij}^{+}Corr_{t-j}^{+} + \gamma_{2ij}^{-}Corr_{t-j}^{-}) + \\ &\sum_{j=0}^{N}(\mu_{2ij}^{+}UNE_{t-j}^{+} + \mu_{2ij}^{-}UNE_{t-j}^{-}) + \sum_{j=0}^{N}(\sigma_{2ij}^{+}GFCF_{t-j}^{+} \\ &+ \sigma_{2it}^{-}GFCF_{t-j}^{-}) + \sum_{i=1}^{N}\varphi_{2i}\Delta ECM_{t-1} + \varepsilon_{2it} \end{aligned} \quad (13)$$

$Corr_t^{+}$ and COC_t^{+} denote a decline in corruption levels while $Corr_t^{-}$ and COC_t^{-} denote an increase in corruption levels. UNE_t^{+} is the increase in unemployment rate, UNE_t^{-} is the reduction in unemployment rate, $GFCF_t^{+}$ is an increase in capital investment while $GFCF_t^{-}$ is the decrease in capital investment. The βs are the long coefficients. δ, λ, μ, and ρ are the long-run coefficients. The error term is represented by the epsilon (ε) in both equations. ϕ is the speed of adjustment for the short-run error-correction model (ECM) which captures the time that the system requires to adjust to equilibrium.

3.6. Panel Threshold Model

This study uses a panel threshold model to model a threshold level of corruption which has a non-detrimental impact on economic development in the SADC region. Equation 14 below is a panel threshold model adopted from a study by Aye and Edoja (2017):

$$Y_{it} = \mu_i + \beta_1^{'}Z_{it}I(q_{it} \leq \gamma) + \beta_2^{'}Z_{it}I(q_{it} > \gamma) + \varepsilon_{it} \quad (14)$$

Where i represents the country and t represents time. μ_i is the country specific effect and ε_{it} is the error term. γ denotes the threshold level and Z_{it} is a vector of explanatory variables which are allowed to change with the threshold variable and may also include the lagged values of the dependent variable (Y_{it}) (Ersin et al., 2022). I is the indicator function specifying the regime defined by the threshold value $q_{it.}$ The betas are the parameters. Substituting the variables this study uses into the above equation (eq.14), for the two models of this study equation 14 can be rewritten as follows:

$$HDI_{1it} = \mu_{1i} + \beta_1 Z_{it} I(COC_{it} \leq \gamma) + \beta_2 Z_{it} I(COC_{it} > \gamma) \quad (15)$$

$$HDI_{2it} = \mu_{2i} + \beta_3 Z_{it} I(Corr_{it} \leq \gamma) + \beta_4 Z_{it} I(Corr_{it} > \gamma) \quad (16)$$

Corr and COC are the threshold variables, and unemployment rate and capital investment are represented by Z_{it}, a vector of endogenous control variables.

4. RESULTS AND DISCUSSION

4.1. Cross-Sectional Dependence Test Results

Tables 1 and 2 represent the cross-sectional dependency test results, highlighting the presence of cross-sectional dependency in the data as the P-values for the Pesaran CD and Breusch-Pagan LM tests are all >5% level of significance. This shows

Table 1: Cross-sectional dependence test results for model one

CSD	Chi-square	P-value
Pesaran CD	13.545	0.0000***
Breusch-Pagan LM test	666.718	0.0000***

***Represent statistical significance at 1%
Source: Author's construct using STATA 18

Table 2: Cross-sectional dependence test results for model two

CSD	Chi-square	P-value
Pesaran CD	20.459	0.0000***
Breusch-Pagan LM test	841.321	0.0000***

***Represent statistical significance at 1%
Source: Author's construct using STATA 18

that the cross-sectional variables are correlated and hence, the second-generation unit root tests, which consider the presence of cross-sectional dependency, are appropriate stationarity tests to use.

4.2. Unit Root Test Results

As shown in Tables 1 and 2, there is a presence of cross-sectional dependency between the cross-sectional variables. This requires the use of second-generation unit root tests and as such, the Im-Pesaran-Shin (IPS) (2003) and the Pesaran Cross-Sectional Augmented Dickey-Fuller (PESCADF) are used to test for the variables' stationarity. Tables 3 and 4 present the unit root test results, and it shows that in both model II and model III, gross fixed capital formation (GFCF) is stationary at level (I(0)) while other variables (HDI, COC, Corr, & UNE) are stationary after first difference (I(1)). This mixed integration order satisfies one of the conditions for using autoregressive distributed lag model.

Table 3: Unit root test results for model one

Variables	Specification		IPS	PESCADF	Order of integration
HDI	Level	Trend	1.0000	0.153	I (1)
		Demean	0.5701	0.133	
	First difference	Trend	0.0000***	0.003***	
		Demean	0.0000***	0.000***	
COC	Level	Trend	0.0320**	0.911	I (1)
		Demean	0.8659	0.884	
	First Difference	Trend	0.0000***	0.002***	
		Demean	0.0000***	0.000***	
UNE	Level	Trend	0.1231	0.022**	I (1)
		Demean	0.9903	0.919	
	First difference	Trend	0.0000***	0.201	
		Demean	0.0000***	0.000***	
LNGFCF	Level	Trend	0.0001***	0.000***	I (0)
		Demean	0.8096	0.002***	
	First difference	Trend	0.0000***	0.002***	
		Demean	0.0000***	0.000***	

** and *** represent statistical significance at 5% and 1%
Source: Author's construct using STATA 18

Table 4: Unit root test results for model two

Variables	Specification		IPS	PESCADF	Order of integration
HDI	Level	Trend	1.0000	0.127	I (1)
		Demean	0.4487	0.047**	
	First difference	Trend	0.0000***	0.134	
		Demean	0.0000***	0.001***	
Corr	Level	Trend	0.0203**	0.546	I (1)
		Demean	0.6172	0.979	
	First difference	Trend	0.0000***	0.167	
		Demean	0.0000***	0.001***	
UNE	Level	Trend	0.1886	0.048**	I (1)
		Demean	0.9863	0.909	
	First difference	Trend	0.0000***	0.023**	
		Demean	0.0000***	0.000***	
LNGFCF	Level	Trend	0.0001***	0.008***	I (0)
		Demean	0.3522	0.487	
	First difference	Trend	0.0000***	0.002***	
		Demean	0.0000***	0.000***	

** and *** represent statistical significance at 5% and 1%
Source: Author's construct using STATA 18

4.3. Cointegration Test Results

4.3.1. Pedroni cointegration test results

Tables 5 and 6 present the Pedroni cointegration test results for model one and two, and they confirm a long-run relationship between economic development, corruption, capital investment, and unemployment rate as at least 2 out of 3 tests show that the variables cointegrated at 1% and 5% level of significance.

4.3.2. Kao cointegration test results

Table 7 presents cointegration test results for model one and it shows that there is no long-run relationship between economic development, corruption, capital investment, and unemployment rate. Table 8 on the other hand confirms a long-run relationship

Table 5: Pedroni cointegration test results for model one

Cointegration test statistics	Statistic	P-value
Modified Phillips Perron t	1.2186	0.1115
Phillips Perron t	−3.7111	0.0001***
Augmented Dickey-Fuller t	−2.0609	0.0197**

Source: Author's construct using STATA 18
** and *** represent statistical significance at 5% and 1%

Table 6: Pedroni cointegration test results for model two

Cointegration test statistics	Statistic	P-value
Modified Phillips Perron t	3.4584	0.0003***
Phillips Perron t	−1.6713	0.0473**
Augmented Dickey-Fuller t	−0.6798	0.2483

*** and ** indicate the level of significance at 1% and 5%
Source: Author's construct using STATA 18

Table 7: Kao cointegration test results for model one

Cointegration test statistics	Statistic	P-value
Modified Dickey-Fuller t	0.7805	0.2175
Dickey-Fuller t	−0.1049	0.4582
Augmented Dickey-Fuller t	−0.4949	0.3103
Unadjusted Modified Dickey-Fuller t	0.7453	0.2281
Unadjusted Dickey-Fuller t	−0.1354	0.4461

Table 8: Kao cointegration test results for model two

Cointegration test statistics	Statistic	P-value
Modified Dickey-Fuller t	0.5207	0.3013
Dickey-Fuller t	−1.8561	0.0317**
Augmented Dickey-Fuller t	−1.5220	0.0640*
Unadjusted Modified Dickey-Fuller t	0.6736	0.2503
Unadjusted Dickey-Fuller t	−1.7429	0.0407**

** and *** specify significance at 5% and 10% level
Source: Author's construct using STATA 18

Table 9: Westerlund cointegration test results for model one

Variance ratio test	Statistic	P-value
Variance ratio	2.1216	0.0169**

**Represent statistical significance at 5%
Source: Author's construct using STATA 18

Table 10: Westerlund cointegration test for model two

Variance ratio test	Statistic	P-value
Variance Ratio	2.6241	0.0043**

**Specify significance at 5% level
Source: Author's construct using STATA 18

between economic development, corruption, capital investment, and unemployment rate for model two.

4.3.3. Westerlund cointegration test results

Tables 9 and 10 present the Westerlund cointegration test rests and both confirm the existence of a long-run relationship between economic development, corruption, capital investment, and unemployment rate in both model one and two. It is thus concluded that there is a long-run relationship between economic development, corruption, unemployment rate, and capital investment as, for model one, both the Pedroni and Westerlund cointegration test results confirm the existence of a long-run relationship between the variables while the for model two, the cointegration test results from Pedroni, Kao, and Westerlund cointegration test confirm the long-run relationship.

4.4. Nonlinear Autoregressive Distributed Lag Model Long-run Results

Table 11 shows the long-run asymmetric results for model one and it shows that an increase in corruption levels, denoted by COC^-, is positively correlated with economic development. This suggests that the higher the levels of corruption, the greater the economic development. A decline in corruption levels, denoted by COC^+, is also positively correlated with economic development, suggesting that the lower the levels of corruption, the higher the economic development. Comparing the coefficients for COC^- and COC^+, a decline in the levels of corruption has a more positive impact (0.058) on economic development than an increase in levels of corruption (0.037). Therefore, this suggests corruption hinders economic development in the SADC region.

The results for model one further show that a decline in unemployment rate (UNE^-) as well as increase in unemployment rate (UNE^+) are both negatively correlated with economic development, with increase in unemployment rate having a greater negative impact on economic development than a decline in unemployment rate. The odd negative association between a decline in unemployment rate and economic development can be supported by the fact that, while employment is necessary to boost economic growth through increased demand, high demand can lead to increase in prices of goods and services which can lead to accessing essentials such as healthcare services and education more expensive and ultimately affecting health outcomes negatively in the long-run. As health and education are two of the indicators for economic development, a reduction in education and health outcome can lead to a decline in economic development.

Both a decline in capital investment ($LNGFCF^-$) and increase in capital investment ($LNGFCF^+$) are positively correlated with economic development in the long-run and are also statistically significant. It is often a rare case for a decline in capital investment to have a positive impact on economic development. However, this can be explained by the increase in capital investment can lead to misallocation of resources which diverts the resources from productive initiatives in the long-run. Such a situation can lead to a decline in economic development. Hence, when there is a decline in capital investment, this can lead to a more productive use of resources and lead to an increase in economic development.

Model two long-run results are presented in Table 12 whereby corruption is measured by control of corruption. The results show that both increase ($Corr^-$) and decrease ($Corr^+$) in the corruption levels are positively correlated with economic development. However, increase in corruption levels has a more positive impact on economic development than a decrease in corruption levels in the long-run. Such results support the grease the wheels hypothesis that corruption has a positive impact on economic development. These results differ with the ones in model one where corruption is measured by control of corruption. It is important to note that corruption perception index measures corruption from what is being perceived as corruption. It is the perceived level of corruption and not the actual corruption, hence why the results support the role of corruption on economic development.

For model two, both increase in unemployment rate (UNE^+) and decrease in capital investment ($LNGFCF^-$) are negatively correlated

Table 11: NARDL long-run results for model one

D.HDI	Coefficient	Standard error	Z	P> |Z|	[95% conf. interval]	
COC^-	0.0366782	0.015296	2.40	0.016**	0.0066985	0.0666578
COC^+	0.0575568	0.0165213	3.48	0.000**	0.0251756	0.089938
UNE^-	−0.0034901	0.0020033	−1.74	0.081***	−0.0074164	0.0004363
UNE^+	−0.0065381	0.0018987	−3.44	0.001**	−0.0102594	−0.0028168
$LNGFCF^-$	0.0327483	0.0022305	14.68	0.000**	0.0283766	0.03712
$LNGFCF^+$	0.0312898	0.0023539	13.29	0.000**	0.0266762	0.0359033

**Specify significance at 5% level
Source: Author's construct using STATA 18

Table 12: NARDL long-run results for model two

D.HDI	Coefficient	Standard error	Z	P> |Z|	[95% conf. interval]	
$Corr^-$	0.0153774	0.0022315	6.89	0.000***	0.0110037	0.019751
$Corr^+$	0.0134242	0.0020295	6.61	0.000***	0.0094463	0.017402
UNE^-	−0.0046532	0.0031492	−1.48	0.140	−0.0108255	0.0015191
UNE^+	−0.0061651	0.0027453	−2.25	0.025**	−0.0115459	−0.0007844
$LNGFCF^-$	−0.0022168	0.0011131	−1.99	0.046**	−0.0043948	−0.0000352
$LNGFCF^+$	−0.0004732	0.0006963	−0.68	0.497	−0.0018379	0.0008916

** and ***indicate that the estimated parameters are significant at 5% and 1%, respectively
Source: Author's construct using STATA 18

with economic development in the long-run. This suggests that high unemployment rates reduce economic development as individuals' access to quality healthcare services, education and proper standards of living is dependent on employment. The negative relationship between a decline in capital investment and economic development can be linked to misallocation of resources.

4.5. Nonlinear Autoregressive Distributed Lag Model Short-run Results

Tables 13 and 14 present the short-run results for model one and two, respectively. All the variables in both models are statistically insignificant, except for corruption in model two. Both increase and decrease in the levels of corruption in model two are positively correlated with economic development in the short-run. However, the decrease in levels of corruption has a more positive impact on economic development than increase in levels of corruption. Thus, corruption negatively impacts economic development. The error-correction term (ECT) in model one and two, which reflects the speed of adjustment, is negative and statistically significant, showing that the system in both models adjust to long-run equilibrium.

4.6. Discussion of the Results

The empirical long-run asymmetric results from this study show a negative relationship between corruption and economic development, supporting the sand the wheels hypothesis that corruption hinders economic development. Even though this study uses a methodology that most scholars have not used to analyze the relationship between corruption and economic development, the results can still be compared to those by other scholars who used different methodologies. For example, studies by Akkoyunly and Ramela (2017) and Xhindi and Gjika (2022) used different methodologies as compared to this study and still found a negative relationship between corruption and economic development. While the SADC region comprises of low- and middle-income countries, the countries included in the study by Xhindi and Gjika (2022) are mostly high-income countries (Western Balkan countries). Regardless of income status, impacts of corruption on economic development is still negative.

The results of this study are in line with a panel study by Hoinaru et al. (2022) comprising of low- and high-income countries that found both positive and negative correlation between corruption and economic development. In the case of low-income countries, the study found a positive relationship between corruption and economic development while in the case of high-income countries a negative relationship was found. Such results support both theories. However, as these countries have two different income statuses, they also have distinct levels of corruption and hence the results support both grease the wheels hypothesis and sand the wheels hypothesis.

For the control variable unemployment rate, the results from this study show a negative relationship between unemployment rate and economic development. This study is in line with Priambodo (2021), Salam et al. (2021), and Kolawole (2022) who found a negative correlation between economic development and unemployment rate, implying that unemployment hinders economic development. Unemployment affects economic development both directly and indirectly through education, living standards and access to healthcare service. The government's ability to provide access to quality healthcare services and education dependents on its tax revenues which also dependents on income tax from employment individuals.

The empirical findings from this study show that increase in capital investment is positively correlated with economic development in the long-run while a decline in capital investment is negatively correlated with economic development. This highlights the importance of investment in capital for greater

Table 13: NARDL short-run results for model one

D.HDI	Coefficient	Standard error	n	P>	[95% conf. interval]	
COC^-	−0.0024539	0.0042384	−0.58	0.563	−0.010761	0.0058532
COC^+	−0.0010994	0.0058063	−0.19	0.850	−0.0124795	0.0102806
UNE^-	−0.0018005	0.001504	−1.20	0.231	−0.007483	0.0011473
UNE^+	−0.0014094	0.0014127	−1.00	0.318	−0.0041782	0.0013594
$LNGFCF^-$	0.0005405	0.0035855	0.15	0.880	−0.006487	0.0075679
$LNGFCF^+$	0.0005215	0.0035613	0.15	0.884	−0.0064585	0.0075015
ECT	−0.0858679	0.0209145	−4.11	0.000***	−0.1268596	−0.0448762
Cons	−0.0025581	0.0041828	−0.61	0.541	−0.107562	0.0056399

***Specify significant at 1% level
Source: Author's construct using STATA 18

Table 14: NARDL short-run results two

D.HDI	Coefficient	Standard error	Z	P>Z	[95% conf. interval]	
$Corr^-$	0.0005733	0.0003231	1.77	0.076*	−0.00006	0.0012065
$Corr^+$	0.0007245	0.0003316	2.18	0.029**	0.0000746	0.0013745
UNE^-	−0.0006674	0.0025077	−0.27	0.790	−0.0055824	0.0042476
UNE^+	−0.0004663	0.0024574	−0.19	0.849	−0.0052828	0.00443501
$LNGFCF^-$	0.0073117	0.0053765	1.36	0.174	−0.003226	0.0178494
$LNGFCF^+$	0.0047286	0.0037569	1.26	0.208	−0.0026348	0.0120921
EC	−0.0397948	0.0217122	−1.83	0.067*	−0.0823535	0.0027567
Cons	0.0121948	0.003974	3.07	0.002***	0.004406	0.0199836

*, ** and *** indicate that the estimated parameters are significant at 10%, 5% and 1%, respectively
Source: Author's construct using STATA 18

economic development. However, capital should be allocated where it will be more productive as to ensure a positive outcome in economic development. This study confirms what many Scholars such as Taraki and Arslan (2019), Sahoo and Sethi (2017), and Aduloju and Oluwaleye (2023) who found a positive correlation between capital investment and economic development.

Studies by Pulok and Ahmed (2017), Nurudeen and Marcin (2015), Obono (2019), and Niyimbanira et al. (2024), also found a negative relationship between corruption, economic growth, and economic development, supporting findings by this study. In addition, the literature with regard to grease the wheels hypothesis assumes that corruption positively impact economic growth and development as highlighted by Gillanders (2023) and Leff and Heidenheimer (2017), sand the wheels hypothesis however, contradicts this notion and emphasizes that corruption is an obstacle for economic development as per the argument by Feruna et al (2017) and Xhindi and Gjika (2022). Amongst theoretical and empirical findings by these scholars, there is a common gap within the used methodology. Furthermore, it is not shown to what level corruption has an impact on economic development. This study hence fills such methodology and literature gap by using a threshold model to estimate the level to which corruption does not have a detrimental effect of economic development, specifically in the SADC region.

Table 15: Threshold estimator for model one

Model	Threshold	Lower	Upper
Th-1	0.6411	0.4766	0.6615

Source: Author's construct using STATA 18

Table 16: Threshold estimator for model two

Model	Threshold	Lower	Upper
Th-1	41.0000	39.5000	42.0000

Source: Author's construct using STATA 18

4.7. Discussion of Panel Threshold Results

Tables 15 and 16 provide the threshold regime results for model one and two. The estimated regime for model one is 0.6411 which falls between 0.4766 and 0.6615, while the estimated regime for model two is 41.0 and falls between 39.6 and 42.0. For model one, the estimated single fixed effect threshold model with a threshold regime of 0.6411 is rejected as the p-value, highlighted in Table 17, is greater than the level of significance. For model two, the estimated single fixed effect threshold model with the threshold regime of 41 is accepted as the P-value is less than the level of significance as highlighted in Table 18. Regardless of the single fixed effect threshold model for model one not being statistically significant, estimation results for such a model are still significant as highlighted in Table 19.

Table 19 provides panel threshold model estimation results for model one. It shows that when corruption levels are below the threshold level of 0.64, corruption has a negative impact on economic development. This is denoted by "0" in Table 19. Control of corruption measures corruption on a scale of −2.5-+2.5 with any score closer to −2.5 highlighting high levels of corruption. Since 0.64 is further from +2.5 and hence it demonstrates high levels of corruption. The impact of corruption on economic development when corruption levels are 0.6411 as per the threshold level or more, is as shown in Table 19. However, such impact is less than the impact before the threshold level, highlighting that the more corruption levels decline, the greater the economic development.

The threshold estimation results for model two shows that before the threshold regime of 41, corruption has a positive impact on economic development as shown on Table 20 by "0". When the level of corruption is below 41, economic development still grows, but at a slower place. However, after the threshold level of 41 (between 39.5 and 42.0), economic development still grows as well, but at a greater pace than that before the threshold level.

Table 17: Test for threshold effects for model one

Threshold	RSS	MSE	Fstat	Prob	Crit10	Crit5	Crit1
Single	0.4661	0.0018	10.66	0.8267	44.3513	59.0653	75.8941

Source: Author's construct using STATA 18

Table 18: Test for threshold effects for model two

Threshold	RSS	MSE	Fstat	Prob	Crit10	Crit5	Crit1
Single	0.7332	0.0038	50.61	0.0000***	9.0613	10.3544	14.9233

***Specify significance at 1%

Source: Author's construct using STATA 18

Table 19: Threshold estimation results for model one

HDI	Coefficient	Standard error	t	P>|t|	[95% conf. interval	
Threshold COC						
0	−0.0757206	0.0137628	−5.50	0.000***	−0.1028224	−0.0486189
1	−0.0249163	0.0146053	−1.71	0.089*	−0.053677	−0.0038444
Cons	0.5365161	0.0051286	104.61	0.000***	0.5264168	0.5466154
Prob>F				0.0000		

* and *** specify significance at 10% and 1%, respectively. "0" specify the fixed effects results before threshold estimation. "1" denotes threshold results for the single fixed effects threshold model

Source: Author's construct using STATA 18

Table 20: Threshold estimation results for model two

HDI	Coefficient	Standard error	t	P>|t|	[95% conf. interval	
Threshold Corr						
0	0.0013074	0.0007577	1.73	0.086*	−0.0001872	0.0028019
1	0.0041798	0.0004185	9.99	0.000***	0.0033542	0.0050054
Cons	0.4818792	0.0211528	22.78	0.000**	0.4401547	0.5236037
Prop>F			0.0168**			

*, ** and *** specify significance at 1%, 5% and 10%, respectively. "0" specify the fixed effects results before threshold estimation. "1" denotes threshold results for the single fixed effects threshold model

Source: Author's construct using STATA 18

As corruption perception index measures corruption on a scale of 0-100, with any score closer to 100 highlighting low levels of corruption and any score closer to 0 highlighting high levels of corruption, the results for model two suggests that high levels of corruption has a negative impact on economic development and it is crucial to combat corruption at all costs for greater economic development.

5. CONCLUSION AND POLICY RECOMMENDATIONS

This study addresses a gap in the existing literature regarding the grease the wheels and sand the wheels hypotheses. Many researchers examining the influence of corruption on economic development, often neglect to analyse how variations in corruption levels, both increases and decreases, affect economic progress. The study employed a nonlinear panel autoregressive distributed lag model alongside a panel threshold model, thereby contributing to both the literature and methodological frameworks in the context of corruption and economic development in the SADC region.

The findings of this study indicate that a non-linear relationship exists between corruption and economic development, whereby corruption poses a significant challenge to economic progress within the Southern African Development Community (SADC) region. This underscores the urgency for government and all stakeholders in SADC nations to formulate and implement targeted policies aimed at eradicating corruption. The elevated levels of corruption are associated with various economic and social repercussions, including but not limited to hunger, poverty, high unemployment rates, inadequate living standards, limited access to quality healthcare and education, increased income inequality, and stagnated economic growth and development. To effectively combat corruption, it is essential to first identify the underlying causes of its prevalence in individual countries. Corruption is frequently linked to the presence of inadequate institutions, and the efficacy of institutional frameworks in many SADC nations raises concerns. These countries often exhibit dysfunctional or weakened institutional structures, particularly within the legal framework, which create a conducive environment for corrupt practices. When vital institutions, such as those enforcing legal standards, are compromised, public officials, including ministers and politicians, may escape accountability for their unethical actions, adversely affecting the lives of marginalized citizens. Therefore, enhancing the quality of institutions represents a critical step toward mitigating corruption.

To effectively address the issue of corruption, this paper suggest that countries establish private anti-corruption agencies that engage in regular audits and investigations of public stakeholders. However, there must also be counter-investigation into the anti-corruption agencies. Furthermore, corruption eradication can be enhanced through collaboration among national anti-corruption agencies, facilitating the sharing of information, effective practices, and coordinated efforts to tackle cross-border corruption. Such partnerships can lead to the exchange of valuable tools and technologies that may be lacking in some countries, as well as the sharing of proven strategies effective in combating corruption. Raising awareness about the detrimental impacts of corruption through educational initiatives is a cost-effective approach that could be particularly beneficial for many countries within the Southern African Development Community (SADC). Educating these countries' population on how corruption adversely affects economic and social outcomes is crucial. The study acknowledges that the sample size might be limited thus the results favour or give impression that corruption stimulate economic development, therefore, further research might use different and bigger sample size which might give different results. Therefore, the contribution of the study is the provision of threshold that corruption is detrimental to economic development.

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