THE ANALYSIS OF THE DETERMINANTS OF SOVEREIGN CREDIT RATINGS: EVIDENCE FROM SADC COUNTRIES

by

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DECLARATION

I, Dakalo Priviledge Netswera, declare that the dissertation hereby submitted to the University of Limpopo, for the degree of Master of Commerce has not previously been submitted by me for a degree at this or any university; that it is my work in design and in execution, and that all material contained herein has been duly acknowledged.

Dakalo Priviledge Netswera (Ms) Date: 08/11/2021

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ABSTRACT

The main aim of the study is to analyze determinants of sovereign credit ratings (SCRs) for Southern African Development Community (SADC) countries, namely Angola, Botswana, Mozambique, South Africa and Zambia. The analysis is based on the SCRs given by Standard and Poor's (S&P). The selected explanatory variables are gross domestic product (GDP) per capita, inflation, external debt, foreign direct investment (FDI) inflows and control of corruption for the period 1990-2016, based on annual data. The panel root test results, namely IPS, LLC, ADF Fisher and PP Fisher, show that GDP per capita, external debt and FDI are stationary at 5% level of significance. The Hausman test results indicates that the identified explanatory variable explains 80% of SCRs. The model observed a positive relationship between SCR, inflation and control of corruption. It also observed a negative correlation between SCR, GDP per capita, external debt and FDI. The Pedroni residual cointegration test results indicate that there is no long-run relationship among variables and no autocorrelation as shown by serial correlation LM test results. The study recommends that the selected member states of SADC develop strategic plans for reducing budget deficits. This will help countries to manage their debts, especially foreign currency denoted debt and to attract foreign investment.

Keywords: Sovereign credit ratings, fixed effects model, random effects, Hausman test.

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CHAPTER 1

INTRODUCTION AND BACKGROUND

1.1 INTRODUCTION

The financial markets across economies have increased the debate on sovereign credit ratings (SCRs) resulting from asymmetric information and transparency between lenders and borrowers. SCRs can be defined as system of determining the capabilities to fulfill financial commitments by countries through willingness to pay its debt and interest rates on time. In other words, these are forward-looking assessments on the probability of default. Credit rating agencies conduct the evaluation, which considers both qualitative and quantitative factors (economic, social, and political) to determine the country's creditworthiness. Most African countries are faced with a high level of budget deficit, leading to increased government borrowing from internal or external creditors. Among the reasons for the existence of rating agencies is that investors require additional information on the risk premium and security when lending money. Lenders would not risk lending their money to borrowers with a high probability of default or without knowing if the borrower will be able to repay the principal and interest on time. Elkhoury (2008) has explained the aim of SCRs as measuring the risk that sovereign governments may default on their own debt obligations.

Pretorius and Botha (2014) have highlighted that African countries are characterized by poor economic growth, a high unemployment rate, political unrest, high inflation and an increase in external debt. As a result of such characteristics the structure of private capital markets has changed, leading to excess demand for bond issues. Failure to accommodate government borrowing by domestic capital market, international capital markets then becomes the option in sourcing the funds. If access to international financial markets is sought, SCRs may represent a ‘ticket’ for the issuer of bonds to obtain a loan. Afonso, Gomes and Rother (2007) have highlighted significant roles which SCRs plays in the international financial markets, economic agents and governments. Firstly, SCRs have been found to be one of the determinants of borrowing cost, namely the interest rate in global financial markets. Secondly, SCRs may have an impact on the ratings assigned to domestic banks or companies. There are many rating agencies responsible for assessing SCRs, Moody's, Fitch, Standard and Poor's (S&P) being the top three rating agencies. These agencies use different scales to assess the capabilities of a country to fulfil the financial obligations. The higher the rating scale, the higher the credit rating (see table 2.2). These credit agencies use different methodologies in measuring SCRs. Fitch (2019) and S&P's (2019) credit ratings seek to assess possibilities of country's being in default and meeting its financial obligations. By contrast, Moody's seeks to measure the expected loss associated with a possible default. A study by Afonso (2003) has shown that a downgrade of sovereign debt and corporate ratings will be followed by a position adjustment of lenders and borrowers. Such an adjustment will be reflected in the way in which borrowers gain access to capital and the way lenders determine the terms of borrowing. Downgrades are associated with high sovereign credit risks, leading to a position of paying higher interest rates in the financial markets.

According to the IMF (2019), Southern African Development Community (SADC) countries are confronted by the following challenges: poorly performing economic growth, a high unemployment rate, political unrest, high inflation and an increase in external debt. Economic development prospects in the SADC are at risk because of those challenges. As a result, investors are confronted with uncertainties in terms of when and where to invest owing to challenges faced by members of the SADC. The work by Aimeida, Cunha, Ferreira and Restrepo (2017) investigates the consequences of SCR downgrades. They found evidence that a poor SCR leads to greater decreases in potential foreign direct investment (FDI). This would mean that failure by government and policy makers to deal with potential determinants of SCRs and policies to improve economic, social and political factors can affect capital inflows seriously. Chee, Fah & Nassir (2015) have argued that its SCR does not only affect the sovereign country; it also affects global financial markets, as evidenced by the worldwide history of sovereign defaults that have affected global financial markets, such as Greece and Italy.

1.2 STATEMENT OF THE RESEARCH PROBLEM

S&P (2019) highlighted that investors have started using SCRs to improve the effectiveness of their investment decisions. Among emerging economies including members of the SADC, African countries has been identified to be offering highest risk-adjusted returns on FDI (Price Waterhouse Cooper, 2019). Rating agencies assess countries' risk of default based on economic, social and political factors. The IMF (2019) report shows that the SADC region still experiences a low economic growth rate, high rate of unemployment and political instability that plays an important role in the analysis of the ratings.

The ratings by S&P ranging between 2015-2019 indicates that four selected member states of SADC, namely Zambia, South Africa, Angola and Mozambique were affirmed at speculative grade which is defined by exposer to poor conditions in the economy, S&P (2019). While Botswana was affirmed at investment grade. The ratings indicates poor performing economies of the countries, which in term affected the ratings. The ratings sends a strong message in terms of how countries' macroeconomic indicators are performing in order for the government to improve their budget balance in order to fulfil their financial obligations and attracting investment.

The work by Aimeida, Cunha, Ferreira and Restrepo (2017) investigates the consequences of SCR downgrades. They found evidence that a poor SCR leads to greater decreases in potential foreign direct investment (FDI). This would mean that failure by government and policy makers to deal with potential determinants of SCRs and policies to improve economic, social and political factors can affect capital inflows seriously. Chee, Fah & Nassir (2015) have argued that its SCR does not only affect the sovereign country, it also affects global financial markets, as evidenced by the worldwide history of sovereign defaults that have affected global financial markets, such as Greece and Italy.

1.2.1 THE SIGNIFICANCE OF THE STUDY

The study on the determinants of SCRs for selected SADC countries, namely Angola, Botswana, South Africa, Mozambique and Zambia is of great importance since the SCRs plays an important attracting foreign direct investment/ capital flows, and also it plays an major role in global financial markets. This study is very important to policy makers in understanding the determinants of SCRs and to come up with policies and strategic to improve the determinants of SCRs as to obtain higher ratings. The selection of member states of SADC for this study is based on the availability of data for explanatory variables.

1.3 RESEARCH AIM AND OBJECTIVES

1.3.1 The aim of the study

This study aims to undertake an empirical analysis of the determinants of SCRs for selected SADC countries, namely Angola, Botswana, South Africa, Mozambique and Zambia. The selection of SADC countries was on the data availability of data.

1.3.2 The objectives of the study

The objectives of the study are to:

- Determine the nexus between SCRs, inflation, GDP per capita, external debt, FDI inflows and control of corruption.
- Analyze the effect of the relationship between SCRs, inflation, GDP per capita, external debt, FDI inflows and control of corruption for members of the SADC.
- Investigate if long-run relationships possibly exist between SCRs, inflation, GDP per capita, external debt, FDI inflows and control of corruption among members of the SADC.

1.4 RESEARCH QUESTIONS

- Is there any nexus between SCRs, inflation, GDP per capita, external debt, FDI inflows and control of corruption?
- What is the effect of the relationship between SCRs, inflation, GDP per capita, external debt, FDI inflows and control of corruption?
- Are there possibly any long-run relationships between SCRs, inflation, GDP per capita, external debt, FDI inflows and control of corruption for member states of the region?

1.4 DEFINITION OF CONCEPTS

This section reflects the definition of concepts that forms the main variables of the study.

- **Sovereign credit ratings**

Fitch (2019) has defined SCRs as forward-looking assessments focusing on the risk of a government defaulting on its debt obligations, including the ability and willingness to honor debt commitments to private-sector creditors in full and on time.

- **Inflation**

It is traditionally defined as a general continuous increase in prices (Mohr & Associates, 2008). It is measured by the consumer price index.

- **Gross domestic product per capita**

The World Bank (2019) has defined GDP per capita as “GDP divided by the midyear population”.

- **External debt:**

Black, Calitz & Steenekamp (2012) have defined external debt of a government as “the sum of all the outstanding financial liabilities of the public sector that is owed to nonresidents in respect of which there is a primary legal responsibility to repay the principal amount and interest.”

- **Foreign direct investment inflows**

The World Bank (2019) has defined FDI as "net inflows of investment to acquire a lasting management interest (10% or more of voting stock) in an enterprise operating in an economy other than that of the investor".

- **Control of corruption**

Control of corruption is described by the World Bank (2019) as "perceptions of the extent to which government authority is used for private gain."

1.6 CONCLUSION

This study is organised into five chapters. The first chapter is about introducing the study area, showing the background of the study, formulating the study problem and research aim and objectives. Following the introduction in chapter one, chapter 2 examines the theoretical and empirical literature review on SCRs and their determinants, followed by SCR systems framework. Chapter 3 discusses the model specification. It shows data sources for the variables, estimated equation and econometrics techniques in analysing data. Chapter four details the interpretation of findings. Chapter five concludes the study with some policy recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter will look closely at previous studies and their results on determinants of SCRs. Section two will examine the theoretical literature on SCRs and their determinants. The following session will be the review of empirical literature, outlining the study's results. Section four deals with an SCR systems framework. It will be followed by a background study of the SADC, including the lessons learnt from the European Union (EU) debt crisis.

2.2 THEORETICAL LITERATURE

The discussion in this section will be drawn from the economic theory of probability and risk. The concept of probability is interpreted in different ways. Gillies (2000), cited in Alfonso & Ivan (2015), divides the interpretation into objective and epistemological categories. Alfonso & Ivan (2015) view probability as reflecting the measurement of the degree of belief. The above interpretation of probability is therefore understood in terms of knowledge and belief of human beings.

The discussion by Alfonso & Ivan (2015) shows that epistemological interpretation of probability can be understood both objectively and subjectively. The first contribution of the theory of probability was made by Keynes in *Treatise on Probability* in 1921. He interpreted epistemological probability objectively, while other authors, such as Ramsey (1990), adopted a subjective epistemological interpretation of probability. In the treatise on probability by Keynes (1921), he considered probability as an objective logical relation between two set of propositions. Keynesian economic theory on the probability approach proposes that individuals who have the same information or evidence after an assessment will assign the same value to a particular probability. However, Jones, Langrall & Mooney (2007) argues that people may not converge on the same probability to reach a given conclusion. This simply means that if people have different evidence after an assessment, they will end up with different probabilities. By contrast, in the subjective theories approach of epistemological probability, Ramsey (1931) & De Finetti (1937) state that individuals who have the same information after an assessment will assign different numerical values/scale levels to a particular probability.

Jones, Langrall & Mooney (2007) has outlined some of the important aspects of the concept of probability by Keynes's argument. Firstly, there is the rule of probability reflecting the measurement scales, meaning that probability must be measureable. O'Connell (1996) presents Keynes's theory of probability, pointing out that the numerical scale measurements of probability are not always available. In some cases, this has led to internal scale measurements being regarded as the option for a range of probabilities, as long as axioms of probability are being followed. Secondly, weight has been identified as another important concept of Keynesian theory of probability. Jones *et al* (2007) defines weight in relation to probability, which he relates to the total amount of evidence and the level of confidence confronting the probability decision. In other words, the higher the confidence and relevant amount of evidence confronting a particular probability, the heavier the weight.

Keynes's view on the probability theory is that "when the probability of some event appears known the act of economic decision is called upon in risk condition'' (Baltatescu 2015: 684). Since credit rating agencies use different scales to rate sovereign governments, this simply means that these ratings are used to measure the sovereign credit rating.

Sakai (2016) has identified two theories of probability. The first is the frequency theory based on the starting point, which consists of many data and their oriented induction. The second is the axiomatic theory reflecting many axioms and their oriented induction. He mentions that some studies on statistical mathematics have used the first frequency theory as their starting point. As stated above, the aim of rating government's credit is to measure the risk that the government may default on its debt obligation. In the Keynesian view, risk is derived from probability; implying that risk must be in a position where it could be measured. This is done by assigning risks to different rating notches. Credit rating agencies, through their aim and purpose, have shed some light not only on the financial markets but also on government and investors in terms of making informed decisions. Skidelsky (2011) holds the notion that risks can be correctly measured or priced. In a discussion by Elkhoury (2008) about the role of rating agencies and their contribution in developing countries, SCRs are said to play an critical role in financial markets because they are able to reduce among others the problem of asymmetric information between lenders and borrowers.

2.3 EMPIRICAL LITERATURE

Cantor and Packer (1996) performed an initial analysis on the factors that influence SCRs they identified a set of macroeconomic factors to be considered when assessing a country's creditworthiness given by S&P and Moody's for September 1995: GDP growth, income per capita, inflation, fiscal balance, external balance, government external debt, economic development through IMF classification of industrialized countries and default history. Data were collected for 49 countries (emerging and industrialized). The study was analyzed using the ordinary least squares (OLS) estimation technique. The results indicated that high per capita income, lower inflation and external debt have a significant positive relationship with high ratings.

Since then, a number of studies on the determinants have emerged to examine the question of how SCRs are determined for both developed and developing countries. Afonso (2003) extended the basis of Cantor and Packer's (1996) study on the SCRs determinants by utilizing both linear and logistic transformation of the rating scale, which was different from Cantor & Packer's (1996) study. Data were collected for 81 developed and developing countries for the variables identified by S&P and Moody's. The results indicated that GDP per capita, default history, inflation, real growth rate, level of economic development through classification of industrialization of the country and external debt as percentage of export have a positive relationship in explaining the of SCRs. The important result was that external debt is strongly related to SCR in developing countries.

Arefjeus & Braslins (2013) studied the determinants of SCRs of Latvia for the period 1997-2012 assigned by Moody's, S&P and Fitch. Before commencing with data analysis, they tried to align and transform the rating scales into values as indicated in table 2.2. The study used OLS regression for the analysis. The analysis used six variables, namely GDP per capita, inflation, the external debt-to-export ratio, budget balance as percentage of GDP and the external government debt-to-export ratio.

The regression equation was then adjusted, leading to only two macroeconomic variables for further analysis, GDP and unemployment. The reason was that they provided the highest explanatory power in the Latvian case, for example by making the equation statistically more reliable. The study found that a GDP growth rate of 1% point per year will improve the average SCR by 0.086 units, while an increase in unemployment by 1% will negatively affect the SCR by 0.236 units.

Montes & Oliveria (2016) widened the study by adding inflation target, financial transparency and democracy, exchange rate stability and less corruption, in addition of the above identify macroeconomic variables. They defined less corruption by the extent to which public power is not exploited by private, which results to corruption as well as capturing of the state.

The study analyzed the determinants of SCR given by S&P, Moody's and Fitch for the period 1994-2013 in developing countries. Montes & Oliveria (2016) extended the study by adopting the dynamic panel data framework for data analysis of the factors of SCRs of developing countries. Their findings indicate that a country's credit rating is determined by GDP growth, per capita GDP, inflation, foreign reserves, and government budget balance and foreign debt. In addition to these variables, they included inflation targeting, easy access to financial markets, a democracy process, exchange rate stability and less corruption, defined by the extent to which public power is not exploited by private which results to corruption as well as capturing of the state.

The results showed that inflation targeting, financial openness and a democratic process enhance the credit ratings for these three rating agencies. Exchange rate stability and less corruption have been found to increase the ratings of at least one agency. None of the empirical publications examined differs from one study to the other when it comes to the potential determinants that best describe SCRs.

Periklis & Panagiotidis (2014) have studied the economic policy uncertainty and SCR decisions using different framework being panel quantile in the Eurozone area to access the significant importance of factors defined by quality and quantity. The study used annual data for Eurozone countries for the period 2002 to 2015. The following set of variables was selected, as identified earlier in literature: GDP per capita, government debt, current account balance, inflation rate, unemployment rate and regulatory quality index. SCRs from Moody's, Fitch and S&P rating agencies were used. The results suggested that GDP per capita is significant determinant of countries with high ratings, whereas countries with low ratings are mostly affected by the regulatory environment and competition in the markets.

Their conclusion is that the creditworthiness of countries with low ratings have a greater impact than that of countries with high ratings when economic policy uncertainty is on the rise. Tugba (2019) has studied how SCRs are determined for emerging economies using the panel ordered probit model. The study identified the following significant factors for defining SCRs: current account deficits, external debts, GDP per capita, real exchange rates, inflation, unemployment and political qualities on SCRs by Moody's, S&P and Fitch. Data were collected for the period 2000-2017. External debt, inflation, current account deficit, GDP growth, and unemployment all have negative effects on sovereign ratings, but GDP per capita has a positive impact.

However, for competence and comparison, Afonso, Gomes &Rother (2011) have gone further in an attempt to explain how SCR provided by S&P, Moody's and Fitch for the period 1995-2005 have been determined. Their study used linear methods and ordered response models, with a specification model that allows one to differentiate among short and long-run effects on the determinants of SCRs. GDP per capita, GDP growth rate, government debt and government balances are statistically significant in explaining the short-run effect of a county's debt rating. On the other hand, long-run determinants are explained by government effectiveness, external government debt, foreign reserves and default history. For model specification purposes, the study performs the Hausman test for the selection of the most appropriate model between the fixed and random effects models. The Hausman test reveals that a country's specific error term is uncorrelated with the regressor, meaning that the preferred model then becomes random effect over fixed effect. .Irrespective of whether the factors are short- or long-run factors of SCRs, they still form part of the same group of factors identified by Cantor & Packer (1996).

Kabadayi & Celik (2015), in a study involving 19 emerging economies rated by S&P, Moody's and Fitch, tried between 1993 and 2009 to analyze data using panel probit and logit analyses to investigate how SCRs are determined. They found that external debt, the inflation rate, current account deficit and exchange rate in real terms were significantly and affected SCRs negatively. GDP per capita, the gross domestic savings-to-GDP ratio and foreign investment were found to be significantly and to have a positive impact on SCRs. Canuto, Santos & Sa Porto (2012) studied 66 countries rated by S&P, Moody's and Fitch over the period 1998 to 2002. They tried to develop another version of the analysis by using a larger sample and the same explanatory variables used in Cantor & Parker's (1996) study, with the substitute explanatory variable as current account deficit/GDP ratio and incorporating gross central government debt/total fiscal receipt. They applied a pooled cross-section model, fixed effects model and first difference model for the analysis.

They found that among the above model frameworks, there is a powerful relationship in the form of a correlation between a country's ratings as well as the level of explanatory factors, namely GDP growth, GDP per capita, inflation, total net external debt, , gross debt of central government, level of openness, development level defined by level of industrialization and default. Oluyomi & Adeola (2019) investigated how SCRs are determined in 20 emerging markets for the period 2001 to 2015, utilizing S&P and Moody ratings. Using a pooled OLS regression model, the study indicated that GDP per capita, inflation, government debt, reserves and external debt were found to be essential determinants of SCR.

From the above discussion of the review of empirical studies on how SCRs are determined on the determinants of SCRs, it is clear that many macroeconomic variables affect sovereign ratings. Most of the empirical results indicate that the variables that are significant in explaining the SCRs for most developing countries are GDP growth, GDP per capita, inflation, external debt, government budget balances and foreign reserves.

2.4 SOVEREIGN CREDIT RATING SYSTEMS

2.4.1 Background and Functions of Credit Rating Agencies

The concept of credit rating services came into existence in early 1850 as a result of the expansion of the railroad system in America. As railroad companies were growing larger, this posed financial challenges because initially these companies were raising money through issuing equity and bank credit. Only a few investors and banks participated in developing a solution to the funding challenges through the bond market in early 1850. This situation called for information asymmetries to assist both parties to have sufficient information in making informed decisions and as a result the first credit rating agency was born.

In 1914 Moody's Investor Services was established as a result of bond market expansion. It was followed by Poor's Publishing Company in 1916, Standard Statistic Company in 1922 and Fitch Publishing Company in 1924, Fitch (2019). Later, in 1941, Poor's Publishing Company and Standard Statistic Company merged and created what is currently known as S&P. These three agencies, S&P, Moody's and Fitch, are the principal international credit rating agencies, controlling about 92.1% of the credit rating markets according to the European Securities and Markets Authority (2019). The other credit ratings agencies in the market include Equifax, Experian, TransUnion and Crediva.

The financial transactions between creditors and borrowers in the international financial markets have created a high demand for transparency and asymmetric information about international bond markets and their products. Creditors need to know the resources that borrowers have and how macroeconomic indicators are performing. Borrowers, on the other hand, must know their capacity to repay the borrowed amount and their willingness to pay. Credit rating agencies provide important information on macroeconomic and political indicators of sovereign governments. This information is important because investors use the ratings as a guiding tool for their investment decisions. SCR (2019) states that SCRs refers to the assessment of capabilities of the country to fulfil its financial commitment in terms of paying its debt. SCRs have become one of the vital factors or drivers to global financial markets and to sustainable economic growth, despite the exposer of the financial markets to risk of uncertainty more especially in the global environment. Ratings assigned to sovereign governments as well as negative outlooks and credit watches serve as guiding tool for anticipating economic prospects. Kaminsky and Schmukler (2002) argue that developing countries are more sensitive to changes in ratings, e.g. downgrades, than developed countries, leading to instability in the financial markets.

2.4.2 Credit Rating Methodology

S&P, Moody's investors' services and Fitch ratings are the common well-known international private credit rating agency principals. They use both quantitative and qualitative factors, such as economic, social and political variables, to analyse a country's capability and creditworthiness. The reasons for these different stages of economic development and performance are usually the prevailing government shaping policies, which in turn shape the business environment and therefore influence investors, natural factor endowments with different sizes of land and political uncertainties. Different stages of development and economic performance play important roles because they shape the direction of SCRs. S&P (2019) and Fitch (2019) explain their ratings as ones seeking to measure and assess the future probability of government defaults. Government default refers to a situation in which the debtor government fails to meet the terms and conditions of contractual obligations. However, investors need to know the amount of money they may recover in the event of default. On the contrary, Moody's is interested in the expected loss from the default. Countries are categorized into different regions or unions; however, countries have different stages of development and economic growth performance. A sovereign rating is divided into local and foreign denominated currency sovereign ratings. The local currency sovereign rating refers to government debt denoted in local currency; government can repay its debt through increasing tax or creating money. External debt is rated based on the foreign currency sovereign ratings. Governments many increase taxes and secure foreign reserves as ways to service foreign currency denominated debts. Table 2.1 shows a summary of rating criteria applied by Fitch and S&P.

Table 2.1: Summary of Sovereign Ratings Methodologies

Assessment factors	Key measurement areas
Macroeconomic	• GDP growth outlook • Credibility and adaptability in macroeconomic policy • Macroeconomic stability
Public finances	• Fiscal financial flexibility • Public debt sustainability • Fiscal rigidity
External finances	• Foreign debt funding adaptability • Foreign debt sustainability • Vulnerability to shocks
Structural features	• Political risk • Threats to the financial sector • Business setting

Source: Fitch and S&P (2019)

All members of the SADC are characterized by poorly performing economic growth, a high unemployment rate, political unrest, high inflation and an increase in external debt. The intention of rating agencies is to assess the systematic risk posed by challenges faced by sovereign governments and the implementation of both monetary and fiscal policies. This is to provide information and transparency to investors or creditors about the sovereign governments to guide them in making investment decisions. These rating agencies use a rating scale in explaining the results of their assessments.

2.4.3 Description of Rating Scales

Table 2.2 shows SCR scales, a summarized description and transformation of rating scales into numeric scales. The rating scales vary according to rating agencies, the highest rating scale being AAA and the lowest D by S&P and Fitch, Moody's having Aaa. As the ratings scale increases, there is low chances of country's to default. With many credit rating agencies in the market, it becomes difficult to make comparisons because each agency uses different ratings.

Table 2.2: Sovereign risk rating scales

S&P	Fitch	Moody's	Rating description	Numeric scale
AAA	AAA	Aaa	Prime	16
AA+	AA+	Aa1	High grade	15
AA	AA	Aa2		14
AA-	AA-	Aa3		13
A+	A+	A1	Upper medium grade	12
A	A	A2		11
A-	A-	A3		10
BBB+	BBB+	Baa1	Lower medium grade	9
BBB	BBB	Baa2		8
BBB-	BBB-	Baa3		7
BB+	BB+	Ba1	Non-investment grade speculative	6
BB	BB	Ba2		5
BB-	BB-	Ba3		4
B+	B+	B1	Highly speculative	3
B	B	B2		2
B-	B-	B3		1
CCC-D	CCC-D	c	Substantial risks Default	0

Source: Standard & Poor's and Fitch (2019)

2.4.3.1 Rating description by S&P

Investment Grade

- AAA_ Highest rating presenting highly capabilities to repay debt.
- AA _A high level of debt repayment capacity.
- A _High level of debt repayment capacity, confronted with changes in economic conditions.
- BBB_ Adequate capacity to repay debt, but confronted factors that threatens the good prospect economy.
- BBB- _ A low level of debt repayment capacity because of the poor investment drive. This entails market participants assigning the lowest investment grade.

Speculative Grade

- BB+_ A highest level of capacity to repay debt because of the highest speculative grade by market participants.
- BB _ Low levels of exposer in the short-term but still confronted with continuous uncertainties in the conditions with financial markets and economy.
- B _ High levels of being expose to poor conditions in the financial markets and economy. CCC _ more exposed to vulnerability and needs better conditions in the financial markets and economy.
- C _ more vulnerability to not repaying debt or default. D _ default on a repaying debt.

2.4.3.2 CreditWatch and Outlooks

Since SCRs depend on the above identified factors, namely macroeconomic factors, public finance, external and structural features, any shift in the economy or circumstances affecting a certain industry will have an impact on the ratings. For instance, a decrease in the commodity price may hurt the production and revenues of the industry. Rising or deteriorating debt levels and debt service cost may change the ratings. Rating agencies may predict/expect a change in the ratings due to the expectation of improvement in economic prospects or other factors that determine the ratings. This is referred to as CreditWatch , where rating agencies may express a change in ratings. S&P's rating outlook is based on six months' to two years' projection based on the economic environment, business, financial and political conditions. It indicates whether the change would be "positive meaning that the rating may be raised, negative meaning that the rating may be lowered, stable meaning that the rating is not likely to change and developing meaning rating may be lowered or raised" (S&P, 2019). The rating watch list is based on 90 days, indicating that events that might occur in coming days may change the ratings. The rationale of CreditWatch and outlooks to this study relates to the potential change in the change that might occur, which express the forward–looking assessment of sovereign governments to meet their financial obligations, is based on the analysis of assessing the likelihood of defaults. During assessments, S&P takes into account future situations to accommodate the probability of future performance through CreditWatch and outlook.

2.5 SOUTHERN AFRICAN DEVELOPMENT COMMUNITY COUNTRIES

The SADC is a regional economic community made up of countries in Southern Africa. It aims at achieving economic integration, addressing political stability and furthering peace and security among member states (SADC, 2017). It consists of 16 member countries, namely Angola, Botswana, Comoros (from August 2017), the Democratic Republic of Congo (DRC), Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, the United Republic of Tanzania, Zambia, and Zimbabwe. The SADC aims at promoting economic integration through achieving economic development and macroeconomic stability among member states in the region. The SADC originated when Southern Africa established the Southern African Development Co-ordination Conference (SADCC) in 1980 for integration and co-operation through historical, economic, political, social and cultural factors. At the time of the establishment of the SADCC, it had Angola, Botswana, Lesotho, Malawi, Mozambique, Swaziland, Tanzania, Zambia and Zimbabwe as its first members. In 1990 membership increased to include Namibia. The SADCC was established to address the following (SADC, 2017):

- to help member states to deal with systems such as apartheid;
- to reduce political instability through the promotion of peace and security; and
- to mobilize resources for economic integration among member states in the region through partnerships and the mobilization of resources to promote national and regional policies.

The formation of the SADCC and collaboration among member states strengthened the independence of members and their struggle against colonialism. It was evident that the SADCC needed strengthening and a decision on this was taken on 17 August 1992. After the approval of the transformation of the SADCC to the SADC on 17 August 1992, additional member states where added, these being countries such as South Africa and Mauritius in 1994 and 1995 respectively, the DRC and Seychelles, both in 1997, and

Comoros. The SADCC was transformed to the SADC with the following objectives for promoting efficiency and effectiveness, SADC (2017):

- to strengthen and promote deeper economic integration and co-operation in order to sustain economic growth and socio-economic development. Addressing the socio-economic infrastructure, market size and low levels of income are some of the factors the SADC aims to address through the transformation;
- to recognize the importance of improving production efficiency and infrastructure systems in order to improve the economic development; and
- to allow member states to identify and outline the cooperation among member state in order to have the economic reforms for the region.

Treaty (as amended, 2009), Article 5 identified the following SADC common agenda as the key principles and values guiding and shaping the prospects of the regional integration agenda (Article 5 of the Treaty, as amended, 2009; SADC, 2017):

- To eradicate poverty, improve living standards and quality of life, and assist the socially disadvantaged through sustainable and equitable economic growth and socioeconomic development supported by regional economic integration.
- To help promote common political principles and systems by strengthening democratic, legal, and effective institutions;
- To support the peace and security within SADC member states;
- Ensure alignment between national and regional strategies and programmes;
- Ensure that the region's resources are used effectively and that sustainable employment is maximized;
- Ensure that natural resources are used sustainably and that the environment is protected;
- Improve and strengthen health systems;
- Promote SADC activities and programmes aimed at improving standard of living and eradicating poverty; and
- Ensure gender is mainstreamed in the in the process of development.

Based on the vision, mission and agenda of the SADC region to foster economic integration through socio-economic, political and security integration among member states, the Regional Indicative Strategic Development Plan (RISDP) for a 15-year period was formulated and adopted by the SADC summit in 2003.

The SADC Vision and Mission, SADC (2017):

> *"The SADC vision is one of a common future, a future in a regional community that will ensure economic wellbeing, improvement of the standards of living and quality of life, freedom and social justice and peace and security for the peoples of Southern Africa" (SADC, 2017).*

> *"To promote sustainable and equitable economic growth and socio-economic development through efficient productive systems, deeper co-operation and integration, good governance, and durable peace and security, so that the region emerges as a competitive and effective player in international relations and the world economy" (SADC, 2017).*

The RISDP is defined as the developmental framework shaping the priorities, policies, goals and strategies guiding regional integration for achieving the vision, mission and common agenda of the SADC region. The RISDP helps member states to design policies, strategies and programs to be aligned with the objectives of the region to ensure efficiency and partnership in attaining the common agenda of the region. SADC member states are defined by the different stages of economic development, levels of economic performance, size of the markets and natural resource endowments. This has resulted in some countries attaining high levels of economic performance, whereas others only achieved low-level growth rates. Despite the spillover effects of unsustainable economic development and performance of one member state in relation to the other, the SADC region is the richest and largest region in the economic grouping in sub-Saharan Africa (African Development Bank 2014). The region has South Africa as the largest contributor to the regional GDP, even though the per capita income of Botswana and Mauritius is greater than South Africa's.

Mlachila, Park and Yabara (2013), cited in Bara, Mugano and Le Roux (2016), indicate that high economy growth rates in the Southern region of Africa region have been achieved through the exploitation of the natural resources and agriculture, supported by sound macroeconomic policies. There has been a debate on the role of institutions in attaining a sustainable economic growth rate in the SADC region. Mbulawa (2015), in ‘‘Determinants of economic growth in the Southern African Development Community: the role of institutions’’, highlight that institutions are defined by the guidelines they use to interact with member states and other economic participants across the globe. Such guidelines include laws, constitutions, political stability, traditions and codes of conduct. Mbaluwa (2015) argues that member states’ failure to comply with these guidelines gives rise to the following socio-economic challenges that pose a threat to the allocation of resources and obstruct the achievement of sustainable economic growth and development: lack of government effectiveness, collapse of regulation, corruption and political instability. Most SADC member states have made good progress towards attaining price stability in the form of single-digit inflation since the financial crisis in 2008, which pushed up inflation rates as a result of high oil and food prices. This has been achieved by the adoption of inflation targeting.

2.6 SOCIO-ECONOMIC INDICATORS FOR ANGOLA, BOTSWANA, MOZAMBIQUE, SOUTH AFRICAN AND ZAMBIA

2.6.1 Angola

The economic performance of Angola relies mainly on oil and diamond production. Angola has registered fluctuating and suitable economic growth rates at market price ranging from 1% to 10% for the period 2000 to 2016. S&P (2019) has identified economic reforms as contributing significantly to the improvement of governance and higher economic growth rates in the country. The following economic reforms have been identified: improvement of fiscal consolidation, exchange rate flexibility, governance and business environment and economic diversification. The dependence of the Angolan economy on the hydrocarbon sector shows the economy to be vulnerable to international factors such as fluctuations in international oil prices. The hydrocarbon sector has been experiencing a reduction in oil revenues since 2014, which affected growth rates adversely.

2.6.2 Botswana

Botswana has been listed as a middle-income economy by the IMF along with South Africa, Lesotho, Namibia and Swaziland (IMF, 2019). It is also classified as one of the world's largest producers of diamonds. Strong GDP growth rates have been registered in past decades, driven by sustainable growth in production in the diamond industry. Since 1990, Botswana has registered a significant increase in GDP growth rate, ranging from 2% to 7% (Standard and Poor's, 2019). The diamond industry has been registered as the biggest contributor to Botswana's total revenue, contributing close to 40% of total revenue. Botswana's fiscal position has continued to be strengthened by well-managed institutions, the mineral sector and effective economic policies. Strong economic reforms have shaped Botswana to be a middle-income economy, thus ensuring sustainability by lowering the external debt burden. The external debt in relation to GDP has been highly favorable at only 9.5% in 2016; the trend from 1990 to 2015 ranged between 3.3% and 24% (World Bank 2019). The favorable trend is mainly attributed to the accelerated GDP in the diamond industry. The external debt trend since 1990 indicates how effective economic reforms and revenue from the diamond sector have managed the debt levels. The contribution of the diamond industry to total revenue has resulted in a budget surplus in several years.

According to Rousseau, Meintjies and Barnard (2002), the reasons for the budget deficit in 1998 was a decline in revenue from the diamond industry in that year. Botswana has made great progress towards establishing price stability and low inflation in single digits. World Bank (2019) show how Botswana has been successful in establishing price stability in recent years, from 16% in 1992 to 3% in 2016. A significant share of Botswana's consumer basket consists of tradeable goods from trading partners such as South Africa and Zambia. With about 75% of the imported consumer's basket from trading partners, Botswana is exposed to domestic inflation pressures of trading partners. Since 1996, the inflation and currency fluctuations in Botswana have been controlled through the South African currency and IMF's special drawing rights (Standard and Poor's, 2017).

2.6.3 Mozambique

Mozambique's GDP growth is driven by the agriculture, forestry and fishing sectors. In the 1990s, Mozambique's economy improved substantially as a result of economic reforms and political stability. From 1993 to 1998, economic growth was boosted by favorable weather conditions and foreign aid flows. Mining, manufacturing, transport, communication and tourism are regarded as potential contributors to Mozambique's economy. According to the SADC (2017), Mozambique's economy has been identified as highly dependent on imported capital and intermediate goods. With such high dependence, it is exposed to international shocks such as exchange rate depreciation and increases in oil and food prices. As a result, the spillover effect of inflation poses a threat to the economy. In 1996, Mozambique registered 48% inflation attributed to uncontrolled money supply and the rate of depreciation. An improvement in the monetary stance/reforms was the backbone of a significant decrease in inflation in 1997 at 8.7% going onwards. Even though Mozambique's economy is relatively small, it is faced with fiscal budget challenges such as a low tax base that is unable to finance government expenditure (SADC, 2017). This has resulted in a build-up of external debt dependence in the 1980s and 1990s. The economic reforms that brought along debt negotiation and rescheduling agreements from 1980 identified Mozambique as one of the countries under the program for highly indebted developing countries eligible for support. World Bank (2017) show that Mozambique's debt position has improved following the HIPC initiative.

2.6.4 South Africa

South Africa has been identified as the biggest contributor to GDP in the SADC region. However, like every member state, it is faced with challenges that have a negative impact on economic growth and fiscal balances. The South African economy remains vulnerable to internal and external shocks such as labor unrest, low investor confidence, employment and international commodity prices. The Integrated Paper on Recent

Economic Development in the SADC (SADC, 2017) identified the following factors as challenging South Africa's long-run economic stability and growth: lack of employment creation, labor unrest and the highly volatile exchange rate. The South African economy registered a decline of 1.3% in 2016Q4 from 2.4% 2013Q1 for the GDP growth rate at market (StatsSA, 2017). These factors have significantly affected growth and inflation. In terms of spillovers by factors constraining production and prices, government revenues remain vulnerable to low tax revenue. It implies that the government will have to borrow more to finance budget shortfalls, thus increasing the budget deficit and debt burden. The increase in the debt burden indicates how debt was managed. South Africa registered moderate external debt ranging from 18% to 49% of the GDP for the period 1990 to 2016 (World Bank, 2019). Inflation has been managed as a result of monetary policy such as inflation targeting of 3%-6%. However, inflation remains a threat through currency depreciation and international commodity prices. South Africa registered a decline in real per capita GDP growth rate ranging from -4% to 1% between 1990 to1999. In 2014, 0.25% of per capita GDP was registered and it continued to decline till 2016 at -1.01%. SADC (2017) indicated that South Africa must maintain a prudent macroeconomic and fiscal policy stance in order to strengthen the economy through promoting monetary objectives.

2.6.5 Zambia

Production in mining, agriculture, electricity and copper remains the backbone of the Zambian economy, with agriculture alone contributing 18% of the GDP in 2000 and mining contributing 8.75% during the same period. The exploration of investment opportunities in the mining and agriculture sectors has contributed to a significant growth rate in the country, with the GDP growth rate at market price ranging from 4% to 10% between 2000 and 2016. The fiscal deficit and debt burden remained high through pressure on the economic prospects of the country. Zambia has been experiencing an increase in external debt in relation to GDP from 15.3% in 2011 to 23.9% in 2014 (IMF, 2015). Zambian external debt levels have been improved through a number of initiatives for debt relief. It benefited from the following debt relief initiatives: Paris Club rescheduling of US$650 million in 1996, Britain and Germany canceling bilateral debt owed to them in 1999, HIPC, which was approved by the IMF and World Bank, Bretton Woods Institutions debt relief, US$325 million in 1992 and US$300 million in 1996 SADC, 2002. Changes are seen as external debt levels declining as a result of the initiatives intended to relieve Zambia of its debt. External debt in relation to the GDP has been reduced from 164% in 1992 to 32.2% in 2016.

2.7 SOVEREIGN CREDIT RATINGS OF SADC COUNTRIES

This section presents the SCR of Angola, Botswana, Mozambique, South Africa and Zambia by S&P.

2.7.1 Angola

The S&P affirmed its “B-/B” short and long-term foreign and local denominated currency debt on 09 February 2018. S&P predicted the accumulation of government debt to slow significantly until 2021. The ratings were based on the following rationale: weak economic prospects, high government debt, rising debt service costs with low levels of economic growth rates, poor GDP per capita and devaluation of the currency and the expectation that inflation would remain at approximately 30%. The country nevertheless remained optimistic, motivated by the expectation that economic growth would increase and the hope that the government’s net debt position could decrease and economic reforms would have a positive impact on government fiscal consolidation plans and economic diversification. S&P predicted attention paid to the hydrocarbon industry to increase as a result of a high price in 2018 and economic growth driving acceleration; this could support overall economic growth.

2.7.2 Botswana

In 2018, S&P affirmed Botswana’s short -term foreign and local denominated currency as well as for the long-term SCRs at ‘A-/A-2’ respectively. On 27 October 2017, the outlook was revised from negative to stable. These ratings were motivated by:

- improvement in the diamond industry, supported by high international prices, resulting in acceleration in production and stabilization of prices, which in turn supported economic prospects and the fiscal position of the government;
- strong institutions, supporting shaping of policies promoting a middle-income economy;
- a well-managed minerals-based economy;
- a low debt burden and debt service cost; and
- real GDP per capita, estimated to be 1.4% over the 2010-2020 period.

2.7.3 Mozambique

S&P (2019) affirmed Mozambique at “SD” for short and long-term foreign denominated currency SCRs, while local denominated currency SCRs were affirmed at “B-’’, with a stable outlook. This implies that Mozambique will be able to meet its financial obligations denominated in local currency. According to S&P (2019), the rating of “SD” does not carry an outlook, since it expresses a condition of default, not a forward-looking opinion of default probability. The rating “SD” was affirmed after Mozambique had fallen into arrears of six months’ interest payment on foreign denominated currency. Mozambique’s authorities and holders of a Eurobond of US$727 million maturing in 2023 decided to conduct restructuring talks. S&P indicated that raising a foreign currency rating from “SD” could be expected once the restructuring talks had been completed.

2.7.4 South Africa

In November 2017, S&P announced that it had lowered its foreign denominated currency SCRs for the long-term for South Africa to ‘‘BB’’ from ‘‘BB+”. The rating for local currency debt was affirmed at “B”. In its statement, S&P (2019) expressed its view of a further downgrade of South Africa’s economic outlook and its public finance owing to economic reforms that had been focusing on distribution rather than growth. On the other hand, the outlook on both foreign and local currency reflects S&P’s argument of political stability following the change in leadership with the governing African National

Congress in December 2017, in the hope of accepting policy measures to improve economic performance and stabilize public finance. The downgrade reflects the following rationale: South Africa is constrained by its weak economic performance accompanied by high levels of government debt, weak fiscal position and political risks, while monetary flexibility is viewed as the key strength.

2.7.5 Zambia

In July 2015, S&P affirmed Zambian SCRs at "B'' with a stable outlook denoted at long-term foreign currency as well as local currency. Zambia remains vulnerable though to unfavorable fiscal positions such as fiscal deficit and a debt burden, which pose a risk to economic growth. S&P predicted copper prices and production to improve, which would support economic growth that would improve the fiscal balance. S&P based its expectation of a stable outlook on Zambia improving economic prospects and lowering debt. According to S&P (2019), ratings had been put under pressure by factors such as low wealth levels, high fiscal deficits and a debt burden. However, an improvement in copper prices, production volumes and agricultural sector were seen as the backbone of Zambia's economic outlook, thus improving the SCRs. Tension in the political environment defined institutions, thus shaping fiscal policies, with negative spillover effects of high levels of fiscal deficit and debt. S&P predicted that the government would continue to introduce measures to address slower fiscal consolidation in order to improve the fiscal position of the county. The rationale behind ratings on Zambia was mainly supported by the revenue from copper exports, which led to a current account surplus, thus enabling the country to finance some of its debt.

Table 2.3: Sovereign Credit Rating of SADC Countries

Country	S&P, 2016	
	Rating	Outlook
Angola	B-	Stable
Botswana	A-/A-2	Stable
Mozambique	SD	--
South Africa	BB	Stable
Zambia	B	Stable

Source: S&P (2019)

2.8 LESSONS FOR SADC FROM EU DEBT CRISIS

Evidence-based events in the EU about the debt crisis are lessons for all countries, including those in the SADC, about how they should manage their debts to avoid a situation of defaulting. With reference to the case of Greece, a lesson learnt is that it is vital to deal with determinants of SCRs to avoid situations that could lead to investors losing confidence in investing in SADC countries. Reserve Bank of Zimbabwe (2017) identified some lessons for SADC countries and for the future, referring to Greece as an example. Developing and implementing effective macroeconomic policies and ensuring good governance finances are crucial. Prevailing macroeconomic policies shape positive economic outcomes and in turn lead to good SCRs. Enforcing strict public debt management rules and disciplined allocation of resources avoid inefficiency in addressing any issues relating to budget deficits and public debts.

2.9 SUMMARY

In this chapter, theoretical and literature reviews are presented. The findings from the reviews show that SCRs are defined by GDP growth rates, GDP per capita, inflation, external debts, economic development and foreign reserves. Furthermore, an analysis of the SADC shows that macroeconomic, social and political variables of each member state plays an important role in explaining SCRs. In the following chapter, the econometric methodology for analysis is introduced; this includes model specification, data sources and estimation techniques. Drawing from lessons learnt from the EU debt crisis, it is critical for SADC countries in dealing with challenges affecting growth and prospects of sustainable socio-economic development.

CHAPTER 3:

METHODOLOGY

3.1 INTRODUCTION

In the previous chapter, different determinants of SCRs were identified and theoretical as well as empirical literature interrogated. Chapter 3 deals with the framework of the research methodology by initially giving a brief overview of the model specification for this study and discusses the panel data framework. A linear regression equation is formulated to assess any correlation that might exist between the explanatory variables and SCRs. The data sources of the SCRs and explanatory variables are identified and this chapter concludes with the estimation techniques that will be employed to analyze the factors that determines SCRs.

3.2 MODEL SPECIFICATION

Different econometrics models have been employed in many existing empirical analyses when studying the determinants of SCRs. For the purpose of this study, the panel data framework is employed for the empirical analysis. Brook (2008) defined and outlined the advantages of using panel data as follows: A panel data set framework is defined as an investigation analytical tool for a given sample of countries, individuals, firms and other entities. Panel data analysis has the following advantages: It yields a large amount of data for a given sample, it ensures consistence, less correlation among explanatory variables, opportunity for explanatory variables to vary in the analysis and more optimization. The panel data framework has been identify to be the appropriate technique in this study to analyze the dynamic changes of the proposed explanatory variables for selected SADC countries. Panel data reduce bias that might occur with dynamic changes of proposed explanatory variables (Gujarati and Porter, 2009)

Model estimation is essentially based on the existing empirical studies presented in chapter 2. Based on the empirical literature, the study used a set of explanatory variables that defines the SCRs from selected SADC countries that were applied in other studies (Afonso, 2003; Cantor & Packer, 1996; Montes & Oliveria, 2013). The functional form of the model to be used in this study is as follows:

$$SCR_{it} = (INFL_{it}, GDP\ PerCapita_{it}, ExtDEBT_{it}, FDI\%GDP_{it}, CC_{it}) \quad (1)$$

Based on both the empirical literature review and set of explanatory variables, the linear regression equation model for this study becomes:

$$SCR_{it} = \beta_o, \beta_1 INFL_{it}, \beta_2 GDP\ PerCapita_{it}, \beta_3 ExtDebt_{it}, \beta_4 FDI\%GDP_{it}, \beta_5 CC_{it} \quad (2)$$

Where

SCR = Sovereign credit ratings
Infl = Inflation
GDP per capita: Gross domestic product per capita
ExtDebt = External debt
FDI%GDP = Foreign direct investment inflows percentage of GDP
CC: Control of corruption.
Z_{it} Is the vector representing time-invariance
ε_{it} Is the disturbance term, which is independent across countries and over time.
α_i Accounts for individual effects for each country.
The index *i* (*i*=1, 5) denotes the country, the index *t* (*t*=1990, 2016) indicates the period. One observes the dependent variable and independent variable ($Y_{it\ and} X_{it}$) respectively.

3.3 DATA SOURCES

The study will utilise secondary data covering the period 1990-2016. Data are collected from World Bank, IMF and S&P for the following variables: external debt, control of inflation, inflation rate, GDP per capita, FDI, and SCRs for Angola, Botswana, South Africa, Mozambique, and Zambia. The choice of selected explanatory variables is determined by the existing empirical studies on how SCRs are determined for developing countries and the availability of data (Cantor & Packer, 1996; Afonso, 2002; Montes & Oliveria, 2013; Arefjeus & Braslins, 2013). The choice of selected S&P is determined by the availability of the ratings of selected SADC countries. The rationale for S&P is that it seek to assess possibilities of country's being in default and meeting its financial obligations.

3.4 ESTIMATION TECHNIQUES

This section explains the techniques that will be used to analyze the panel data for the proposed study.

3.4.1 Panel Unit Root Test

Levin & Lin (1992) were the first authors to establish the foundation for the panel unit root test. Since then a few common tests have been proposed and implemented. These include tests such as Im, Pesaran & Shin (1997) (IPS) & Maddala-Wu (1999) (MW). The IPS test is a method of integrating data on the unit root hypothesis from N unit root performance on N cross-section units with evidence on the unit root hypothesis. The IPS is performed with a Dickey-Fuller (DF) or Augmented-Dickey Fuller (ADF) estimation equation. Im, Pesaran & Shin (1997) and Maddala (1999) identified the following assumptions for the IPS test: It is assumed that when conducting an IPS test, T is the same for all cross-section units. This means that IPS is applied only for balanced data. The IPS test is not limited to ADF; when all the t-statistics for the unit root in each cross-section are identically distributed, it can also be used in conjunction with balanced data. However, Hoang & Mcnown (2006) applied the IPS and MW test using a weighted symmetric approach when examining the performance of these tests under different data properties. According to their simulation results, a panel data unit root test with weighted symmetric estimation has more features than ADF and DF. This study applied the IPS method developed by Im, Pesaran and Shin (1997) & Fisher-ADF and Fisher-PP by Maddala-Wu (1999).

a) Non-Stationary Test

3.4.1.1 Im, Pesaran and Shin Test (2003)

Im, Pesaram & Shin (1997, 2003), developed a procedure for testing panel unit root test, which is referred to as the t-bar statistic. It is important to note the advantage of this framework:

- It allows simultaneous stationarity meaning that ρ_i is allowed to differ between individuals and non-stationary series.
- It allows for serial to be correlated and heterogeneity of the dynamics and error variances across groups.
- The ADF t-statistic is used to deal with serial correlation.

The model for applying the IPS test is:

$$y_{it} = \alpha_i + \beta_i x_{it-1} + \varepsilon_{it} \quad t = 1,2,..,T, \quad i = 1,2,\dots,N \tag{3}$$

WhereX_{it-1}, represent the exogenous variable in model (3), including any constant parameters within variables or individual trends. *T* denotes the period covered by the study; *N* represents the number of cross-sections; β_i is the autoregressive coefficients, and error $\varepsilon_{it,}$ is assumed to be mutually independent. Im, Pesaram & Shin (1997), presented the panel unit root test, which allows for a heterogeneous coefficient of Y_{it-1}. This framework requires that N/T → 0 for N → ∞. With the above model for the IPS test, the null hypothesis of this test is:

$H_0: \rho_i = 1$, for all individuals. (4)

IPS (1997) proposed a procedure for testing alternative hypothesis focuses on the averaged individual unit root test statistic. Thus, the alternative hypothesis is defined as:

$H_{1/\alpha}: \beta_i < 1$, for some i of the individuals. (5)

Therefore, the alternative hypothesis is defined as:

H_0 : β_i=1, *i*=1, 2, N. (6)

When performing ADF for the IPS test, if $\beta_i < 1$, it means that γ_{it} recommends stationary. Alternatively, if $\beta_i = 1$, then γ_{it} is said to have a unit root. For testing procedures for the IPS-ADF test, the study followed the Monte-Carlo investigation design.

The regression models for the IPS test through ADF each cross-section *i*:

$$\gamma_{it=\alpha_i+\beta_i X_{it-1}+\sum_{k=1}^{p}\theta_{it}\Delta y_{i,t-1}+\varepsilon_{it,}} \quad {}_{t=1,2,\ldots,T:i=1,2,\ldots,N} \tag{7}$$

T Is estimated for each cross section i, $i = 1,2,..,N$, to calculate the t-statistic for β_i.

3.4.1.2 Maddala and Wu Test (1999)

Another commonly used test in panel unit root determination is the MW test (1999) using Fisher-ADF and PP tests. This test combines probability values in each cross-sectional unit of the test statistic (Maddala & Wu Test, 1999). Hoang and Mcnown (2006) state that MW is recommended for the following reasons: Firstly, any unit root on a single time series allows for MW to be performed. Secondly, while IPS requires balance data, MW does not require a balanced panel, it allows for *T* to differ across sections.

The ADF equation for the MW test for each individual series is estimated as follows:

$$\gamma_{it=\alpha_i+\beta_i X_{it-1}+\sum_{k=1}^{p}\theta_{it}\Delta y_{it-1}+\varepsilon_{it,}} \quad {}_{t=1,2,\ldots,T} \tag{8}$$

$$\gamma_{it} = \alpha_i + \beta_i X_{it-1} + \sum_{k=1}^{p} \theta_{it}\Delta \ldots \ldots.$$

3.4.1.3 Choi (2001)

Choi (2001) extended the study by proposing another testing procedure for the panel unit root test to overcome the limitations of the Levin-Lin-Chu (LLC) and IP tests. Both p-values from a unit root test applied to each category in the panel data are combined in this test. The following were identified as limitations of the LLC and IS tests:

- Both of them necessitate an infinite number of categories.
- Non-stochastic elements are assumed to be the same for all groups.
- The same group is allowed to have a unit root while others do not have one.
- The choice of lag length in the individual ADF regression affects the critical values.

Therefore, the proposed Choi (2001) model is:

$$Y_{it} = d_{it} + x_{it} \quad , \; {}_{i=1,2,\ldots,N,} \quad {}_{t=1,2,\ldots,T}$$

Where:

$$Y_{it} = d_{it} + x_{it}\ ,\ i=1,2,\ldots\ldots,N,\quad t=1,2,\ldots\ldots,T$$

$$d_{it} = \alpha_{i0} + \alpha_{i1}t + \ \ldots.. + \alpha_{imi}t^{mi}$$

$$x_{it} = \rho_i x_i(t-1) + u_{it}$$

Whereby u_{it} is integrated into order zero. Choi's (2001) model specifications are defined as:

- Model with two-way error component ;
- Time trend;
- There is only one factor that is taken into account;
- Observations of data y_{it} made up of no stochastic process d_{it} and a stochastic process x_{it} ; and
- Each time series y_{it} assumed to have an identical sample size for the observed data and different characteristic of non-stochastic and stochastic components depending on i.

The null hypothesis for the model becomes:

$$H_0: \rho_i = 1 \quad for\ all\ i \tag{9}$$

which is interpreted as non-stationary for all the time series,

against the alternative hypothesis, which is:

$$H_0: |\rho_i| < 1, for\ atleast\ one\ i\ for\ finite\ N \tag{10}$$

Implying that some series are allowed to be nonstationary while others are not.

$$H_0: |\rho_i| < 1, for\ some\ \ i's\ for\ infinite\ N \tag{11}$$

which means that the time series is stationery when the null hypothesis is rejected.

3.4.1.4 Breitung (2000)

Breitung (2000) developed a testing procedure for a unit root test in a panel data framework based on the non-existence of a bias correction factor. Because of its framework, it has the power to rule out a homogenous alternative. Serial correction has been identified as the limitation of this framework. However, in the development of this framework, options to avoid serial correction were identified as:

Option 1: Subtracting the initial observation from regression equation

$$\breve{y}_{it} = y_{it} - y_{it} - 1 \tag{12}$$

Option 2: Having a small sample performance, which involves the following step:

$$\Delta y_{it} = \alpha_i + \sum_{j=1}^{p_i} y_{ij} \Delta y_{it} - j + v_{it} \tag{13}$$

Computing $\tilde{e}_{it}$ and $\tilde{f}_{it}$ residuals as follows:

$$\tilde{f}_{it} - 1 = y_{it} \tag{14}$$

Therefore, the hypothesis is defined as :$H_O : \emptyset = 0$.

3.4.1.5 Levin and Lin (1992)

Levin & Lin (1992) developed a test for testing the null hypothesis of non-stationarity in a panel data set. The basis of the test is to allow constant parameters, individual deterministic components and heterogeneous serially correlated errors in the panel data framework. N and T are assumed to be infinity with T increasing at a faster rate than $N/T \to 0$. Phillips and Moon (1999) stated that it will become more difficult to identify asymptotic properties of estimators and non-stationary tests when N and T are infinity. The panel root test is based on the following model:

$$Y_{it} = P_{it} Y_{it-1} + \acute{Z}_{it} Y + \mu_{it} \tag{15}$$

where: i = 1, 2,….., N is the individual

t = 1, 2,…., T time series observation

$\acute{Z}_{it}$ = is the deterministic trend/ component

N_{it} = is stationary process

Z_{it} = could be zero, one, the fixed effects (μ_{it})

Testing for the null hypothesis is defined as:

$$H_0 = \rho = 1 \quad (16)$$

against the alternative hypothesis with heterogeneity

$$H_1 : \rho < 1 \quad (17)$$

3.4.1.6 Levin, Lin and Chu (2002)

In 2002, Levin, Lin & Chu extended the analysis of the initially developed framework to test the null hypothesis of non-stationarity in a panel data set by allowing model specifications to be incorporated:

- Individual deterministic effects, which may be constant and/or a linear time trend;
- The error terms have a heterogeneous serial correction structure.; and
- Assuming that both $N\ and\ T$ tend to be infinity; however, allowing T to increase at a faster rate such that $N/\ T = 0$.

Using a pooled t-statistic, this model will compare the hypothesis that each individual time series includes a unit root to the alternative hypothesis that each time series is stationary. Therefore, the model structure of LLC is derived from model (15) from Levin & Lin (1992), by assuming homogenous autoregressive coefficients between individuals. Thus, based on the model (15), the structure of the LLC model analysis is defined as follows:

$$\Delta Y_{it} = PY_{it-1} + \alpha_{0i} + \alpha_{1i}t + \mu_{it} \quad (18)$$

where: $i = 1,2, \dots , N$ is the individual

t = 1,2,…., T time series observation

$\alpha_{it}t$ = time trend

α_{it} = individual effects.

μ_{it} = is a stationary invertible ARMA process, which is assumed to be independently distributed across individuals.

$$\mu_{it} = \sum_{j=1}^{\infty} \theta_{ij}\mu_{it-j} + \varepsilon_{it} \tag{19}$$

Barbieri (2005) identified the limitations of the LLC test:

- In the presence of cross-sectional correction, the test is not applicable, since it depends more strongly upon the independence assumption.
- Autoregressive parameters are considered to be identical across the panel. However, the extension of panel unit root test analysis by Im, Pesaran and Shin (1997, 2003) has helped to overcome the limitations identified above, with the exclusion of assumption of identical first-order correction under the alternative.

b) Stationarity Tests

3.4.1.7 Hadri (2000)

All the above tests for the panel unit root evaluated the null hypotheses. Hadri (2000) extended the study on the panel unit root test by developing a panel test for null stationarity, which allows the residual-based Lagrange multiplier (LM) test of stationarity to be formulated and also allows both the presentation of stationary and non-stationary variables. The rationale for this test is that the null hypothesis is stationary in all units against the alternative of a unit root in all units. Barbieri (2005) emphasized the fact that time series tests for stationarity tend to have high size distortions when null tends to be close to the alternative of a unit root.

The model test is formulated as: $Y_{it} = \acute{Z}_{it}Y + r_{it} + \varepsilon_{it}$ (20)

where: $\acute{Z}_{it}$ is the deterministic component

r_{it} is a random walk, $r_{it} = r_{it-1} + \mu_{it}$

ε_{it} is a stationary process.

The alternative hypothesis is defined as: $H_O = \sigma^2{}_\varepsilon = 0$, implying that the panel has a unit root. Therefore, the null hypothesis is that there is no unit root in any series.

The model component becomes:

$$Y_{it} = \acute{Z}_{it}Y + e_{it} \tag{21}$$

where e_{it} denotes $\sum_{j=i}^{\infty} \mu_{tj} + \varepsilon_{it}$

- $\hat{e}_{it}$ Is allowed to be the residual from the regression (21).
- $\hat{\sigma}^2$ denotes a consistent estimator of the error variance under H_O, given by $\frac{1}{N}\sum_{i=1}^{N}\sum_{t-1}^{T}\hat{e}_{it}{}^2$.
- S_{it} = partial sum process of the residual , $S_{it=}\sum_{j}^{t}\hat{e}_{it}$.

Therefore, the LM statistic is derived as:

$$\text{LM}= \frac{1}{\hat{\sigma}_{e^2}}\frac{1}{NT^2}\left[\sum_{i=1}^{N}\sum_{t=1}^{T}S^2{}_{it}\right] \tag{22}$$

The method proposed by Hadri (2002) has the following advantages: Firstly, as $T \text{ and } N \to \infty$, the asymptotic normal distribution is derived using Monte Carlo simulation and secondly, it is possible to determine $\sigma^2{}_\varepsilon$ for each individual time series.

Choi (2001)

The testing procedure for the panel unit root test for stationarity was extended by Choi (2001) by allowing the verification of null stationarity.

The null hypothesis becomes:

$$H_0 : |\rho_i| < | \text{ for all } i \tag{23}$$

implying that all time series are stationary.

An alternative hypothesis is derived as:

$$H_1 : |\rho_i| = 1 \tag{24}$$

implying that the time series is stationary for at least one i (observation), for finite N (groups/ individuals), and for some i (observation) for infinity (N) individuals.

3.4.2 Pooled OLS Regression Model

Pooled OLS regression, also known as the constant coefficients model, assumes that the regression coefficients are the same for all countries or entities. Like the fixed effect least squares dummy variables (LSDV) model, pooled OLS regression has the problem of an unobserved or heterogeneity effect. Gujarati and Porter (2009) believe that there is a high possibility of correlation with one or more regressors in relation to the problem of an unobserved effect. Wooldridge (2002) summarizes the properties of pooled OLS with reference to the following linear panel data equation:

$$\gamma_{t=}x_t\beta + \varepsilon_t \qquad t = 1,2, \dots, T \tag{25}$$

Having x_{it} allows the parameters to change over time. In some of the variables of x_{it}, they may not be time-varying, e.g. gender dummies. Kalliomaki & Andersson (2012) emphasize that "Pooled OLS does not control for unobserved country effects in addition to being the inferior choice with regards to efficiency." *For consistency, pooled OLS will not be considered as a potential estimator.*

3.4.3 The One-Way Error Component Regression Model

Panel data regression is defined by the following model with double subscript on its variables:

$$Y_{ti} = \alpha + \acute{X}_{it}\beta + U_{it} i = 1, . . , N; \quad t = 1, \dots, T \tag{26}$$

where i denotes individuals/countries and subscript denotes the cross-section dimension,

t denotes time and subscript denotes the time-series,

α is a scalar,

β is *K* × 1 and X_{it} is the it observation on *K* explanatory variables.

Baltagi (2005) highlighted that for the disturbances, most panel data implementations use a one-way error component model, for the following

u_{it}=μ_i+ v_{it} , can also be written as: $u = Z_\mu \mu + v$ (27)

where $\mu_i$denotes the unobservable individual-specific effects and v_{it} denotes the denotes the remaining disturbance, which varies with individuals and time, and can be thought of as the actual disturbance in the regression. Therefore, equation (26) can be written in the vector form as:

$$y = \alpha l_{NT} + X\beta + u = Z\delta + u \quad (28)$$

where y is $NT \times 1, X\ is\ NT \times K, Z = (l_{NT}, X), \acute{\delta} = (\acute{\alpha}, \acute{\beta})\ \ and\ l_{NT}$ is the vector of ones of dimension NT.

3.4.3.1 Fixed Effects Model

Fixed effect is one of the techniques used to analyze a panel data set. For evaluating the influence of variables that change over time, the fixed effect is used. It is based on the following assumptions: Each country has unique characteristics that may or may not have an effect on the predictor variables. Another assumption is that each country's intercept does not vary over time, meaning that its time-invariance is unique. The μ_i is considered to be fixed parameters to be calculated in the fixed effects model, and the remainder disturbance is stochastic with v_{it} and identically distributed. The X_{it} is assumed to be independent of the v_{it} for all $i\ and\ t.$ Baltagi (2005) recommends fixed effects model specification if one is dealing with a set of N countries or firms with inference being restricted by the behavior of a set of firms or countries. The inference is appropriate for the specific N firms/countries that are observed. Therefore, in order to get the estimates of: $\alpha, \beta\ and\ \mu$.

Baltagi (2005) proposes the following procedure of substituting the disturbance from equation (27) into equation (11) in order to get:

$$Y = \alpha l_{NT} + X\beta + Z_\mu \mu + v = Z\delta + Z_\mu \mu + v \quad (29)$$

Fixed effect can be explained further by the LSDV model. Since the fixed effect model does not allow heterogeneity among subjects, LSDVs provide significant understanding of the fixed effect by allowing heterogeneity. Gujarati & Porter (2009) identified several problems that must be considered when using the fixed effect LSDV model. Introducing many dummy variables will pose the risk of the degrees of freedom problem and the possibility of multicollinearity. ''Fixed -effects model does not mean that the individual effects α_i are not random in true model; meaning that estimation is conditional on unobserved heterogeneity'' (Thomas, 2004). Through OLS in equation (27), $\alpha, \beta \ and \ \mu$ are estimated.

where: $Z \ is \ NT \times (K+1) \ and \ Z_\mu$

$NT \times N$ is the matrix of individual dummies.

Baltagi (2005) highlights that equation (27) will have too many individual dummies if N is large. For the LSDV estimator, equation (27) is multiplied by Q and therefore OLS is performed on the resulting transformed model:

$$Qy = QX\beta + Qv \qquad (30)$$

It implies that the Q matrix wipes out individual effects. This is defined by the regression of $\tilde{y} = Qy$ with ($y_{it} - \tilde{y}_i$) on $\tilde{X} = QX$ with ($X_{it,k} - \bar{X}_{i.,k}$ for the kth regressor, $k = 1,2, \dots, k.$ Therefore the OLS estimator is defined:

$$\tilde{\beta} = (X'QX)^{-1}X'Qy \qquad (31)$$

The simple one–way error component regression model is defined as:

$$y_{it} = \alpha + \beta X_{it} + \mu_i + v_{it} \qquad (32)$$

Therefore, the equation for the fixed effect model is written as:

$$SCR_{it=\alpha+ \beta_1 INFL_{it}+ \beta_2 GDP \ per \ capita_{it} + \beta_3 ExtDEBT_{it} + \beta_4 FDI\%GDP_{it} + \beta_5 CC_{it} + \mu_i + v_{it}} \qquad (33)$$

where;

SCR = Sovereign credit ratings

Infl = Inflation
GDP per capita: Gross domestic product per capita
ExtDebt = External debt
FDI%GDP = Foreign direct investment inflows percentage of GDP
CC: Control of corruption.
Z_i is the vector representing time-invariance.

ε_{it} is the disturbance term, which is independent across countries and over time. α_i accounts for individual effects for each country. The index $i = 1,2,\ldots$ denotes the country, the index *t* (*t*=1990, 2016) indicates the period. Incorporating averaging over time, the equation becomes:

$$\overline{SCR}_i = \alpha + \beta_i\overline{INFL}_{it} + \beta_2\overline{GDP\ PerCapita}_{it} + \beta_3\overline{ExtDEBT}_{it} + \beta_4\overline{FDI\%GDP}_{it} + \beta_5\overline{CC}_{it} + \mu_i + \bar{v}_{it} \quad (34)$$

Baltagi (2005) identifies limitations of the fixed effects model least squares:

- It has a significant loss of degrees of freedom.
- It is associated with a highly possibility of multicollinearity among the regressors.
- Time-invariant variables such as race, religion or sex cannot be estimated. Because of the process of Q transformation, these variables that are time-invariant are removed.

The fixed effects estimator analysis is that, as $T \to \infty$, the fixed effects estimator is consistent. If T is fixed and $\to \infty$, then the fixed effects estimator of β is consistent. As N increases, fixed effects estimators of the individual effects ($\alpha + \mu_{it}$) become inconsistent.

3.4.3.2 Random Effects Model

Baltagi (2005) indicates that the limitations of fixed effects models such as too many parameters and If the μ_i can be considered to be random, loss of degrees of freedom can be eliminated. In such a case $\mu_i \sim IID\left(0, \sigma^2{}_{\mu}\right), v_{it} \sim IID\ (0, \sigma^2{}_V)$ and μ_i are independent of v_{it}. Baltagi (2005) highlights the point that a random effects model is an appropriate specification if one is drawing *N* individuals randomly from a large population, especially in the case of a household panel. N is normally high in such cases, and a fixed effects model will result in a massive loss of degrees of freedom. As a result, the individual effect will be labeled as random, and inference will be made about the population from which this sample was drawn at random. In the following component model observations are classified by group as a single term.

The one-way error component model reads:

$$Y_{it} = \alpha + X_i + \varepsilon_{it} \tag{35}$$

$$\varepsilon_{it} = U_{it} + V_{it}$$

$$U_{it} \sim i.i.d.(0, {\sigma_U}^2)$$

$$V_{it} \sim i.i.d(0, {\sigma_v}^2),$$

$$\varepsilon_{it} \sim N(0, \sigma^2)$$

where ε_{it} are independent random variables, X_i are independent random variables with distribution $N(0, \sigma^2)$, X_i and ε_{it} are independent of each other, $i = 1,2,..,N, t = 1,2,..,T$. The treatment effects are treated under hypothesis:

$$H_0: {\sigma_T}^2 = 0, H_1: {\sigma_T}^2 > 0 \tag{36}$$

Therefore, if ${\sigma_T}^2$=0, then all random effects are 0. If ${\sigma_T}^2 > 0$, random effects vary and cannot be equal to zero.

3.4.4 The Two-Way Error Component Regression Model

Wallace & Hussain (1969), Nerlove (1971) and Amemiya (1971) extended the regression model study identified by equation (26) by including two-way error component disturbances. The two-way error component model described classification in which sample observations are grouped as individual effects and time effects. According to Wooldridge (2002), when some of the variables are grouped as time-varying, it means that each element of x_t varies over time for some cross-section units.

$$u_i = \mu_i + \lambda_t + v_{it} \qquad i=1,\ldots,N; \quad t=1,\ldots,T \tag{37}$$

where μ_i represent individual effect which is not observable;

λ_t is the unobservable time effect, which provides for individual-invariant effects as well as any time-specific effects not included in the regression. v_{it} is the remainder of the stochastic disturbance term.

3.4.4.1 The Fixed Effects Model

The two-way error component model described classification in which sample observations are grouped as individual effects and time effects. According to Wooldridge (2002), when some of the variables are grouped as time-varying it means that each element of x_t varies over time for some cross-section units.

$$Y_{it} = \alpha_i + x_t + \varepsilon_{it} \qquad i = 1, \ldots, N. \quad t = 1, \ldots, T. \tag{38}$$

where α_i and x_t are treated as fixed parameters, representing individual effects and time-invariant effects respectively. ε_{it} denotes the disturbance term, which is independent across countries and over time. The two-way error fixed effects model is explained by equation (37) along with the following assumptions:

- Assuming that μ_i and λ_t are fixed parameters to be estimated and the remainder disturbance stochastic with $v_{it} \sim IID(0, \sigma^2{}_{V})$;
- Assuming that X_{it} are independent of the v_{it} for all i and t; and
- Assuming that inference is dependent on a particular group of N individuals and over a specific time period observed.

Baltagi (2005) highlights the point that if *N or T* is large, then there will be too many dummy variables in the regression, causing loss in degrees of freedom, which in turn will cause the problem of multicollinerialty. By following the same procedure using the one-way error component model, equation (38) will be averaged over individuals in order to get:

$$\bar{y}_{.t} = + \beta \bar{X}_{.t} + \lambda_t + \bar{v}_{.t} \tag{39}$$

where the $\sum_i \mu_i = 0$ restriction is utilized in order to avoid dummy variable problems.

OLS is given by the following model:

$$(y_{it} - \bar{y}_{i.} - \bar{y}_{t.} + \bar{y}_{..}) = (x_{it} - \bar{x}_{i.} - \bar{x}_{.t} + \bar{x}_{..})\beta + (v_{it} - \bar{v}_{i.} - \bar{v}_{.t} + v_{..}) \tag{40}$$

For the two-way model, this model provides an inside estimator, defined by β. Baltagi (2005) shows that the within estimate of the intercept is derived from $\bar{\alpha} = \bar{y}_{..} - \bar{\beta}\bar{x}$, while $\mu_i \; and \; \lambda_t$ are deduced from:

$$\tilde{\mu}_i = (\bar{y}_{i.} - \bar{y}..) - \bar{\beta}(\bar{x}_{i.} - \bar{x}..) \tag{41}$$

$$\tilde{\lambda}_t = (\bar{y}_{.t} - \bar{y}..) - \bar{\beta}(\bar{x}_{.t} - \bar{x}..) \tag{42}$$

It is important to note that the within estimator suffers from Q transformation, which wipes out the variable. As a consequence, estimating the results of time-invariant and individual invariant variables becomes difficult. Given the above discussion, all sets of dummy variables are ignored by OLS; on the other side of one-way error fixed effects estimator, OLS ignores only time dummies. According to Baltagi (2005), If time dummies are statistically important, the one-way error fixed effects estimator would suffer from omission bias.

3.4.4.2 Random Effects Model

The reason behind the random effect model, according to Gujarati and Porter (2009), is that variance between entities is believed to be random and uncorrelated with the independent variables used in the model, which implies that individual effects are included in the disturbance term. Time-invariance is included in the model, Gujarati and Porter both conclude that the error term of the entity is unrelated to the independent variables. Eliasson (2002) mentions that random effects as the estimation technique are important because they are able to capture the country-specific heterogeneity. Fingleton (2015) maintains that "the random effects approach attempts to model the individual effects as drawings from a probability distribution instead of removing them." If N

individuals are drawn at random from a large population, the random effects model, according to Baltagi (2005), is an effective model specification. The two-way random effects model consists of both unobserved individual effects and a time-specific constant or time effect. According to Kunst (2010), the two-way model is important in economic application because it incorporates both the individual effect and time effect.

$$y_{it} = \beta_{1i} + \beta_2 X_{2it} + \beta_3 X_{3it} + u_{it} \quad (43)$$

β_{1i} is treated as a random variable with a mean value of β_1. The intercept value for an individual is defined as:

$$\beta_{1i} = \beta_1 + \varepsilon_i \quad i = 1, 2, \dots, N \quad (44)$$

where $\varepsilon_i$denotes a random error term with a mean value of zero and variance of $\sigma_\varepsilon{}^2$.

Therefore, by substituting (44) into (43), one obtains:

$$y_{it} = \beta_1 + \beta_2 X_{2it} + \beta_3 X_{3it} + \varepsilon_i + u_{it} \quad (45)$$

where $w_{it} = \varepsilon_i + u_{it}$, denoting a composite error term consisting of the two components, ε_i, representing individual-specific components, and u_{it}, representing a combination of time series and cross-section error components.

3.5 Hausman Test

With reference to the fixed effect model and random effect model, the choice of an efficient estimation model to be employed will depend on whether the normal conditions of uncorrelated error components and regressors are fulfilled. This can be determined by performing the Hausman test, developed by Hausman (1978). The most important thing to think about is whether the country-specific error is unrelated to the regressors. E $(\alpha_i \backslash X_{it} Z_i) = 0$ for the one-way model. If this condition is satisfied, the random effect and fixed effect model will be consistent; however, the fixed effect model will be insufficient. This means that the fixed effect model will be preferred. In the absence of this condition, both random effect estimation and pooled OLS estimation will be inconsistent and unreliable. Fixed effect estimation is consequently preferred. If random effects are correlated with one or more repressors, the null hypothesis is rejected.

3.6 Panel Cointegration Test

After the development of panel unit root, cointegration analysis follows. Cointegration analysis helps to determine whether long-run relationship exists, namely cointegration, between SCRs, GDP, external debt, inflation and GDP per capita. Given that all variables are integrated, the study will proceed to implement a panel cointegration test developed by Pedroni (1999; 2004). The number of cointegrated vectors needed to run a vector error correction model is one of the reasons for cointegration analysis (VECM) or vector autoregressive model (VAR). According to Gujarati & Porter (2009), the trace statistic and the maximum eigenvalue are two likelihood ratio test statistics that can be used to calculate the number of cointegrating vectors in a sequence. A long-run relationship in cointegration analysis can be identified using Engle-Granger's residual-based test (1987).

Cointegration regression model:

$$Y_{it} = \alpha_i + \delta_i t + \beta X_{it} + \varepsilon_{it} \qquad (46)$$

where α_i and δ_i are fixed cross-section and trend effects respectively.

3.6.1 Pedroni Residual Cointegration Test (1995)

Pedroni (1999) piloted a residual-based panel cointegration test for the null hypothesis of no cointegration in panels with homogeneous cointegration vectors (β_i). Based on the strictly exogenous regressor and homogeneous cointegrating vectors, the residual-based test is asymptotically equivalent to the distribution for a raw panel unit root test based on null distribution. The limitation of this test is that the slope coefficient is hypothesized despite the slope being heterogeneous. Therefore, it becomes difficult to interpret the results of the null hypothesis for no cointegration. Pedroni (1999) extended the analysis of the residual-based panel cointegration test by proposing more than one independent variable in the regression equation. The proposed tests for cointegration in time series through cross-sections are grouped into averaging test statistics. The averaging is done in portions in the other category, so the restricting distributions are based on piecewise numerator and denominator term limits. The first group statistic is based on the form of the average of the Phillips and Ouliaris (1990) statistic:

$$\hat{\rho}_{NT-1} = \frac{\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{e}_{it-1}\Delta\hat{e}_{it} - \hat{\lambda}_i}{\sum_{i=1}^{N}\sum_{t=2}^{T}\hat{e}_{it-1}{}^{2}} \tag{47}$$

where the panel autoregressive coefficient estimator $\hat{\rho}_{NT}$ is constructed under the null hypothesis of no cointegration. $\hat{\lambda}_i$ denotes a scalar equivalent to the correlation matrix Γ, which is also responsible for any correlation effect. Pedroni (1999) extended the study by developing the limiting distribution of these two tests:

$$PC_1 = \frac{T\sqrt{N(\hat{\rho}_{NT-1})}}{\sqrt{2}} \Rightarrow N(0.1) \tag{48}$$

$$PC_2 = \frac{\sqrt{NT(T-1)}}{\sqrt{2}}(\hat{\rho}_{NT-1}) \Rightarrow N(0.1) \tag{49}$$

Drakos, Kouretas, Stavroyiannis & Zarangas (2017) highlight that the proposed tests for panel cointegration by Pedroni (1999) take into consideration heterogeneity through employing parameters that are different across individual members of the sample. In order to estimate the long-run relationship through Pedroni's test (1999), the following model is taken into account:

$$Y_{it} = \alpha_i + \delta_i t + \beta X_{it} + \varepsilon_{it} \tag{50}$$

where: $i = 1,2,..,N, t = 1,2,...,T$.

$N =$ Denotes the number of individual members in the panel and T is the number of observations over time. Therefore, the structure of estimated residuals is given by:

$$\hat{e}_{it} = \hat{\rho}_1\hat{e}_{it-1} + \hat{u}_{it} \tag{51}$$

Pedroni (1999) went further by piloting seven panel cointegration test statistics. These statistics are categorized as follows:

1. Four are within dimensions, also referred to as "pooling", with the following null hypothesis of no cointegration for the panel cointegration test:

$$H_0: y_i = 1 \; for \; all \; i \qquad (52)$$

$$H_0: y_i = y < 1 \; for \; all \; i \qquad (53)$$

2. Three are in between dimensions, with the following null hypothesis cointegration for a panel cointegration test: $H_0: y_i = 1 \; for \; all \; i$ (54)

$$H_0: y_i < 1 \; for \; all \; i \qquad (55)$$

The common feature of these tests is that no co-integration is maintained.

The first step is to compute regression residuals from the hypothesized cointegration. This is explained by the following regression equation:

$$y_{it} = \alpha_i + \delta_i t + \beta_{1i} x_{1it} + \beta_{2i} x_{2it} + \cdots + \beta_{Mi} x_{Mit} + e_{it} \qquad t = 1, \ldots T; i = 1, \ldots . N \quad (56)$$

where T denotes the number of observations over time and N is the number of individuals in the panel. M represents the number of regression variables, $x \; and \; y$ are assumed to be integrated of order one. $\beta_{1i}\beta_{2i}, \ldots, \beta_{Mi}$, denoting the slope coefficients and specific intercept α_i, vary across individual members. In order to estimate the residual from equation (50), Pedroni (1999) piloted seven statistics:

1. Panel v-statistics: $T^2 N^{3/2} Z_{\hat{v}NT} \equiv T^2 N^{\frac{3}{2}} \left(\sum_i^N \sum_{t=1}^T \hat{L}_{11i}{}^{-2} \hat{e}^2{}_{it-1} \right)^2$

2. Panel ρ -statistics:

$$T\sqrt{N} Z_{\hat{\rho}_{NT-1}} = T\sqrt{N} \left(\sum_{i=1}^N \sum_{t=1}^T \hat{L}_{11i}{}^{-2} \hat{e}^2{}_{it-1} \right)^{-1} \sum_{i=1}^N \sum_{t=1}^T \hat{L}^{-2}{}_{11i} \left(\hat{e}_{it-1} \Delta \hat{e}_{it} - \hat{\lambda}_i \right)$$

3. Panel t- statistics (non-parametric):

$$Z_{tNT} = (\tilde{\sigma}^2_{NT} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}{}^{-2} \hat{e}^2{}_{it-1})^{-1/2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}^{-2}{}_{11i} (\hat{e}_{it-1} \Delta \hat{e}_{it} - \hat{\lambda}_i)$$

4. Panel t- statistics (parametric)

$$Z^*{}_{tNT} = (S^{*2}{}_{NT} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}{}^{-2} \hat{e}^{*2}{}_{it-1})^{-1/2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}^{-2}{}_{11i} (\hat{e}^*{}_{it-1} \Delta \hat{e}^{*2}{}_{it})$$

5. Group ρ- statistics

$$TN^{-1/2} \tilde{Z}_{\tilde{\rho}_{NT^{-1}}} = TN^{-1/2} \sum_{i=1}^{N} (\sum_{t=1}^{T} \hat{e}_{it-1}{}^2)^{-1} \sum_{t=1}^{T} (\hat{e}_{it-1} \Delta \hat{e}_{it} \hat{\lambda}_i)$$

6. Group t- statistics (non-parametric):

$$N^{-\frac{1}{2}} \tilde{Z}_{\tilde{\rho}_{NT}} = TN^{-\frac{1}{2}} \sum_{i=1}^{N} (\hat{\sigma}_i{}^2 \sum_{t=1}^{T} \hat{e}_{it-1}{}^2)^{-\frac{1}{2}} \sum_{t=1}^{T} (\hat{e}_{it-1} \Delta \hat{e}_{it} - \hat{\lambda}_i)$$

7. Group t-statistic (parametric):

$$N^{-\frac{1}{2}} Z_{tNT}{}^* = N^{-\frac{1}{2}} \sum_{i=1}^{N} (\hat{S}_i{}^{*2} \sum_{t=1}^{T} \hat{e}_{it-1}{}^{*2})^{-1} \sum_{t=1}^{T} (\sum_{i=1}^{N} \hat{e}_{it}{}^* \Delta \hat{e}^{*2}{}_{it}$$

3.6.2 Kao Cointegration (1999) Test

Kao (1999) proposed two tests for testing the null hypothesis of no cointegration in panel data. The first one is the Dickey-Fuller test, which depends directly on constant estimation of long-run parameters, and the second is the augmented Dickey-Fuller test, which does not depend on constant estimation of long-run parameters. Both test are based on the following assumptions:

- The long-run variance covariance matrix is assumed to be the same for all cross-section observations.
- No heterogeneity is allowed on either test.

Therefore, Kao's test model is described as:

$$y_{it=\alpha_{it}+\beta X_{it}+\varepsilon_{it}} \; i = 1,2 \ldots \ldots, N, t = 1,2 \ldots \ldots, T \tag{57}$$

$$Y_{it} = Y_{it-1} + \mu_{it}$$

$$X_{it} = X_{it-1} + \varepsilon_{it}$$

$\alpha_{it=}$ are the fixed effects varying across the cross-section observations

$\beta =$ is the slope of the parameter, which is common across $i \; and \; u_{it}$

$Y_{it} X_{it} =$ are random walks for all i.

The long rung-run covariance matrix of $w_{it} = \left(\mu_{it,}\varepsilon_{it}\right)$ is defined by:

$$\Omega = \lim_{T\to\infty} \frac{1}{T} E\left(\sum_{t=1}^{T} w_{it}\right)(\sum_{t=1}^{T} w_{it})' = \Sigma + \Gamma + \Gamma' \equiv \begin{bmatrix} \sigma_{0u}{}^{2} & \sigma_{0u\varepsilon} \\ \sigma_{0u\varepsilon} & \sigma_{0\varepsilon}{}^{2} \end{bmatrix} \tag{58}$$

where $\Gamma = \lim_{T\to\infty} \frac{1}{T} \sum_{k=1}^{T-1} \sum_{t=k+1}^{T} E\left(w_{it} w'_{it-k}\right) \equiv \begin{bmatrix} \Gamma_u & \Gamma_{\varepsilon u} \\ \Gamma_{\varepsilon u} & \Gamma_u \end{bmatrix}$

and $\Sigma = \lim_{T\to\infty} \frac{1}{T} \sum_{t=1}^{T} E\left(w_{it} w'_{it}\right) \equiv \begin{bmatrix} \sigma_u{}^{2} & \sigma_{u\varepsilon} \\ \sigma_{u\varepsilon} & \sigma_\varepsilon{}^{2} \end{bmatrix}$.

The Dickey-Fuller test can be derived from the estimated residuals.

$$\hat{e}_{it} = \rho_{\hat{e}_{it}} + V_{it} \tag{59}$$

The null hypothesis of no cointegration becomes: …. $H_0: \rho = 1$ (60)

against the alternative hypothesis : $H_0: \rho < 1$ (61)

Therefore, the OLS estimate of ρ is given by:

$$\rho = \frac{\sum_{i=1}^{N} \widehat{\sum_{t=2}^{T}} \hat{e}_{it} \; \hat{e}_{it-1}}{\sum_{i=1}^{N} \sum_{t=2}^{T} \hat{e}^{2}{}_{it}} \tag{62}$$

The estimated residual of the augmented Dickey-Fuller test is derived as:

$$\hat{e}_{it} = \rho \, \hat{e}_{it-1} + \sum_{j=1}^{\rho} \varphi_j \;\; \Delta\hat{e}_{it-j} + V_{itp} \qquad (63)$$

It allows the lagged changes in the residuals to be added in the regression.

The null hypothesis of no cointegration is:

$H_0 : \rho_{1=0}$, which is based on the following t- statistic for each i;

$$t_{ADF} = \frac{(\hat{\rho} - 1)[\sum_{i=1}^{N}(\acute{e}_i Q_i e_i)]}{s_v} \qquad (64)$$

where $\hat{\rho}$ is the OLS estimator of ρ, defined by

$$(\hat{\rho} - 1) = \left[\sum_{i=1}^{N}(\hat{e} Q_i \; e_i)\right]^{-1} \left[\sum_{i}^{N}(\acute{e}_i Q_i V_i)\right] \qquad (65)$$

3.7 SUMMARY

In chapter 3, the framework methodology for data analysis was presented. The chapter explained the model specification and data collection and concluded with estimation techniques for the research. In chapter 4, the results of the research are presented.

CHAPTER 4

INTERPRETATION OF FINDINGS

4.1 INTRODUCTION

Chapter 3 presented the study methodology with a brief overview of the model specification within the panel data framework. A linear regression equation was formulated to determine the correlation among between SCRs and the explanatory variables. The data sources for the variables were identified as follows: World Bank, IMF and S&P. Estimation techniques such as the panel unit root test, the one-way error component regression model, the two-way error component regression model, Hausman test, panel cointegration test, Granger causality, and diagnostic and stability test were identified for analyzing determinants of SCRs.

Chapter 4 analyzes the panel dataset using methods identified in chapter 3. The results are presented and discussed with the aim of analyzing the determinants of SCRs. The data on SCRs, inflation, GDP per capita, external debt, FDI and control of corruption covering the period of 1990–2016 of five SADC countries were utilized for empirical analysis. The countries are Angola, Botswana, Mozambique, South Africa and Zambia. The focus in chapter 4 is on data analysis, presentation of the findings and interpenetration of the findings. The first test conducted involves the computation of descriptive statistics of the data for each of the five countries being analyzed; secondly panel unit root test analysis is applied. Thirdly, the regression model is estimated, followed by cointegration and Granger causality. Lastly, the analysis focuses on the diagnostic and stability diagnostic. Full details of the tests are provided in the appendices.

4.2 DESCRIPTIVE STATISTICS OF MACRO-ECONOMIC VARIABLES

Table 4.1 represents the summarized statistics of macro-economic variables for the five selected SADC member states. For the purpose of measuring the distribution of the series, the study will consider skewness, kurtosis and Jargue-Bera test results. Skewness is a metric that measures the asymmetry of a series' distribution around its mean; the results indicate that distribution has a long right tail. Using kurtosis, the analysis will determine if the series' distribution is peaked or flat. Series are normally distributed at 3; if it’s above 3, the dissemination of series has reached its apex and if below 3 the dissemination of series is flat.

The rate inflation varies from low of 1.38% to high of 325%. The mean is 21.93% with a standard deviation of 42.72%. It recorded a skewness of 4.58% and kurtosis of 27.56% .This suggests that the mean 21.93% is greater than the median 10.08%, indicating that the distribution is more peaked than the normal distribution 27.56 $>$ 3. The results are in consistence with the study findings of Oluyomi and Adeola (2019), which reported positive skewness and kurtosis, indicating a highly peaked distribution.

GDP per capita growth of the SADC countries varies from lowest of -10.95% to a highest of 18.30%. The average mean is recorded at 2.27% with a standard deviation of 4.23%. It has a positive skewness of 0.33% and kurtosis of 6.3%. This indicates that there are few observations and the distribution is highly peaked. The findings are consistent with the study findings of Oluyomi and Adeola (2019). Their study reported GDP per capita with a constructive skewness and kurtosis, with an indication of highly peaked distribution. The external debt varies from the lowest of 3.7% to the highest of 277.53%. Its mean is at 47%, with a standard deviation of 50.50%. It recorded a constructive skewness of 2.18% and kurtosis of 8.06%. Observation recommends that the mean is higher than the median. The results indicate that the distribution of a series is highly peaked. The results are in contrast with the results of Oluyomi and Adeola (2019), which indicated a less peaked distribution.

The external debt varies from the lowest of -6.89% to the highest of 39.45%. Its mean is at 4.73%, with a standard deviation of 7.38%. The results indicate a positive skewness and kurtosis of 2.53% and 10.26% respectively. This suggests a high mean of 2.73% $>$ median 2.62%. The results indicate that the distribution of a series is highly peaked. The results concerning control of corruption range from the lowest of 0.00% to the highest of 81.31%%. The mean is at 27.70% with a standard deviation of 28.12%. Positive skewness and kurtosis of 0.53%% and 1.75% respectively were recorded. This recommends that the distribution is flat.

The Jargue-Bera test is observed to test whether the series is normally distributed. At 5% level of significance null hypothesis of normal distribution is rejected. This is indicated by the small probability value of 0.00 for all series.

Table 4.1: Descriptive Statistics

	INFLATION	GDP_PER_CAPITA_GROWTH__A	EXTERNAL DEBT	FDI___GDP	CONTROL_OF_CORRUPTION
Mean	21.93954	2.275101	47.50324	4.738889	27.70016
Median	10.08286	2.254363	31.40000	2.625090	21.46342
Maximum	324.9969	18.30014	277.5303	39.45620	81.31313
Minimum	1.385382	-10.95642	3.700000	-6.897680	0.000000
Std. Dev.	42.72540	4.239649	50.50089	7.389526	28.12968
Skewness	4.589900	0.333975	2.180741	2.532100	0.530533
Kurtosis	27.56625	6.300612	8.068666	10.26111	1.753042
Jarque-Bera	3180.934	52.44841	206.8018	362.4606	12.39854
Probability	0.000000	0.000000	0.000000	0.000000	0.002031
Sum	2435.289	252.5362	5272.859	526.0166	3074.718
Sum Sq. Dev.	200800.6	1977.208	280537.3	6006.561	87040.66
Observations	111	111	111	111	111

Source: Author

4.3 PANEL ROOT TEST

Table 4.2 presents the findings of the panel unit root tests, namely the IPS, LLC, ADF Fisher and PP Fisher tests. The findings show that GDP per capita, external debt and FDI are stationary at 5% level of significance. The null hypothesis is rejected for GDP per capita, external debt and FDI on all panel root tests across all five SADC counties. The findings of both panel unit root tests confirmed that inflation and control of corruption are not stationary at a level where the null hypothesis is rejected. Inflation and control of corruption to be stationary, first differencing is required to make it stationary. The results show that after first difference adjustment for inflation and control of corruption, the null hypothesis is rejected.

Table 4.2: Panel unit root tests at level

	Test							
	Im-Pesaran and Shin		Levin, Lin and Chu		ADF Fisher		PP Fisher	
Variables	**Static**	**Prob****	**Static**	**Prob****	**Static**	**Prob****	**Static**	**Prob****
SCR	-2.78743	0.0027	-2.60323	0.0046	25.3556	0.0047	19.1842	0.0380
Inflation	-1.50466	0.0662	-2.85726	0.0021	17.0849	0.0725	16.1336	0.0959
GDP per capita	-3.79971	0.0001	-3.30373	0.0005	33.5386	0.0002	61.1939	0.0000
External debt	-3.01211	0.0013	-3.68751	0.0001	27.6700	0.0020	23.1455	0.0102
FDI	-2.35617	0.0092	-0.99096	0.1609	23.7380	0.0083	41.2242	0.0000
Control of corruption	0.16310	0.5648	0.16310	0.6193	6.94024	0.7311	40.7068	0.0000

** Probabilities for Fisher tests are computed using an asymptotic Chi
Exogenous variables: Individual effects
Source: Author

Table 4.3: Panel unit root tests at 1st difference

	Test							
	Im-Pesaran and Shin		Levin, Lin and Chu P-value		ADF Fisher		PP Fisher	
Variables	**Static**	**Prob****	**Static**	**Prob****	**Static**	**Prob****	**Static**	**Prob****
SCR	-6.21380	0.0000	-5.35231	0.0000	54.7244	0.0000	98.2117	0.0000
Inflation	-8.40695	0.0000	-7.77038	0.0000	76.5085	0.0000	76.5085	0.0000
GDP per capita	-9.72043	0.0000	-9.07419	0.0000	88.8176	0.0000	109.123	0.0000
External debt	-3.90512	0.0000	-4.30311	0.0000	34.2093	0.0002	60.1784	0.0000
FDI	-8.31842	0.0000	-5.86479	0.0000	73.8476	0.0000	102.798	0.0000
Control of corruption	-7.23882	0.0000	3.27590	0.9995	64.7230	0.0000	122.517	0.0000

** Probabilities for Fisher tests are computed using an asymptotic Chi
Exogenous variables: Individual effects
Source: Author

After considering the first difference at 5% level of significance the researcher rejects the null hypothesis, so the first difference of inflation and control of corruption is stationary.

4.4 REGRESSION MODEL

The panel least square regression model's results are presented in this section. The findings presented in Table (4.4) summarizes that the regression model fits the data and the model as a whole is statistically significant (R^2= 0.62, P-value= 0.00). This means that 62% of the SCRs of the five selected SADC countries is defined by explanatory factors within the model. The findings of the panel least squares regression model as presented in table 4.4 shows that GDP per capita, external debt and FDI have a negative relationship with SCRs as represented by negative coefficients. A positive relationship is observed between SCR, inflation and control of corruption. Inflation has a positive coefficient of 0.01 and that of control of corruption is 0.06. This suggests that one unit in inflation will lead to a possible downgrade or change in outlook by 0.01. A one-unit improvement in corruption control would result in a 0.06-notch increase in SCR. On the contrary, Jošić & Mlinarić (2018) observed a negative correlation among inflation and SCR. A negative relationship is observed between SCR, external debt and FDI, with a negative coefficient.

Table 4.4: Panel least square regression model

	Panel least square		
Variables	**Coefficient**	**t-statistic**	**Prob**
Inflation	0.011219	1.957275	0.053
GDP per capita	-0.11144	-2.18854	0.0308
External debt	-0.0253	-4.99536	0.000
FDI	-0.11929	-4.22031	0.0001
Control of corruption	0.066465	8.230197	0.000
Total panel observations	**111**		
Cross-sections	**5**		
Adjusted R-squared	0.6001380		
R-squared	0.618314		
Durbin-Watson static	0.863324		
F-statistic	34.01899		
Prob (F-statistic)	0		

*, **, *** 10%, 5%,1% level of significance respectively. Source: model estimation

Source: Author

4.4.1 Fixed effects model

In the light of the model results of fixed effects, the explanatory power of independent variables on the dependent variable, i.e the R^2 value, is defined by 80%. This recommends that explanatory variables explains about 80% of SCRs identified by S&P. The model is statistically valid (F-statistic p< 0.05). This also implies that the defined explanatory variables cannot account for 20% of SCRs. Inflation is positively significant, with SCR with a p-value of 0.02. This indicates that rising inflation may result in a downgrade or a shift in the outlook from positive to negative. The result is supported by the findings in the literature by Kalliomäki and Andersson (2012). On the contrary, Jošić & Mlinarić (2018) found a negative correlation between inflation and SCR. Control of corruption has a positive coefficient of 0.06, which denotes that one unit of improvement in control of corruption will result to 0.06 s increase in SCR. A negative correlation has been identified between GDP per capita and SCR. Its p-value is 0.58, indicating that it is not statistically significant at 10%, 5% or 1%, resulting in the rejection of Ho. The results contrast with the findings in the publication by Oluyomi and Adeola (2019), who observed a positive relationship between GDP per capita and SCR. A negative correlation is also identified between external debt and SCR, which is statistically significant with a p-value of 0.00. External debt has a negative coefficient of -0.03, which indicates a 1% furthermore in external debt will results in lowering SCR by 0.03. FDI is statistically significant at 1% with a p-value of 0.00. The findings are in consistence with the study findings by Oluyomi and Adeola (2019), Jošić & Mlinarić (2018)) and Afonso, Gomes and Rother (2010), all identified a negative correlation between external debt and SCR. A negative coefficient of -0.07 is observed, which denotes that a 1% increase in FDI will lead to 0.07 notches decrease in SCR.

Table 4.5: **Fixed effect model**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INFLATION	0.011871	0.005306	2.237445	0.0281
GDP_PER_CAPITA_GROWTH__A	-0.030564	0.056259	-0.543281	0.5885
EXTERNAL_DEBT____OF_GDP	-0.032231	0.004685	-6.880119	0.0000
FDI___GDP	-0.074602	0.026629	-2.801536	0.0064
CONTROL_OF_CORRUPTION	0.096001	0.008043	11.93628	0.0000
C	4.223678	0.447510	9.438172	0.0000
R-squared	0.796242			
Adjusted R-squared	0.716287			
F-statistic	9.958564			
Prob (F-statistic)	0.000000			

*, **, *** 10%, 5%,1% level of significance respectively
Source: Author

4.4.2 Random effects model

The random regression results below suggest that 60% of SCRs by S&P are explained by identified explanatory variables. A positive relationship between SCR and inflation and control of corruption is observed, with a p-value of 0.00. Both inflation and control of corruption have positive coefficients of 0.01 and 0.06 respectively. This suggests that one unit increase in both inflation and control of corruption will lead to an increase in SCR by 0.01 and 0.06 units. The results are supported by the findings in the literature by Kalliomäki and Andersson (2012) and Mutize and Nkhalamba (2020), who observed a positive relationship between SCR, inflation and control of corruption. However, the results contrast with the findings in the literature by Oluyomi and Adeola (2019), who observed a negative relationship between SCR and inflation, as denoted by a negative coefficient. The following variables affect sovereign credit rates negatively: GDP per capita (-0.11), external debt (-0.03) and FDI (-0.12). The results suggest that a 1% improvement in GDP per capita will results to a change in outlook; in external debt it will result to 0.03 notches decrease in SCR and in FDI it will lower SCR by 0.12. The results are supported by the findings in the literature by Tugba (2019) and Jošić & Mlinarić (2018), who observed a negative relationship between SCR, GDP per capita and external debt.

Table 4.6: Random effects model

	Random effects		
Variables	**Coefficient**	**t-statistic**	**Prob**
Inflation	0.011219	3.53089	0.0006
GDP per capita	-0.11144	-3.52102	0.0006
External debt	-0.0253	-5.80226	0
FDI	-0.11929	-5.67909	0
Control of corruption	0.066465	6.25013	0
Total panel observations			
Cross-sections			
Adjusted R-squared	0.600138		
R-squared	0.618314		
Durbin-Watson static	0.863324		
F-statistic	34.01899		
Prob(F-statistic)	0		

*, **, *** 10%, 5%,1% level of significance respectively
Source: Author

4.4.3 HAUSMAN TEST

As explained, the Hausman test will be performed to determine an appropriate estimation model between fixed and random models. The findings highlighted in table 4.8 indicate that the null hypothesis (H_0) is strongly rejected, since the p value (p-value=0.00) is lower than the 0.05 significance level, which means that the fixed effects model is preferred. The model is explained well with adjusted R-square 0.80. The findings are consistence with the study findings by Jošić & Mlinarić (2018), who found the fixed effects model to be appropriate over the random effects model for GDP growth, GDP per capita, inflation, unemployment, government budget balance, public and external debt.

Table 4.7: Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f	Prob.
Cross-section random	64.086789	5	0.0000

Source: Author

4.5 PANEL COINTEGRATION ANALYSIS

Given the findings of the panel unit root test of rejecting the null hypothesis on all variables and the Hausman test confirming the fixed effects model as an appropriate regression model, the panel cointegration test can be used to determine whether or not there are long-run relationships between variables.

Table 4.8: Pedroni Residual Cointegration Test

Variables	Panel v-statistic		Panel rho-statistic		Panel pp-statistic		Panel ADF statistics	
	Statistic	Prob	Statistic	Prob	Statistic	Prob	Statistic	Prob
Inflation, GDP per capita, External debt, FDI and Control of corruption	0.757954	0.2242	0.796451	0.7871	-1.189691	0.1171	-0.317466	0.3754
Variable	Group rho- Statistic			Group PP-Statistics		Group ADF-Statistic		
	Statistic	Prob		Statistic	Prob	Statistic	Prob	
Inflation, Real GDP, GDP per capita, External debt	1.011655	0.8441		-3.166086	0.0008	-0.667725	0.2522	

Null Hypothesis: No cointegration
Trend assumption: Deterministic intercept and trend
Source: Author

At 5% level of significance, the Pedroni residual cointegration test accepts the null hypothesis, indicating nonexistence of long-run correlation among variables. From table 4.8, the null hypothesis is accepted, except in Group PP-Statistics where the null hypothesis is rejected at 5% level of significance.

4.6 SUMMARY

The empirical test results and findings of the following tests were presented and discussed: descriptive statistics, panel unit root test, fixed and random effects model, Hausman test, and panel cointegration. The study measured the distribution of the series by observing skewness, kurtosis and the Jargue-Bera test results. The distribution of inflation, GDP per capita, external debt and FDI is highly peaked, while the distribution of control of corruption is flat. The test results of the panel root test, namely IPS, LLC, ADF Fisher and PP Fisher show that GDP per capita, external debt and FDI are stationary at 5% level of significance. The null hypothesis is rejected for GDP per capita, external debt and FDI on all panel root tests across all five SADC counties. Inflation and control of corruption became stationary after a first difference adjustment was made. Panel least square regression results conclude that the regression model fits the data and the whole model is statistically significant (R^2= 0.6183, P-value= 0.00). This means that 61.83% of the SCRs of the five selected SADC countries are explained by independent variables in the model.

In order to decide on the best model between fixed and random effects, hausman was utilised. The findings indicated that the null hypothesis (H_0) is strongly rejected, since its p value (p-value=0.0000) is lower than 0.05 significance level, suggesting that the fixed effects model is preferred. According to the model, the defined explanatory variables account for 80% of SCRs by S&P. The model observes a positive relationship between SCR, inflation and control of corruption. It also observes a negative relationship between SCR, GDP per capita, external debt and FDI. The Pedroni residual cointegration test confirms that at 5% level significance, the null hypothesis is accepted, meaning that there is no long-run relationship among variables.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter summarizes the study, starting by emphasising the research design and methodology. It will be followed by the presentation of a summary and the interpretation of research findings in section three. Section four will provide a conclusion of the study, followed by recommendations in section 4. Further research and limitations of the study will be discussed in sections five and six respectively.

5.2 RESEARCH DESIGN AND METHOD

The study utilised secondary data covering annual data from the period 1990-2016. Data were collected from the World Bank, IMF and S&P for the following variables: GDP per capita, inflation, external debt, FDI, control of corruption and SCRs for Angola, Botswana, South Africa, Mozambique and Zambia. The choice of selected explanatory variables was determined by the existing empirical studies on how SCRs for the developing countries are determined and the availability of data. The study used the following estimation techniques: the panel unit root test, fixed and random effects models, hausman test, panel cointegration, and diagnostic and stability tests.

5.3 SUMMARY AND INTERPRETATION OF THE RESEARCH FINDINGS

The study measured the distribution of the series by observing skewness, kurtosis and the results of the Jargue-Bera test. The distribution of inflation, GDP per capita, external debt and FDI is highly peaked, while the distribution of control of corruption is flat. Using the panel framework, the test results of panel root tests, namely IPS, LLC, ADF Fisher and PP Fisher, show that GDP per capita, external debt and FDI are stationary at 5% level of significance. The null hypothesis is rejected for GDP per capita, external debt and FDI on all panel root tests across all five SADC counties. Inflation and control of corruption became stationary after a first difference adjustment was made. The regression model suits the data, and the entire model is statistically significant (R^2= 0.6183, P-value= 0.00), according to the panel least square regression results. This means that 61.83% of the SCRs of the five selected SADC countries are explained by independent variables in the model. In order to identify the appropriate model between fixed and random model, hausman test was performed. The findings indicate that the null hypothesis (H_0) is strongly rejected, since its p value (p-value=0.0000) is lower than 0.05 significance level, suggesting that the fixed effects model is preferred. The results indicates that the identified explanatory variable explains 80% of SCRs. The model observed a positive relationship between SCR, inflation and control of corruption. It also observed a negative correlation between SCR, GDP per capita, external debt and FDI. The Pedroni residual cointegration test confirms that at 5% level of significance, the null hypothesis is accepted, meaning that there is no long-run relationship among variables. The results indicate that the null hypothesis (H_0) is strongly rejected, since its p value (p-value=0.0000) is lower than 0.05 significance level, which means that the fixed effects model is preferred. The Pedroni residual cointegration test shows that the null hypothesis is accepted at a 5% level of significance, implying that there is no long-run relationship between variables. The findings are consistent with the study findings by Canuto, Santos and Sa Porto (2011). The results for the serial correlation LM test show that there is no autocorrelation.

5.4 CONCLUSION

The study aims to analyse SCRs determinants for selected SADC countries, namely Angola, Botswana, Mozambique, South Africa and Zambia, for the period 1990-2016. After an empirical literature review, the following explanatory variables were selected along with the ratings from S&P: GDP per capita, inflation, external debt, FDI and control of corruption. Panel unit root tests, panel least squares regression, the fixed and random effects model, the Hausman test and panel cointegration were utilised to answer the following objectives of the study:

- To determine the nexus between SCRs, inflation, GDP per capita, external debt, FDI inflows and control of corruption.
- To analyse the effect of the relationship between SCRs, inflation, GDP per capita, external debt, FDI inflows and control of corruption for members of SADC
- To investigate whether long-run relationships possibly exist among SCRs, inflation, GDP per capita, external debt, FDI inflows and control of corruption for members of the SADC.

Through the panel tests identified above, the objectives of the study have been achieved.

- **To determine the nexus between SCRs, inflation, GDP per capita, external debt, FDI inflows and control of corruption.**

The objective of the study was to determine the nexus between SCRs, inflation, GDP per capita, external debt, FDI inflows and control of corruption. Therefore, the fixed effects model results indicated that the explanatory variables explains about 80% of SCRs by S&P. The Hausman test identified the fixed effects model as an appropriate regression. The results indicated that the null hypothesis (H_0) is strongly rejected, since its p value (p-value=0.00) is lower than 0.05 significance level.

- **Analyse the effect of the relationship between SCRs, inflation, GDP per capita, external debt, FDI inflows and control of corruption for members of the SADC.**

The study aimed at analysing the effects of the correlation between SCRs and explanatory variables. The coefficient from the fixed effects model confirmed the effect of all explanatory variables on SCRs. A positive relationship is observed between SCR, inflation and control of corruption. A negative correlation is observed between GDP per capita and SCR, with a p-value of 0.58 suggesting that it is not statistically significant. A negative correlation is also observed between SCR, external debt and FDI.

- **Investigate whether long-run relationships possibly exist among SCRs, inflation, GDP per capita, external debt, FDI inflows and control of corruption for members of the SADC.**

The Pedroni residual cointegration test was conducted to investigate whether long-run relationships possibly exist among SCRs, inflation, GDP per capita, external debt, FDI inflows and control of corruption. The test confirmed that at 5% level of significance, the null hypothesis was welcomed, in other terms there was no long-run correlation among variables.

5.5 RECOMMENDATIONS

The study recommends the following based on its findings: Selected member states of SADC should improve their macroeconomic factors for good SCRs, in order to improve the cost of borrowing finances.

- Selected member states of SADC should develop strategic plans for reducing budget deficits. This will help countries to manage their debts, especially foreign currency denoted debt and to attract foreign investment.

5.6 FUTURE RESEARCH

- The study used SCRs offered by S&P. This invites future researchers to compare ratings and determinants with two major ratings agencies, namely Fitch and Moody's.
- The study did not explore categorizing of countries according to their level of development. This situation invites researchers to explore the categorization of countries to analyze how the level of development have an impact of how SCRs are determined.

5.7 LIMITATIONS OF THE STUDY

This study focuses on how SCRs of SADC countries are determined. These determinants are macroeconomic, public finance and external factors, without taking into account factors such as political risk and the business environment. The political and business environment have a significant role in terms of contributing to economic development.

REFERENCES

Afonso, A., 2003. Understanding the determinants of sovereign debt ratings: Evidence for the two leading agencies. *Journal of Economics and Finance,* 1(27), pp. 56-74.

Afonso, A., Gomes, P. & Rother, P., 2007. What "Hides" Behind Sovereign Debt Ratings. *European Central Bank,* 1(711), pp. 7-28.

Afonso, A., Gomes, P. & Rother, P., 2011. Short- and Long-Run Determinants of Sovereign Debt Credit Ratings. *International Journal of Finance and Economics,* 16(1), pp. 3-14.

African Development Bank, 2014. *African Economic Outlook,* Abidjan: African Development Bank.

Aimeida, H., Cunha, I., Ferreira, M. A. & Restrepo, F., 2017. The Real Effects of Sovereign Credit Ratings Downgrades. *Journal of Finance,* 72(1), pp. 21-23.

Alfonso, P. V. & Ivan, H. A., 2015. Keynes's Approach to Macroeconomic Modelling: A Popperian Reconstruction. *Keynes's Approach to Macroeconomic Modelling: A Popperian Reconstruction,* 7(1), pp. 6-14.

Ameniya, T., 1971. The Estimation of the Variances in a Variance-Components Model. *International Economic Review,* 12(1), pp. 1-13.

Arefjevs, I. & Brasliņš, G., 2013. *Determinants of Sovereing Credit Ratings- Example of Latvia.* Riga: University of Latvia.

Baltagi, B. H., 2005. *Econometric Analysis of Panel Data.* 3rd ed. New York: John Wiley & Sons Ltd.

Baltatescu, S., 2015. Uncertainty in Neoclassical and Keynesian Theoretical Approaches: A Behavioural Perspective. *Econpapers,* 7(3), pp. 684-686.

Bara, A., Mugano, G. & Le Roux, P., 2016. Financial Innovation and Economic Growth in the SADC. *Economic Research Southern Africa,* 1(627), pp. 1-3.

Barbieri, L., 2005. *Panel Unit Root Tests: A Review.* Milan: Università Cattolica del Sacro Cuore.

Black, P., Calitz, E. & Steenkamp, T., 2012. Public Economics. In: P. Black, E. Calitz & T. Steenkamp, eds. *Public Economics.* Cape Town: Oxford University Press Southern Africa, p. 324.

Breitung, J., 2000. The local power of some unit root tests for panel data. *Econstor,* 1999(69), pp. 5-23.

Cantor, R. & Packer, F., 1996. Determinants and Impacts of Sovereign Credit Ratings. *Federal Reserve Bank of New York,* 2(2), pp. 89-42.

Canuto, O., Santos, P. F. & Sá Porto, P. C., 2004. *Macroeconomics and Sovereign Risk Ratings.* Washington: World Bank.

Chee, S. W., Fah, C. F. & Nassir, A. M., 2015. Macroeconomics Determinants of Sovereign Credit Ratings. *International Research Research,* 8(2), pp. 42-43.

Choi, I., 2001. Unit Root Tests for Panel Data. *Journal of International Money and Finance,* 20(2), pp. 249-271.

De Finetti, B., 1937. *Studies in Subjective Probability.* New York: Henri Poincaré.

Drakos, A., Kouretas, G. P., Stavroyiannis, S. & Zarangas, L., 2017. Is the Feldstein-Horioka puzzle still with us? National saving-investment dynamics and international capital mobility. *Journal of International Financial Markets, Institutions and Money,* 47(3), pp. 76-88.

Eliasson, A. C., 2002. Sovereign Credit Ratings. *Deutsche Bank Research,* 2(1), pp. 5-13.

Elkhoury, M., 2008. *Credit Ratings Agencies and their Potential Impact on Developing Countries.* Geneva, United Nations Conference on Trade and Development.

Engle, F. R. & Granger, C. W. J., 1987. Co-Integration and Error Correction: Representation, Estimation, and Testing. *Econometrica,* 55(2), pp. 251-276.

European Securities and Markets Authority , 2019. *European Securities and Markets Authority.* [Online]
Available at: https://www.esma.europa.eu/
[Accessed 12 June 2019].

Fingleton, B., J, L. G. & Pirotte, A., 2015. *Panel Data Models with Spatially Nested Random Effects.* London: University of Cambridge.

Fitch Ratings Inc, 2019. *Fitch Ratings.* [Online]
Available at: https://www.fitchratings.com/
[Accessed 10 May 2019].

Gillies, G., 2000. Philosophical Theories of Probability. In: W. H. Newton-Smith, ed. *Philosophical Theories of Probability.* New York: Routledge, pp. 3-4.

Gujarati, D. N. & Porter, D. C., 2009. *Basic Econometrics.* 5th ed. New York: McGraw-Hill.

Hadri, K., 2000. Testing for Unit Roots in Heterogeneous Panel Data. *Econometrics,* 1(3), pp. 148-161.

Harvoje, J. & Mlinaric, D., 2018. *Determinants of sovereign credit ratings: Evidence from CEE countries.* Zagreb: University of Zagreb.

Hausman, J., 1978. Specification Test in Econometrics. *Econometrica,* 46(6), pp. 1251-1271.

IMF, 2019. *International Monetary Fund.* [Online]
Available at: https://www.imf.org/en/Home
[Accessed 23 April 2019].

Im, K. M., Pesaran, H. M. & Shin, Y., 1997. *Testing for Unit Roots in Heterogeneous Panels.* United Kingdom: University of Cambridge.

Im, K. S., Pesaran, H. M. & Shin, Y., 2003. Testing for unit roots in heterogeneous panels. *Journal of Econometrics,* 115(1), pp. 53-74.

Jones, G. A., Langrall, C. W. & Mooney, E. S., 2007. *Research in probability: Responding to classroom realities.* Reston: VA: NCTM.

Jošić, H. & Mlinarić, D., 2018. *Determinants of Sovereign Credit Ratings: Evidence from CEE Countries.* Zagreb: University of Zagreb.

Kabadayi, B. & Çelik, A. A., 2015. Determinants of Sovereign Ratings in Emerging Countries: A Qualitative, Dependent Variable Panel Data Analysis. *International Journal of Economics and Financial Issues,* 5(3), pp. 656-662.

Kalliomäki, M. & Andersson, F. N. G., 2012. *Determinants of Sovereign Defaults: An examination of fundamental factors derived from credit ratings.* Lund: University of Lund .

Kaminsky, G. & Schmukler, S., 2002. Emerging Market Instability: Do Sovereign Ratings Affect Country Risk and Stock Returns?. *Econpapers,* 16(2), pp. 171-195.

Kao, C., 1999. Spurious Regression and Residual-Based Tests for Cointegration in Panel Data. *Journal of Econometrics,* 90(1), pp. 1-44.

Keynes, J. M., 1921. *A Treatise on Probability.* London: Dover Publications.

Keynes, J. M., 1973. *The General Theory and After, Part II, Defence and Development.* London: Macmillan St. Martin's Press.

Kunst, M. R., 2010. *Econometric Methods for Panel Data.* Viena: Institute for Advanced Studies Vienna.

Levin, A., Lin, C. F. & Chu, C. J., 1992. Unit Root Test in Panel Data: Asymptotic and Finite- Sample Properties. *Journal of Econometrics,* 108(21), pp. 1-6.

Levin, A., Lin, C. F. & Chu, C. S. J., 2002. Unit Root Test in Panel Data. *Journal of Econometrics,* 108(1), pp. 1-24.

Madda, G. S. & Wu, S., 1999. *A Comparative Study of Unit Root Tests with Panel Data and a New Simple Test.* United Kingdom: Blackwell Publishers Ltd.

Mbulawa, S., 2015. Determinants of Economic Growth in Southern Africa Development: The Role of Institutions. *Applied Economics and Finance,* 2(2), pp. 91-94.

Mlachila, M; Park, S G; Yabara, M, 2013. Banking in Sub-Saharan Africa: The Macroeconomic Context. *International Monetary Fund,* 13(03), pp. 1-9.

Mohr, P. & Associates, 2008. *Economics for South African Students.* 4th ed. Pretoria: Van Schaik Publishers.

Montes, G. C., Oliveira, D. S. P. & Mendonca, G. F., 2016. Sovereign Credit Ratings in Developing Economies: New Empirical Assessment. *International Journal of Finance & Economics,* 21(4), pp. 382-397.

Mutize, M. & Nkhalamba, M. P., 2020. *A comparative study of economic growth as a key determinant of sovereign credit ratings in Africa.* Cape Town: International Journal of Emerging Markets .

Nerlove, M., 1971. A Note on Error Components Models. *Econometrica,* 39(2), pp. 383-396.

O'Connell, J., 1996. *"Uncertainty in 'A Treatise on Probability' and the 'General Theory'".* Galway: National University of Ireland.

Oluyomi, A. O. & Adeola, E. A., 2019. Determinants of Sovereign Credit Ratings in Emerging Markets. *International Business Research,* 12(5), pp. 158-163.

Pedroni, P., 1999. Critical values for cointegration tests in heterogeneous panels with multiple regressors. *Oxford Bulletin of Economics and Statistics,* 0305(9049), pp. 653-670.

Pedroni, P., 2004. Panel Cointegration: Asymptotic and Finite Sample Properties of Pooled Time Series Tests with an Application to the PPP Hypothesis. *Cambridge University Press,* 20(3), pp. 597-625.

Periklis, B. & Panagiotidis, T., 2014. *Master Thesis: On the Determinants of Sovereign Credit Ratings: Evidence from the Euro Zone.* Thessaloniki: University of Macedonia.

Phillips, P. & Moon, H., 1999. Linear Regression Limit Theory for Nonstationary Panel Data. *Econometrica,* 67(5), pp. 1057-1111.

Phillips, P. & Ouliaris, S., 1990. Asymptotic Properties of Residual Based Tests for Cointegration. *Econometrica,* 58(1), pp. 165-193.

Pretorius, M. & Botha, I., 2014. *A Panel Ordered Response Model for Sovereign Credit Ratings in Africa.* Johannesburg, Economic Reserach Southern Africa.

Price Waterhouse Cooper, 2019. *PWC South Africa.* [Online]
Available at: https://www.pwc.co.za/
[Accessed 8 July 2019].

Ramsey, F. P., 1931. Truth and Probability. *Foundations of Mathematics and other Logical Essays,* 1(5), pp. 156-198.

Ramsey, F. P., 1990. *Philosophical Papers.* 1st ed. New York: Press Syndicate of the University of Cambridge.

Rousseau, B. G., Meintjes, C. J. & Barnard, C., 2002. *SADC Inter-Regional Comparative Report,* Johannesburg: Development Bank of Southern Africa.

Sakai, Y., 2016. J.M. Keynes and F.H. Knight: How to Deal with Risk, Probability and Uncertainty. *Centre for Risk Research,* A-15(1), pp. 3-20.

Skidelsky, R., 2011. The Relevance of Keynes. *Cambridge Journal of Economics,* 35(1), pp. 1-13.

Southern African Development Community (SADC), 2002. *Regional Indicative Strategic Development Plan,* Gaborone: Southern African Development Community (SADC).

Southern African Development Community, 2017. *Southern Africa Development Community: Towards a Common Future.* [Online]
Available at: https://www.sadc.int/
[Accessed 12 August 2017].

Standard and Poors, 2019. *Standard and Poors Global Ratings.* [Online]
Available at: https://www.spglobal.com/ratings/en/
[Accessed 29 April 2019].

Stats SA, 2017. *Statistics South Afica.* [Online]
Available at: http://www.statssa.gov.za/
[Accessed 5 September 2017].

Thomas, S., 2004. *Reconfiguring the Public Sphere: Implications for analyse of Educational Policy.* Britain: British Journal of Educational Studies.

Tugba, D., 2019. Determinants of Sovereign Ratings in Emerging Countries with Panel Probit Analysis. *International Journal of Engineering Management,* 3(1), pp. 6-11.

Wallace, T. D. & Hussain, A., 1969. The Use of Error Components Models in Combining Cross Section with Time Series Data. *Econometrica,* 37(1), pp. 55-72.

Wooldridge, J. M., 2002. *Econometric Analysis of Cross Section and Panel Data.* 1st ed. London: The MIT Press.

World Bank Group, 2019. *World Bank Group.* [Online]
Available at: https://www.worldbank.org/en/home
[Accessed 17 May 2019].

World Bank, 2017. *World Bank Group.* [Online]
Available at: https://data.worldbank.org/indicator
[Accessed 15 August 2017].

APPENDICES

Appendix A: Descriptive Statistics

	INFLATION	GDP_PER_CAPITA_GROWTH__A	EXTERNAL DEBT	FDI___GDP	CONTROL_OF_CORRUPTION
Mean	21.93954	2.275101	47.50324	4.738889	27.70016
Median	10.08286	2.254363	31.40000	2.625090	21.46342
Maximum	324.9969	18.30014	277.5303	39.45620	81.31313
Minimum	1.385382	-10.95642	3.700000	-6.897680	0.000000
Std. Dev.	42.72540	4.239649	50.50089	7.389526	28.12968
Skewness	4.589900	0.333975	2.180741	2.532100	0.530533
Kurtosis	27.56625	6.300612	8.068666	10.26111	1.753042
Jarque-Bera	3180.934	52.44841	206.8018	362.4606	12.39854
Probability	0.000000	0.000000	0.000000	0.000000	0.002031
Sum	2435.289	252.5362	5272.859	526.0166	3074.718
Sum Sq. Dev.	200800.6	1977.208	280537.3	6006.561	87040.66

Sample: 1990-2016

Appendix B: Panel Unit Root Test

AT LEVEL:

Panel unit root test: Summary				
Series: SCR				
Date: 05/28/20 Time: 07:16				
Sample: 1990 2016				
Exogenous variables: Individual effects				
User-specified lags: 1				
Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test				
Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-2.60323	0.0046	5	125
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-2.78743	0.0027	5	125
ADF - Fisher Chi-square	25.3556	0.0047	5	125
PP - Fisher Chi-square	19.1842	0.0380	5	130
** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.				

Panel unit root test: Summary				
Series: INFLATION				
Date: 05/28/20 Time: 07:14				
Sample: 1990 2016				
Exogenous variables: Individual effects				
User-specified lags: 1				
Newey-West automatic bandwidth selection and Bartlett kernel				
			Cross-	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-2.85726	0.0021	5	124
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-1.50466	0.0662	5	124
ADF - Fisher Chi-square	17.0849	0.0725	5	124
PP - Fisher Chi-square	16.1336	0.0959	5	129
** Probabilities for Fisher tests are computed using an asymptotic Chi				
-square distribution. All other tests assume asymptotic normality.				

Panel unit root test: Summary				
Series: GDP_PER_CAPITA_GROWTH__A				
Date: 05/28/20 Time: 19:45				
Sample: 1990 2016				
Exogenous variables: Individual effects				
User-specified lags: 1				
Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test				
			Cross-	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-3.30373	0.0005	5	125
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.79971	0.0001	5	125
ADF - Fisher Chi-square	33.5386	0.0002	5	125
PP - Fisher Chi-square	61.1939	0.0000	5	130
** Probabilities for Fisher tests are computed using an asymptotic Chi				
-square distribution. All other tests assume asymptotic normality.				

Panel unit root test: Summary				
Series: EXTERNAL_DEBT____OF_GDP				
Date: 05/28/20 Time: 19:46				
Sample: 1990 2016				
Exogenous variables: Individual effects				
User-specified lags: 1				
Newey-West automatic bandwidth selection and Bartlett kernel				
			Cross-	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-3.68751	0.0001	5	97
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.01211	0.0013	5	97
ADF - Fisher Chi-square	27.6700	0.0020	5	97
PP - Fisher Chi-square	23.1455	0.0102	5	104
** Probabilities for Fisher tests are computed using an asymptotic Chi				
-square distribution. All other tests assume asymptotic normality.				

Panel unit root test: Summary				
Series: FDI___GDP				
Date: 05/28/20 Time: 19:47				
Sample: 1990 2016				
Exogenous variables: Individual effects				
User-specified lags: 1				
Newey-West automatic bandwidth selection and Bartlett kernel				
			Cross-	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-0.99096	0.1609	5	124
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-2.35617	0.0092	5	124
ADF - Fisher Chi-square	23.7380	0.0083	5	124
PP - Fisher Chi-square	41.2242	0.0000	5	129
** Probabilities for Fisher tests are computed using an asymptotic Chi				
-square distribution. All other tests assume asymptotic normality.				

Panel unit root test: Summary				
Series: CONTROL_OF_CORRUPTION				
Date: 05/28/20 Time: 19:47				
Sample: 1990 2016				
Exogenous variables: Individual effects				
User-specified lags: 1				
Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test				
			Cross-	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	0.30359	0.6193	5	125
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	0.16310	0.5648	5	125
ADF - Fisher Chi-square	6.94024	0.7311	5	125
PP - Fisher Chi-square	40.7068	0.0000	5	130
** Probabilities for Fisher tests are computed using an asymptotic Chi				
-square distribution. All other tests assume asymptotic normality.				

FIRST DIFFERENCE

Panel unit root test: Summary				
Series: D(SCR)				
Date: 05/28/20 Time: 19:49				
Sample: 1990 2016				
Exogenous variables: Individual effects				
User-specified lags: 1				
Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test				
			Cross-	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-5.35231	0.0000	5	120
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-6.21380	0.0000	5	120
ADF - Fisher Chi-square	54.7244	0.0000	5	120
PP - Fisher Chi-square	98.2117	0.0000	5	125
** Probabilities for Fisher tests are computed using an asymptotic Chi				
-square distribution. All other tests assume asymptotic normality.				

Panel unit root test: Summary				
Series: D(INFLATION)				
Date: 05/28/20 Time: 19:49				
Sample: 1990 2016				
Exogenous variables: Individual effects				
User-specified lags: 1				
Newey-West automatic bandwidth selection and Bartlett kernel				
			Cross-	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-7.77038	0.0000	5	119
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-8.40695	0.0000	5	119
ADF - Fisher Chi-square	76.5085	0.0000	5	119
PP - Fisher Chi-square	109.173	0.0000	5	124
** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.				

Panel unit root test: Summary				
Series: D(GDP_PER_CAPITA_GROWTH__A)				
Date: 05/28/20 Time: 19:50				
Sample: 1990 2016				
Exogenous variables: Individual effects				
User-specified lags: 1				
Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test				
			Cross-	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-9.07419	0.0000	5	120
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-9.72043	0.0000	5	120
ADF - Fisher Chi-square	88.8176	0.0000	5	120
PP - Fisher Chi-square	109.123	0.0000	5	125
** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.				

Panel unit root test: Summary				
Series: D(EXTERNAL_DEBT____OF_GDP)				
Date: 05/28/20 Time: 19:50				
Sample: 1990 2016				
Exogenous variables: Individual effects				
User-specified lags: 1				
Newey-West automatic bandwidth selection and Bartlett kernel				
			Cross-	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-4.30311	0.0000	5	90
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.90512	0.0000	5	90
ADF - Fisher Chi-square	34.2093	0.0002	5	90
PP - Fisher Chi-square	60.1784	0.0000	5	97
** Probabilities for Fisher tests are computed using an asymptotic Chi				
-square distribution. All other tests assume asymptotic normality.				

Panel unit root test: Summary				
Series: D(FDI___GDP)				
Date: 05/28/20 Time: 19:51				
Sample: 1990 2016				
Exogenous variables: Individual effects				
User-specified lags: 1				
Newey-West automatic bandwidth selection and Bartlett kernel				
			Cross-	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-5.86479	0.0000	5	119
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-8.31842	0.0000	5	119
ADF - Fisher Chi-square	73.8476	0.0000	5	119
PP - Fisher Chi-square	102.798	0.0000	5	124
** Probabilities for Fisher tests are computed using an asymptotic Chi				
-square distribution. All other tests assume asymptotic normality.				

Panel unit root test: Summary				
Series: D(CONTROL_OF_CORRUPTION)				
Date: 05/28/20 Time: 19:52				
Sample: 1990 2016				
Exogenous variables: Individual effects				
User-specified lags: 1				
Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test				
			Cross-	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	3.27590	0.9995	5	120
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-7.23882	0.0000	5	120
ADF - Fisher Chi-square	64.7230	0.0000	5	120
PP - Fisher Chi-square	122.517	0.0000	5	125
** Probabilities for Fisher tests are computed using an asymptotic Chi				
-square distribution. All other tests assume asymptotic normality.				

Appendix C: Panel Regression Models

Dependent Variable: SCR				
Method: Panel Least Squares				
Date: 05/28/20 Time: 06:09				
Sample: 1990 2016				
Periods included: 27				
Cross-sections included: 5				
Total panel (unbalanced) observations: 111				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
INFLATION	0.011219	0.005732	1.957275	0.053
GDP PER CAPITA	-0.11144	0.05092	-2.18854	0.0308
EXTERNAL DEBT	-0.0253	0.005065	-4.99536	0
FDI	-0.11929	0.028267	-4.22031	0.0001
CONTROL OF CORRUPTION	0.066465	0.008076	8.230197	0
C	5.122671	0.472648	10.83823	0
R-squared	0.618314	Mean dependent var		5.189189
Adjusted R-squared	0.600138	S.D. dependent var		3.399234
S.E. of regression	2.149493	Akaike info criterion		4.420879
Sum squared resid	485.1337	Schwarz criterion		4.567341
Log likelihood	-239.359	Hannan-Quinn criter.		4.480294
F-statistic	34.01899	Durbin-Watson stat		0.863324
Prob(F-statistic)	0			

Appendix D: Fixed Effects Models

Dependent Variable: SCR				
Method: Panel Least Squares				
Date: 05/28/20 Time: 06:27				
Sample: 1990 2016				
Periods included: 27				
Cross-sections included: 5				
Total panel (unbalanced) observations: 111				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
INFLATION	0.002454	0.002576	0.952893	0.3429
GDP_PER_CAPITA_GROWTH__ A	0.015115	0.021042	0.718348	0.4742
EXTERNAL_DEBT____OF_GDP	0.000360	0.002545	0.141297	0.8879
FDI___GDP	0.004845	0.013754	0.352291	0.7254
CONTROL_OF_CORRUPTION	0.027833	0.003823	7.279927	0.0000
C	4.289944	0.205304	20.89552	0.0000
	Effects Specification			
Cross-section fixed (dummy variables)				
R-squared	0.944954	Mean dependent var		5.189189
Adjusted R-squared	0.940049	S.D. dependent var		3.399234
S.E. of regression	0.832302	Akaike info criterion		2.556527
Sum squared resid	69.96533	Schwarz criterion		2.800629
Log likelihood	-131.8872	Hannan-Quinn criter.		2.655552
F-statistic	192.6466	Durbin-Watson stat		1.344820
Prob (F-statistic)	0.000000			

Cross-sectional Effect: Fixed Effect Model

	COUNTRY	Effect
1	Angola	-1.224039
2	Botswana	4.313952
3	Mozambique	-2.912983
4	South Africa	1.589339
5	Zambia	-2.927601

Period effects

Dependent Variable: SCR				
Method: Panel Least Squares				
Date: 05/28/20 Time: 06:35				
Sample: 1990 2016				
Periods included: 27				
Cross-sections included: 5				
Total panel (unbalanced) observations: 111				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
INFLATION	0.011871	0.005306	2.237445	0.0281
GDP_PER_CAPITA_GROWTH__	-0.030564	0.056259	-0.543281	0.5885

A				
EXTERNAL_DEBT____OF_GDP	-0.032231	0.004685	-6.880119	0.0000
FDI___GDP	-0.074602	0.026629	-2.801536	0.0064
CONTROL_OF_CORRUPTION	0.096001	0.008043	11.93628	0.0000
C	4.223678	0.447510	9.438172	0.0000
	Effects Specification			
Period fixed (dummy variables)				
R-squared	0.796242	Mean dependent var		5.189189
Adjusted R-squared	0.716287	S.D. dependent var		3.399234
S.E. of regression	1.810593	Akaike info criterion		4.261680
Sum squared resid	258.9815	Schwarz criterion		5.042806
Log likelihood	-204.5232	Hannan-Quinn criter.		4.578560
F-statistic	9.958564	Durbin-Watson stat		0.914543
Prob (F-statistic)	0.000000			

Appendix E: Random Effects Model

Dependent Variable: SCR				
Method: Panel EGLS (Period random effects)				
Date: 05/28/20 Time: 06:43				
Sample: 1990 2016				
Periods included: 27				
Cross-sections included: 5				
Total panel (unbalanced) observations: 111				
Swamy and Arora estimator of component variances				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
INFLATION	0.011219	0.004828	2.323630	0.0221
GDP_PER_CAPITA_GROWTH__ A	-0.111440	0.042892	-2.598188	0.0107
EXTERNAL_DEBT____OF_GDP	-0.025300	0.004266	-5.930373	0.0000
FDI___GDP	-0.119293	0.023810	-5.010250	0.0000
CONTROL_OF_CORRUPTION	0.066465	0.006802	9.770695	0.0000
C	5.122671	0.398128	12.86689	0.0000
	Effects Specification			
			S.D.	Rho
Period random			0.000000	0.0000
Idiosyncratic random			1.810593	1.0000
	Weighted Statistics			
R-squared	0.618314	Mean dependent var		5.189189
Adjusted R-squared	0.600138	S.D. dependent var		3.399234
S.E. of regression	2.149493	Sum squared resid		485.1337
F-statistic	34.01899	Durbin-Watson stat		0.863324
Prob (F-statistic)	0.000000			
	Unweighted Statistics			

R-squared	0.618314	Mean dependent var	5.189189
Sum squared resid	485.1337	Durbin-Watson stat	0.863324

Appendix F: Hausman Test

Correlated Random Effects - Hausman Test				
Equation: Untitled				
Test period random effects				
Test Summary		Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Period random		64.086789	5	0.0000
** WARNING: estimated period random effects variance is zero.				
Period random effects test comparisons:				
Variable	Fixed	Random	Var (Diff.)	Prob.
INFLATION	0.011871	0.011219	0.000005	0.7669
GDP_PER_CAPITA_GROWTH__A	-0.030564	-0.111440	0.001325	0.0263
EXTERNAL_DEBT____OF_GDP	-0.032231	-0.025300	0.000004	0.0003
FDI___GDP	-0.074602	-0.119293	0.000142	0.0002
CONTROL_OF_CORRUPTION	0.096001	0.066465	0.000018	0.0000
Period random effects test equation:				
Dependent Variable: SCR				
Method: Panel Least Squares				
Date: 05/28/20 Time: 06:44				
Sample: 1990 2016				
Periods included: 27				
Cross-sections included: 5				
Total panel (unbalanced) observations: 111				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.223678	0.447510	9.438172	0.0000
INFLATION	0.011871	0.005306	2.237445	0.0281
GDP_PER_CAPITA_GROWTH__A	-0.030564	0.056259	-0.543281	0.5885
EXTERNAL_DEBT____OF_GDP	-0.032231	0.004685	-6.880119	0.0000
FDI___GDP	-0.074602	0.026629	-2.801536	0.0064
CONTROL_OF_CORRUPTION	0.096001	0.008043	11.93628	0.0000
	Effects Specification			
Period fixed (dummy variables)				
R-squared	0.796242	Mean dependent var		5.189189
Adjusted R-squared	0.716287	S.D. dependent var		3.399234

S.E. of regression	1.810593	Akaike info criterion	4.261680
Sum squared resid	258.9815	Schwarz criterion	5.042806
Log likelihood	-204.5232	Hannan-Quinn criter.	4.578560
F-statistic	9.958564	Durbin-Watson stat	0.914543
Prob (F-statistic)	0.000000		

Appendix G: Panel Cointegration Test

Pedroni Residual Cointegration Test
Series: INFLATION GDP_PER_CAPITA_GROWTH__A EXTERNAL_DEBT____OF_GDP FDI___GDP CONTROL_OF_CORRUPTION
Date: 06/01/20 Time: 01:20
Sample: 1990 2016
Included observations: 135
Cross-sections included: 5
Null Hypothesis: No cointegration
Trend assumption: No deterministic trend
User-specified lag length: 1
Newey-West automatic bandwidth selection and Bartlett kernel

Alternative hypothesis: common AR coefs. (within-dimension)

	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	0.757954	0.2242	-1.228459	0.8904
Panel rho-Statistic	0.796451	0.7871	0.205397	0.5814
Panel PP-Statistic	-1.189691	0.1171	-2.381713	0.0086
Panel ADF-Statistic	-0.317466	0.3754	-0.830801	0.2030

Alternative hypothesis: individual AR coefs. (between-dimension)

	Statistic	Prob.
Group rho-Statistic	1.011655	0.8441
Group PP-Statistic	-3.166086	0.0008
Group ADF-Statistic	-0.667725	0.2522

Cross-section specific results

Phillips-Peron results (non-parametric)

Cross ID	AR(1)	Variance	HAC	Bandwidth	Obs
Angola	-0.280	494.3277	536.1412	2.00	16
Botswana	0.305	6.401574	6.663760	1.00	22
Mozambique	-0.189	10.90365	3.379749	8.00	16
South Africa	0.210	4.913948	4.436451	2.00	26
Zambia	0.576	818.9255	763.5370	4.00	24

Augmented Dickey-Fuller results (parametric)

Cross ID	AR(1)	Variance	Lag	Max lag	Obs
Angola	-0.203	351.2470	1	--	15
Botswana	0.335	5.787049	1	--	20

Mozambique	-0.580	10.22198	1	--	15
South Africa	0.046	4.720707	1	--	25
Zambia	0.382	757.6839	1	--	22

APPENDIX H:DATA	Year	SCR	GDP per capita	Inflation	Ext Debt	FDI % of GDP	Control of Corruption
ANGOLA	1990	2	-3.1195	..	..	-2.9816	0.0000
	1991	1	-4.2065	83.6083	..	6.2666	0.0000
	1992	2	-9.8786	299.0605	..	3.4661	0.0000
	1993	3	-27.1459	1379.4143	..	5.2369	0.0000
	1994	3	0.2280	948.8112	..	3.8370	0.0000
	1995	2	7.0909	2671.7921	..	8.5295	0.0000
	1996	2	8.0698	4145.1076	..	2.3990	0.5376
	1997	2	4.9917	219.1767	..	5.3823	0.0000
	1998	3	3.9436	107.2848	..	17.1216	0.0000
	1999	4	0.3565	248.1959	..	40.1673	0.0000
	2000	4	-0.0653	324.9969	103.1000	9.6239	0.0000
	2001	5	0.8928	152.5610	91.5000	24.0091	0.0000
	2002	4	-10.0617	108.8974	50.5000	11.4062	0.0000
	2003	3	1.6008	98.2237	47.5000	20.0810	0.0000
	2004	3	6.9868	43.5419	38.2000	9.3292	0.9756
	2005	4	14.1073	22.9637	27.6000	-3.5267	0.4878
	2006	4	16.5054	13.3033	14.5000	-0.0720	1.9512
	2007	3	18.3001	12.2487	15.0000	-1.3688	0.4854
	2008	2	9.8327	12.4737	16.7000	1.8963	0.9709
	2009	2	-1.1756	13.7315	20.7000	3.1367	0.0000
	2010	3	-0.2190	14.4705	21.4000	-3.8511	0.9524
	2011	4	0.2738	13.4670	18.9000	-2.7049	0.0000
	2012	4	1.4783	10.2935	18.0000	-1.1438	0.0000
	2013	3	3.1070	8.7761	20.8000	-5.2081	0.4739
	2014	3	1.2145	7.2796	24.7000	2.5101	0.0000
	2015	3	-0.4643	10.2793	31.5000	8.6306	0.4808
	2016	2	-3.9548	34.7362	40.0000	-0.1775	0.9615
BOTSW	1990	8	3.8059	11.3963	11.3711	2.5297	0.0000
	1991	8	4.5143	11.7650	12.1168	-0.2083	0.0000
	1992	8	0.1528	16.1676	12.5322	-0.0377	0.0000
	1993	9	-0.7336	14.3308	12.4451	-6.8977	0.0000
	1994	10	1.0634	10.5429	12.0424	-0.3323	0.0000
	1995	9	4.5426	10.5125	10.9721	1.4885	0.0000
	1996	9	3.5229	10.0829	11.1568	1.4684	66.1290
	1997	8	5.8118	8.7199	..	1.9941	0.0000
	1998	9	-1.2078	6.6614	..	1.9897	71.6495
	1999	10	7.7165	7.7493	..	0.6687	0.0000
	2000	10	0.3072	8.6015	8.2000	0.9877	70.5584
	2001	11	-1.2687	6.5590	7.6000	0.5589	0.0000
	2002	11	4.5787	8.0328	8.5000	7.5015	68.1818
	2003	10	3.2119	9.1899	5.8000	5.5653	81.3131

	2004	11	1.3027	6.9457	4.7000	4.3638	73.6585
	2005	11	3.0624	8.6102	5.2000	4.2377	79.0244
	2006	11	6.7314	11.5552	5.8936	4.8081	74.1463
	2007	11	6.5700	7.0810	3.7000	4.5217	74.2718
	2008	11	4.5021	12.7022	11.2000	4.7594	74.2718
	2009	11	-9.2163	8.0273	24.0000	2.0327	72.7273
	2010	10	6.6786	6.9489	12.1000	1.7079	74.2857
	2011	11	4.1628	8.4582	17.4000	1.9099	72.9858
	2012	11	2.5575	7.5403	13.4000	1.0159	73.4597
	2013	11	9.2933	5.8839	21.8000	0.4505	73.9337
	2014	10	2.2250	4.4031	10.8000	3.1702	72.1154
	2015	11	-3.5075	3.0604	10.9000	2.6251	72.5962
	2016	10	2.3884	3.7693	9.5000	0.7808	74.5192
Mozambique	1990	0	-0.4336	47.0052	..	..	0.0000
	1991	0	2.2426	32.9332	..	0.6074	0.0000
	1992	1	-8.4591	45.4853	..	0.9565	0.0000
	1993	1	4.5630	42.2000	..	1.1686	0.0000
	1994	1	2.1123	63.1834	..	1.2531	0.0000
	1995	1	-1.2795	54.4340	..	1.5512	0.0000
	1996	2	23.0271	48.4914	..	1.7414	23.6559
	1997	1	7.8348	7.3693	..	1.2940	0.0000
	1998	2	9.0172	1.4804	..	4.1848	26.8041
	1999	2	5.0755	2.8595	..	6.4821	0.0000
	2000	3	-1.0386	12.7236	118.7000	2.5082	26.3959
	2001	2	9.5612	9.0500	111.0000	4.8095	0.0000
	2002	2	5.6626	16.7814	71.0000	6.1753	25.2525
	2003	3	3.3842	13.4263	69.5000	5.3837	18.6869
	2004	2	4.6473	12.6635	63.9000	6.2658	20.9756
	2005	2	5.5491	7.1678	60.8000	1.4381	22.4390
	2006	2	6.6678	13.2387	40.1000	2.7449	19.5122
	2007	3	4.3230	8.1626	35.4000	3.9976	23.3010
	2008	2	3.7964	10.3278	55.0000	5.1007	25.2427
	2009	2	3.2894	3.2517	35.7000	7.8161	26.7943
	2010	2	3.6162	12.7012	35.8000	11.3500	27.1429
	2011	3	4.0354	10.3511	31.8000	25.4766	23.2228
	2012	2	4.1187	2.0913	32.1000	34.4637	22.7488
	2013	3	4.0704	4.2080	36.9000	39.4562	21.3270
	2014	2	4.3720	2.2870	39.9000	28.2162	17.7885
	2015	1	3.5560	2.3919	52.3000	24.2515	14.4231
	2016	0	0.8996	9.9662	79.2000	26.2055	12.0192
South Africa	1990	4	-2.4930	14.3210	35.3399	-0.0655	0.0000
	1991	5	-3.2774	15.3348	36.9948	0.2050	0.0000
	1992	5	-4.4304	13.8747	40.3064	0.0025	0.0000

	1993	5	-1.1276	9.7174	43.7840	0.0084	0.0000
	1994	5	0.9331	8.9385	49.2297	0.2679	0.0000
	1995	6	0.9859	8.6804	49.5659	0.8030	0.0000
	1996	6	2.3364	7.3541	48.9130	0.5531	66.1290
	1997	7	0.8634	8.5978	47.8134	2.4973	0.0000
	1998	7	-1.1025	6.8806	49.5834	0.3994	67.5258
	1999	6	0.7982	5.1815	46.7729	1.1003	0.0000
	2000	7	2.6295	5.3390	27.8000	0.7105	65.4822
	2001	7	1.2810	5.7019	25.5000	5.9831	0.0000
	2002	7	2.2544	9.1640	29.4000	1.2814	60.6061
	2003	8	1.6040	5.8590	22.4000	0.4469	60.6061
	2004	8	3.2572	1.3854	19.7000	0.3068	60.4878
	2005	9	4.0411	3.3993	18.9000	2.5302	64.3902
	2006	8	4.4399	4.6416	21.9000	0.2295	61.9512
	2007	8	4.2567	7.0984	25.2000	2.1999	57.7670
	2008	9	2.1165	11.5365	26.1000	3.4470	57.7670
	2009	9	-2.6173	7.1300	26.4000	2.5764	56.9378
	2010	9	1.8136	4.2574	27.8000	0.9840	55.2381
	2011	9	1.9426	5.0005	28.3000	0.9940	54.0284
	2012	7	0.7963	5.6536	35.8000	1.1672	46.4455
	2013	7	1.0231	5.7515	37.4000	2.2442	47.3934
	2014	7	0.2597	6.0672	39.1000	1.6505	49.5192
	2015	7	-0.0783	4.5883	39.1000	0.4789	52.8846
	2016	7	-1.0172	6.3263	48.4000	0.7475	54.8077
Zambia	1990	1	-3.1273	107.0238	244.3805	6.1701	0.0000
	1991	1	-2.6139	97.6423	277.5303	1.0151	0.0000
	1992	1	-4.2020	165.7065	164.7008	1.4142	0.0000
	1993	2	4.1253	183.3120	161.7861	9.6052	0.0000
	1994	2	-10.9564	54.6013	149.2099	1.0939	0.0000
	1995	1	0.1840	34.9296	155.2792	2.8106	0.0000
	1996	2	3.3102	43.0731	175.9345	3.5333	5.9140
	1997	2	0.8899	24.4187	150.0725	4.8196	0.0000
	1998	2	-3.2254	24.4585	161.2322	5.5969	12.3711
	1999	3	1.6916	26.7877	..	4.7587	0.0000
	2000	3	1.0214	26.0304	136.5000	3.3799	12.1827
	2001	2	2.4670	21.3938	117.9000	3.5414	0.0000
	2002	2	1.7216	22.2333	122.8000	7.1149	11.6162
	2003	3	4.1213	21.4016	113.6000	7.0790	18.6869
	2004	3	4.2063	17.9678	94.1000	5.8517	21.4634
	2005	2	4.3847	18.3244	55.2000	4.2840	19.5122
	2006	2	5.0170	9.0196	25.1000	4.8271	21.4634
	2007	1	5.4361	10.6573	18.5000	9.4181	28.6408
	2008	1	4.8367	12.4456	6.7000	5.2405	29.6117

	2009	2	6.1856	13.3953	24.8000	4.5328	25.3589
	2010	2	7.1635	8.5018	17.2000	8.5332	24.2857
	2011	3	2.4955	6.4294	12.2000	4.7250	28.9100
	2012	3	4.4123	6.5759	12.4000	6.7893	36.9668
	2013	3	1.9168	6.9777	13.1000	7.4871	36.0190
	2014	2	1.5608	7.8069	18.5000	5.5535	34.1346
	2015	2	-0.1460	10.1106	31.4000	7.4502	32.6923
	2016	2	0.5448	17.8700	32.2000	3.1631	31.7308