Private capital formation in the Southern African Development Community (SADC) Countries: A non-reversibility analysis

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DECLARATION

I, Mokhele John KHUMALO, hereby declare that this thesis entitled "Private capital formation in the Southern African development community (SADC) countries: A non-reversibility Analysis", submitted for the fulfilment of the requirements for the degree of Doctor of Philosophy in Economics at the North-West University is my own work. I further declare that this thesis has not been previously submitted to any institution or any other University and that all reference sources have been accurately reported and acknowledged.

Signature _____ Date_____

MOKHELE JOHN KHUMALO

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DEDICATION

This thesis is dedicated to my wife and my two children, Andile and Thandile.

ABSTRACT

This study examined the contribution of debt and public capital formation in the South African development community (SADC) countries using panel data analysis for the period 1980 to 2015 with the objective of establishing the reversibility or the non-reversibility nature of the private capital formation in these countries using the reversibility analysis within the neoclassical investment model. This analysis starts with finding the appropriate panel regression method applicable, starting with testing the data poolability, fixed and random effects approaches and estimated the neoclassical private capital formation model for the region. The analysis revealed that the data was not poolable, hence the choice between random and fixed effects, of which the Hausman test was conducted and showed that the applicable model was of fixed effect nature.

The variables of interest, total debt and debt service ratio as well as the public capital formation were found to have negative and significant effects on private capital formation in the SADC countries. The debt service ratio coefficient shows that countries may experience debt-overhang in the long run and could struggle to service their debt. The study further reveals that growth of gross domestic product and gross national savings tend to increase private capital formation, while interest rate, current account balance, political instability and fiscal balance reduce private capital formation.

In an attempt to achieve the main objective of this study, which is to test the reversibility/ non-reversibility of private capital formation model within the

neoclassical presentation, with much emphasis placed on the debt and public capital formation variables, the study applied the fixed effect model and found that in the context of the SADC countries private capital formation was not reversible. The results of the non-reversibility analysis also showed that decreases in public capital formation (PUCF_D) contributed positively to private capital formation in the SADC countries, while overall increases appeared insignificant, despite positive influence. The non-reversibility condition was also confirmed with the use of the Wald test (333.89), which assumed that all regression coefficients were identical and equivalent to zero. The test ejected the null hypothesis in this regard and concluded that the coefficients are not identical and equivalent to zero.

The findings of this study have implications at both regional and country level with regard to policy making. First, countries will have to prioritise their growth strategies to achieve sustainable private capital formation. Secondly, the debt reduction policies and strategies should be undertaken to attract potential private investors, since is a negative correlation between debt and private capital formation and there exist a long-run relationship between private capital formation and its determinants.

KEYWORDS: *Private capital formation, SADC, Non-reversibility, Nonstationarity panel*

LIST OF ABBREVIATIONS AND ACRONYMS

ACF – Auto correlation functions

ADF – Augmented Dicky-Fuller

AfDB – African Development Bank

AGO – Angola

B-P LM – Breusch-Pegan Lagrange multiplier

BWA – Botswana

CAB – Current account balance

COD – Democratic Republic of Congo

CPI – Consumer price index

CUM – capacity utilisation model

DEBTS – Debt service ratio

DRC – Democratic Republic of Congo

DSR –Debt service ratio

DW – Durbin Watson statistic

EGLS – Estimated generalized least squares

EV – Error variance

FA - flexible accelerator

FAID – Foreign aid

FAM - flexible accelerator model

FB – Fiscal balance

FDI – foreign direct investment

FE – Fixed effects

FGLS – Fully Generalized Least Squares

GCFP – Gross private capital formation

GDP – Gross domestic product

GETS – General-to-specific methodology

GLS – Generalized least squares

GNS – Gross national savings

IID – Independent and identically distributed

IMF – International Monetary Fund

IPS – Im-Pesaran-Shin unit root test

JB – Jacque-Berra

LLC – Levin-Lin-Chu unit root test

LM – Lagrange multiplier

LSDV- Least squares dummy variable

MoU – Memorandum of understanding

MMP – Marginal physical product

NATI – Naïve Accelerator Theory of Investment

OLS – Ordinary least squares

PCF – Private capital formation

PCF_D – Private capital formation decrement

PCF_R – Private capital formation increment

POL – Political instability or polity

PP – Phillip-Perron

PUCF – Public capital formation

RE – Random effects

RGDP – Real gross domestic product

RIR – Real interest rate

RISDP – Regional Indicative Strategic Development Plan

SADC – South African development community

SADCC – Southern African development co-ordination conference

SIC – Schwarz information criterion

SSA – Sub-Saharan Africa

SOE – State-Owned enterprises

TDEBT – Total debt

2SLS – Two stage least squares

WEO – World economic outlook

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INTRODUCTION

1.1 Introduction

Economic growth has been in the forefront in addressing the economic challenges that developing countries face, including the economies within the South African Development Community (SADC) bloc. In as far as growth plays important role in development and job creation, the role played by both the public sector and the private sectors cannot be underrated since the two could be said to complement each other. Researchers often differ regarding whether public investment crowds out private investment or it crowds-in private investment. Economic theory in this regard is crucial and has always been at the vanguard of any economic modelling in economics and researchers often rely on that premise when conducting research. In this instance it can be said that theory postulate on one hand that public investment that is being financed by borrowing will reduce the amount of loanable funds that are available for private investment, hence pushing the lending rates up and as a result reduce the level of private investment. This results into crowding out of private investment.

Since private sector in many developing countries might not be willing to commit to large scale investment projects with concomitant risk, infrastructure capital could lower the cost of production and this would augment the productivity of private capital. When this happen the rate of return on such investments would increase,

leading to more investment within the private sector and thus crowds in investment (Boopen and Khadaroo: 2009).

In the past few decades, the role of private sector in engineering growth and development has received considerable attention and the SADC countries are no exception to this initiative. This is due to the apprehension that state involvement in economic activities through public enterprises is not efficient. The financial performance of public enterprises in most developing countries is disappointing despite the huge financial resources dispersed to them. This challenge led to the establishment of the "State owned enterprises (SOE) Network for Southern Africa" by the SADC countries in 2007 in order to avert the poor performance of SOEs. The tendency to boost private sector participation has prominently shaped policy advice at regional and international financial institutions and policy making particularly in these countries, giving rise to a wave of privatization programmes, liberalization policies and other policies geared towards the private sector development (Badawi, 2005). The IMF Survey magazine (2013) highlighted that although South Africa as one of the members of the SADC group has a better infrastructure it has only managed to move forward with structural reforms in order to boost growth and create jobs, more still needed to be done, particularly within the private sector.

Individual countries within the SADC bloc had experienced differing growth levels and capital formation. For example, the economy of South Africa saw the growth

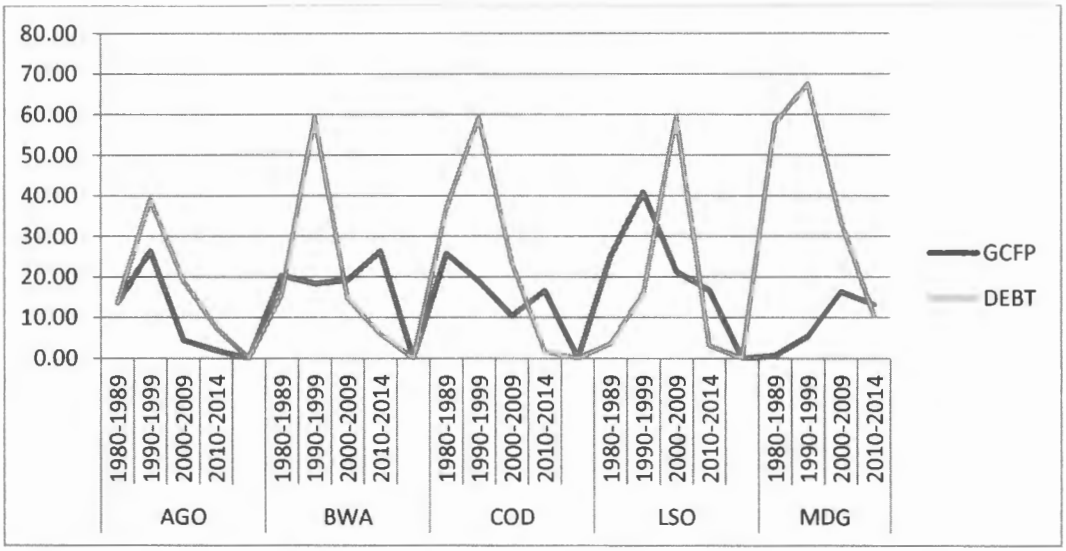
of gross fixed capital formation slow down by about 3 percent from the post-crisis peak of 5 percent in the year 2011 and about 12 percent in the 6 years prior to the start of the financial crisis (African Economic Outlook[1], 2014). The sluggish public investment was seen as the main source of some decline in the gross fixed capital formation. The private sector plays a very important role in South Africa as it contributes about two-thirds of capital formation. The country faces multiple challenges of weaker economic growth, high debt burden, increasing unsecured lending that could lead to overleveraging of the poor households, inflation, unemployment as well as the budget deficit. Similarly, Zimbabwe faces similar challenges as SA and other SADC member states with its debt situation remaining critical and is seen as an impediment to development. Debt overhang in this country amounts to about USD8.4 billion and its public and private external debt at 52 percent of GDP. Another challenge with most of the SADC states is the difficulty of doing business, example, in Zimbabwe it takes approximately 90 days to establish a business and costs 114 percent of income per capita while in South Africa it takes only 19 days and costs less than 0.5 percent of per capita income (World Bank, 2015).

Figure 1.1 depicts the historical pattern of both the GCFP and debt for Angola[2], Botswana, Democratic Republic of Congo (DRC), Lesotho and Madagascar as an average for each decade. Angola recorded averages of 13.45 percent and 13.51 percent GCFP and debt between 1980 and 1989. There were increases in GCFP

[1] Abbreviated AEO
[2] The countries' names are denoted by their ISO codes, Angola: AGO; Botswana: BWA; Democratic Republic of Congo:COD; Lesotho: LSO and Madagascar : MDG.

and debt in 1990 followed by a decrease between 2000 and 2014. Botswana, DRC, Lesotho and Madagascar also experienced higher debt than GCFP as shown by figure 1.1.

Figure 1.1:Gross private capital formation and Debt for five SADC countries



Notes: AGO =Angola, BWA = Botswana, COD = Democratic Republic of Congo, LSO = Lesotho, MDG = Madagascar

It is clear from the graphs above that debt within the five countries as shown is a serious challenge that needs to be addressed if such countries are to achieve favourable levels of capital formation. The graphical presentation of the historical trend of the remainder of the SADC is found in appendix A1.

There is no doubt that infrastructure can be regarded as a catalyst for development within the SADC group. Various governments have sought to encourage private investment by adopting policies without much thorough empirical investigation into the main determinants of domestic private sector capital formation (Frimpong and

Marbuah; 2010). In light with the challenges faced by developing nations many received policy advice from the World Bank and International Monetary Fund (IMF). The policy advice given to these countries included among other things, structural adjustment loans. This package (advice and loans) was aimed at helping developing countries to reduce structural imbalances, which led to the stagnation of their economic growth performance, and promotion of market-based economies. An important noteworthy part of the proposed policy changes in the programme was in the demand management policies (fiscal and monetary) in the respective member states.

The governments' involvement in promoting capital formation is critical in working towards achieving the desirable level of economic growth as stipulated in the SADC Regional Indicative Strategic Development Plan (RISDP) within the region. While these policy prescriptions were a dominant element in the programme, in the empirical literature, there is no consensus regarding the impact of such demand-management policies on macroeconomic performance in less developed countries (LDCs). Some studies such as Blejar and Khan (1984), Aschauer (1989), and Greene and Villanueva (1991), found evidence of complimentarity between fiscal policy (public investment) and private investment. Conversely, Chhiber and Wijnbergen (1988), and Rossiter (2002) report negative effect of public investment on private investment. They argue that public investment may crowd out private investment if the additional investment is financed by a deficit, which leads to an increase in the interest rates, credit rationing and tax burden. An imprecision

similar to that of a fiscal policy on private capital formation is that of a monetary policy. The advocates of the classical paradigm still argue that money supply, henceforth monetary policy variables have little or no influence on real economic outcomes, either in the short-run or long-run, that is monetary policy is window dressing (Tobin and Buiter, 1980).

Khan and Knight (1981,1982), posit that although, the interaction between government policy and private investment is crucial for any analysis of the effects that a stabilization programme involving demand restraint have on the real sector, it still remains a subject of considerable controversy. The mixed results from the IMF and World Bank policy recommendations reveal this controversy. It is essential and necessary to conduct further empirical studies on individual country to assess how private investment responds to changes in government policy-not only in designing long-term development strategies, but also in implementing shorter-term stabilization programs (Blejer and Khan, 1984; Ajayi, 1994).

1.2 Statement of the Problem

Stern (1989) noted that the subject of what determines investment remained a critical issue on economic growth as investment is considered crucial to advancing economic growth and helping address problems such as unemployment. The ratio of private capital formation to GDP in sub-Saharan Africa (SSA) floated around 17 percent of GDP between 1965 and 2013. This figure was below the ratios attained in the developing countries of Latin America (20-22 percent) and Asia (27-29 percent) during the same periods. Pfeffermann and Madarassy (1989) had

advocated and recommended that Sub-Saharan African nations needed to boost their private investment to 25 percent in order for them to see the sustained economic growth and economic development. Despite this recommendation, several developing countries have recorded below the 25 percent point and had on many occasions to revise their growth estimates. The SADC countries are amongst the countries that have not achieved this recommended or desired level of private capital formation. The empirical evidence and international comparisons suggest that the ratio of private capital formation to GDP is low in the SADC countries. This is so despite the stabilization, structural adjustment and private sector improving policies adapted and pursued by most SSA countries, including the SADC countries such as Lesotho, Zambia, Zimbabwe, Democratic Republic of Congo (formerly Zaire), Malawi and Tanzania (Jaspersen *et al*, 1995). This is worrisome for two reasons, first due to the notion that private sector capital formation has significantly stronger effect on growth than government investment, many SSA countries have recently diverted their development strategies to the private sector development as an alternative strategy to boost growth, reduce poverty and improve the standards of living of people (Ouattara, 2002). Secondly, official development assistance, which provides the financing for a large share of public investment in Africa, is declining. Perhaps the primary reason for the low level of private capital formation in the Sub-Saharan Africa and SADC in particular, is the perception held by both domestic and foreign investors, that the risk-adjusted rate of return on capital is low.

Most studies on investment/capital formation in the SADC countries seemed only country-specific (of time series nature) and often ignored the contribution or impact of debt on private capital formation. In addition to these shortcomings, the concept of non-reversibility has not been tested in the SADC countries.

1.3 Research questions

The study seeks to answer the following research questions:

1. What is the effect of debt on gross private formation in the SADC countries?
2. How does public capital formation affect private capital formation in the SADC countries?
3. Is PCF nonreversible in the SADC countries?

1.4 Objectives of the study

The overall objective of the study is to use a panel data analysis to estimate the private capital formation model for the SADC region with a view to establish the impact of debt and public capital formation in the region. The study also intends to construct and test the non-reversibility of the model based on the premise attributed to the theory by Houck (1977). This theorem postulates that an endogenous variable depends on changes in both increases and decreases in explanatory variables in the model. This therefore suggests that instead of using just the usual growth rates of variables, new variables are created such that increases and decreases are considered as exogenous variables. This study seeks to differ slightly with the Houck Model, which only considers the main

independent variable as the subject of concern. Houck's (1977) model assumes a single equation with explanatory variables as incremental changes and decrement changes aggregated.

Specifically, the study attempts:

(1) To establish and determine the contributory effect of debt and public capital formation on private capital formation within the SADC countries.

(2) To determine if there is any long run relationship between private capital formation and debt in the SADC countries.

(3) To test the nonreversibility condition on private capital formation model.

Based on the empirical findings, to make relevant policy recommendations intended to promote private capital formation and maximize the crowding-in effects and to minimize the crowding-out effects of demand management policies on private capital formation.

1.5 Contribution of the study

The study's relevance will be justified by the contribution it will have on the literature on factors that affect private capital formation within the SADC region and or the developing countries as a whole. With most studies centred around the developed nations, this study concentrates more on the SADC countries in order to draw some conclusions on the behaviour of private capital formation and the role total debt plays in enhancing or depressing it. The application of the panel data analysis also provides some guidance on how debt and public capital formation affect private capital formation.

1.6 Research Methodology

The theoretical literature on private formation reviewed in this study assists in yielding a well-defined class of models of the accelerator type and brings forward the arguments that among them, the most popular is the neoclassical model associated with Jorgenson (1967, 1971) and Hall (1977). However, it will be shown that no convergence of the views is apparent in the case of the capital formation model between developed and developing countries, such that several variables assumed to explain capital formation behaviour in the SADC countries and or developing countries are robustly explained under variants of the conventional theories of investment. Nevertheless, no formal establishment of the non-reversible model has been conducted in the past, particularly with emphasis placed on demand management policies (Fiscal and Monetary policies) in the SADC countries. This, therefore, becomes the subject of the "conceptual framework" that seeks to provide new evidence on capital formation. Since capital formation or investment cannot be reversed once actioned or used, the government and the private sectors will become concerned with the possibilities of the levels of capital stock being too high in recessions. Due to this, the study then proposes and tests the non-reversibility of the capital formation model for SADC countries.

1.7 Significance of the study

The importance of the study will be justified by the relevant contribution to the literature and possibly the policy in various ways. Since the study considers both the fiscal and monetary policy variables in its execution, the results will have the

impact of such demand management policies. The inclusion of variables such as polity as a proxy for democracy in the private investment model will highlight the importance of democracy in enhancing investment in the SADC countries. The study uses the panel analysis for the SADC bloc and this will have implications for country level economic development policies. The study uses the data for the entire period that the bloc has existed (1980 – 2015), including the latest data points of the variables used. The application of the panel analysis also helps capture the geographical, cultural and institutional differences on the coefficients in the capital formation. Finally, the study moves away from using the traditional growth rates as independent variables but will attempt to classify such rates into increases and decreases and determine the influence of each variable on private capital formation. The non-reversibility concept has not been tested on capital formation, especially within the panel analysis and the study of this nature will contribute significantly to literature, particularly within the developing countries such as the SADC region.

1.8 Limitations of the study

This study utilises the annual time series data for the period spanning 1980 to 2015 and the period chosen is subject to data availability. The major challenge with the use of secondary data is the quality and reliability of such data. This is grounded on the fact that SADC countries as developing may have data sets available that are either inaccurate or sometimes inconsistent, thus varying between sources. The interpretation, credibility and degree of reliability as well as policy

recommendations drawn from the regression results is done carefully with these limitations taken into account.

1.9 Outline of study

This study is organized into six chapters. Chapter 1 provides an introduction and background to the study and introduces the research problem. This chapter is also devoted to the specification of the aims and objectives, the importance and contribution of the study and justification, as well as the policy relevance of the study to SADC region. Chapter 2 provides the background to the SADC bloc, with the aim of providing some macroeconomic developments, investments trends, macroeconomic policy history, and the current policy stance. All these assist in capturing some relevant features of the regional bloc and in understanding some relevant policy variables to be included in the specification of the empirical model to use in the study.

Chapter 3, divided into theoretical and empirical literature review, presents central theoretical foundations on private capital formation. Thus, conventional theories of capital formation and or investment, and variants of such theories intended for developing countries are elaborated in this chapter. The essence of this chapter is to assess theoretically and empirically various determinants of private capital formation in both developed and developing countries, and to capture the influence of policy variables on private investment on the basis of various studies carried out by other researchers on this field. Thus, the literature review in its entirety assists

in blending various variables that are suitable for inclusion in the specification of the variant of the empirical model used in this study. Finally, this chapter presents as well the synthesis of the literature reviewed.

The research methodology is presented in chapter 4 and the empirical model is specified and presented in this chapter as well. This chapter follows directly and draws heavily from the literature discussed in chapter three as well as consideration of the background of the region presented in chapter 2. This chapter also discusses in detail the estimation technique adapted in this study, not leaving out some *a priori* expectations and expected signs of parameters of the model and the method of data collection and analysis. The time series properties of data are also discussed in this chapter.

The actual data analysis; estimation, presentation and economic interpretation of the results are provided in chapter 5. Finally, the summary of the findings, conclusion and policy recommendations are provided in chapter 6.

Chapter 2

MACROECONOMIC BACKGROUND OF THE SADC COUNTRIES

2.0 Introduction

This chapter is intended to provide a brief background of the SADC region and the performance since the establishment of the bloc with a view to highlight the major elements and state of the region and policy developments over the period under consideration. The background is presented in two sections. Section 2.1 centres on the general overview of the SADC region, the historical background of the bloc and the regional economic agenda. Performance and economic trends, and general economic indicators are discussed in section 2.2.

2.1 An Overview of the SADC countries

The Southern African Development Co-ordination Conference (SADCC) dates back from the mid-1970s when the Frontline States (Lesotho, Botswana, Mozambique, Angola, Swaziland, Tanzania and Zambia) convened in July 1979 and formed what was known as SADCC. It was only in April 1980 that the bloc was officially formed. The bloc was then formalised by means of a Memorandum of Understanding (MoU). The main aim of the bloc was to reduce the economic dependence on South Africa and encourage internal economic development. In 1989 the heads of state decided that SADCC should be given an appropriate status and the MoU be replaced with Charter or Treaty (SADC, 2015). Namibia also joined in 1990 after it had gained independence from South Africa. In August

1992 the Heads of State signed the SADC Declaration and Treaty and the name was changed from SADCC to being the Southern African Development Community (SADC). The name change was followed by the new objective which included regional economic integration and after this name change, the objective then included economic integration The main focus of this economic bloc was to strengthen integration of economic development and reduce dependence on other countries, particularly South Africa. The other principal objectives include forging linkages between member states to create genuine and equitable regional integration and to mobilize member states' resources to promote the implementation of interstate, national and regional economic policies (SADC 1998).

The next countries to join the group after Namibia in the 1990s are South Africa [1994], Mauritius [1995], Democratic Republic of Congo and Seychelles [1998] to complete a 14 nations bloc. It was only in 2005 that Madagascar was admitted to be the 15th member. The now known SADC regional bloc comprises of a 15 member states, namely; Angola, Botswana, Democratic Republic of Congo (DRC), Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe. The mixture of economic and political practices lends itself to an analysis of growth patterns since the 1980s. In addition, the SADC countries address the issues surrounding gender, science and technology in the region, environment and sustainable development,

strives to promote the role of the private sector through wealth creation and employment generation in order to alleviate poverty.

The bloc's Regional Indicative Strategic Development Plan (RISDP) adopted in 2003 outlined a number of macroeconomic convergence targets and these are summarised in table 2.1 below.

Table 2.1:SADC macroeconomic convergence targets

Macroeconomic variable ↓ Year →	2008	2012	2018
Fiscal deficit	5% (GDP)	3% (GDP)	3% (GDP)
Public debt	60% (GDP)	60% (GDP)	60% (GDP)
Current account deficit	9% (GDP)	9% (GDP)	3% (GDP)
Inflation rate	Single digits	5%	3%

Source: SADC RISDP, Burgess (2009)

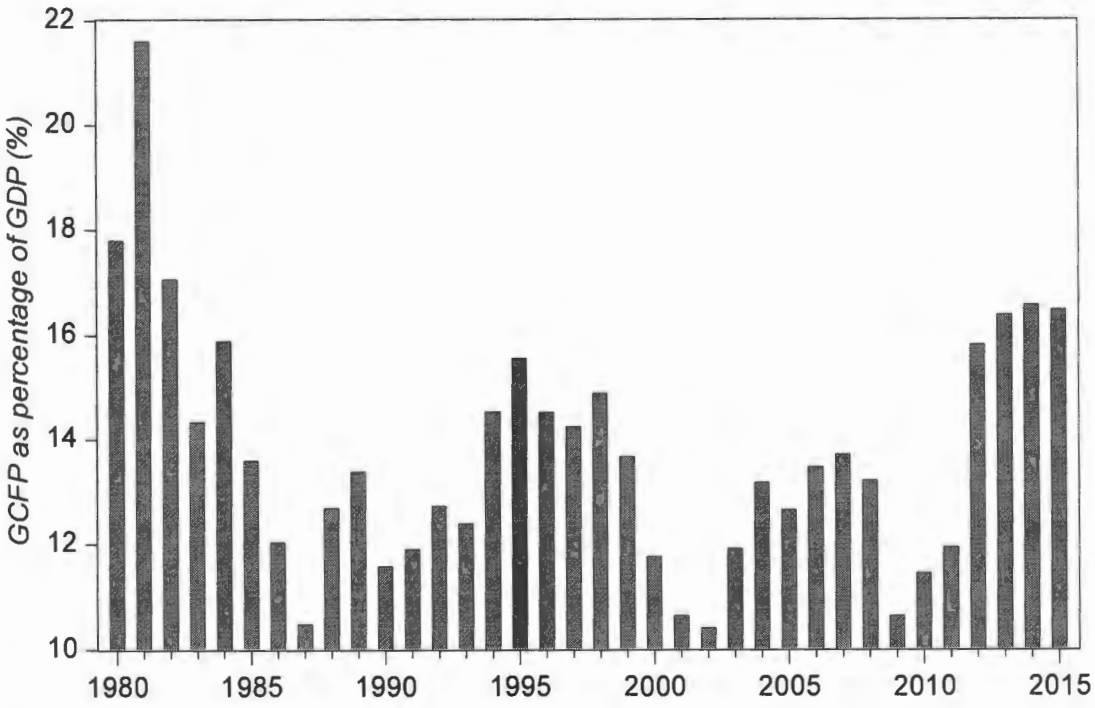
The statistics on table 2.1 depicts the mandated figures for all the SADC nations. The performance of these nations will be presented in the next section.

2.2 Economic performance and historical trends in the SADC region

The data on the SADC countries shows wide differences in performance, with other countries performing poorly while others recorded some favourable growths. These countries can be classified into lower income, lower middle income, upper-middle income as well as the high income countries. The low income countries are DRC, Madagascar, Malawi, Mozambique, Tanzania and Zimbabwe and the lower-

middle income countries include Lesotho, Swaziland and Zambia. The upper-middle income nations in the SADC region are Angola, Botswana, Mauritius, South Africa and Namibia. The only country to be among the high-income economics is Seychelles with a minimum of gross national income per capita of $12,736. Private capital formation in the region (SADC region) has been fluctuating between 10 percent and 22 percent since the establishment of the regional bloc, with the highest record at 21.6 percent. Figure 2.1 below shows the trends of gross capital formation for the private sector within the SADC economies.

Figure 2.1:Gross Private Capital formation of private sector

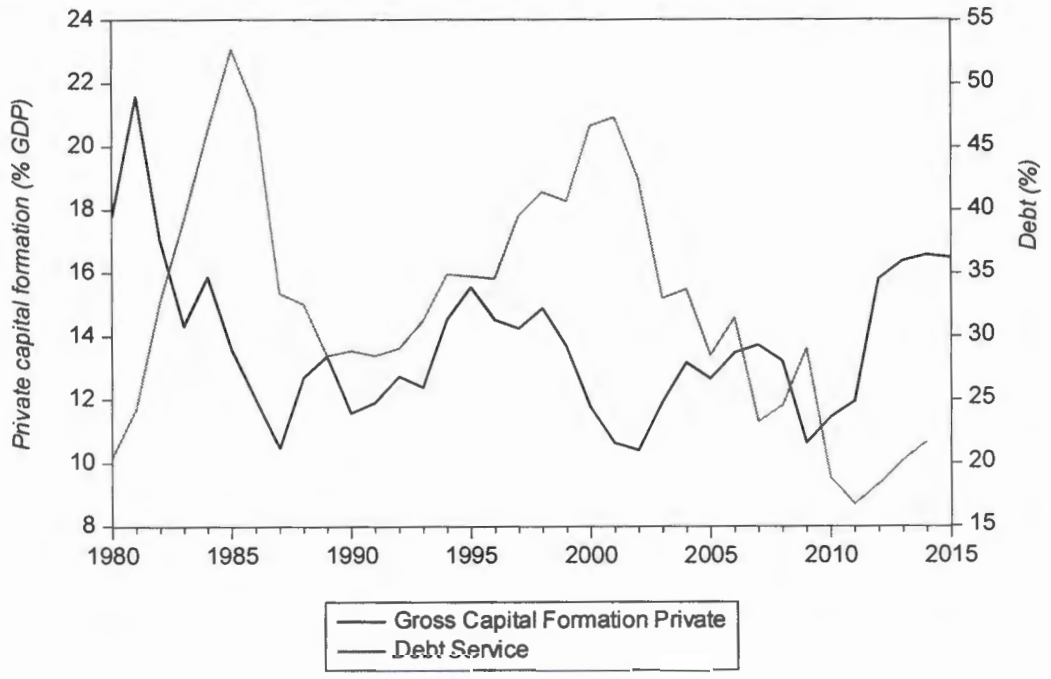


Source: African Development Bank

Figure 2.1 above shows the trends in gross private capital formation for the SADC over the sample period 1980 – 2015. It is observed that gross private capital

formation (GPCF) has been showing a downward trend from 1981 to 1983. In 1984 an increase of 1.55% from the previous 14.33 was recorded while the following year (1985) saw a decline of about 2.3% and a further decrease in 1986 and 1987. The figure shows that on average the SADC countries have been experiencing a decrease in the gross private capital formation between 1980 to 2015, with the lowest figure of 10.4% recorded in 2002. Overall the SADC region has recorded a decreasing GPCF since the establishment of this inter-governmental organisation, with GPCF falling by approximately 3 percent in the first three decades of its establishment. The 1980s saw a 15% of GPCF, and about 12% between 2000 and 2010. The historical pattern of the private capital formation has been much similar to the debt pattern except that the two were moving opposite directions. Figure 2.2 depicts the trends between the two variables.

Figure 2.2:Gross private capital formation and debt service



From Figure 2.2 above it can evidently be noted that when debt service increases, private capital formation decreases and vice versa. This, by looking at the figure suggests a negative relationship between private capital formation and debt service within the SADC region but the extent through which debt affects capital formation cannot be drawn from the graphs or figures. While structural rigidities and other geographical positions are still considered major inhibition to economic growth and economic development, some noteworthy improvements, though inconsistent, were observed in the economic performance between 1996 and 2008 and after 2010. The region's economic growth began recovering in the mid-1990s (see Table 2.2 which gives a summary of the selected macroeconomic indicators of the SADC group). The 1990s began with a growth rate of 0.2984 and a contraction of 0.728 percent, before improving and reaching a peak of 5.457 percent in 1996. Notable improvements were observed with the inflation rate falling from 18.6 per cent in 1981 to 7.6 in 2000. Fiscal discipline has always been problematic since 1980, except for 2006 and 2007 when some budget surpluses were observed. Nevertheless, some progressive improvements in the fiscal position were observed, and this led debt burden remaining at relatively low levels with debt service ratio of less than 35% in the entire period, except for years 1984 and 2000 (See Table 2.2 below).

Table 2.2:The selected Macroeconomic Indicators for SADC (Percentages)

Macroeconomic Indicator	**1980**	**1984**	**1988**	**1992**	**1996**	**2000**	**2004**	**2008**	**2012**	**2014**
Real GDP	6.05	4.48	4.71	-2.13	5.46	4.85	5.41	5.36	3.64	4.18
CPI: Inflation	12.6	14.2	16	8.7	18.6	7.6	9.0	9.3	5.8	8.5
Gross- savings	33.39	25.26	25.17	14.16	19.46	17.88	17.59	22.23	20.18	20.33
Gross C. Formation	24.32	21.28	18.64	17.25	18.53	16.56	18.20	22.12	21.58	22.52
▪ *Private sector*	17.78	15.88	12.69	12.73	14.53	11.76	13.18	13.21	15.82	16.58
▪ *public*	6.54	5.40	5.95	4.52	4.00	4.80	5.05	8.91	5.76	5.94
Fiscal Balance	-2.88	-5.55	-5.17	-7.61	-3.84	-2.15	-1.75	-1.74	-2.28	-2.99
Current A/C	0.081	-3.11	0.62	-0.73	-1.40	-0.43	-2.67	-4.12	-4.33	-4.76
balance	29.20	38.90	40.89	51.39	52.93	49.49	47.69	47.62	69.68	68.96
Total Debt to GDP	20.51	46.19	32.56	29.06	34.59	46.68	33.73	24.55	18.33	21.70
Debt Service Ratio										

Source: AfDB, IMF, WEO
***Note**:Gross C. Formation = gross capital formation*

Table 2.2 confirms that gross capital formation has been on a decline since the first decade of the establishment of the bloc (1980s). It declined from 24.32 percent in 1980 to 21.28 percent in 1984. Remarkably, the contribution of private capital formation to gross capital formation accounts for much of the decline, from 17.78 percent in 1980 to 11.76 percent in 2000. Although private capital formation has been decreasing, this does not correspond with a fall in government investment. Table 2.3 outlines the real gross domestic product (GDP) and the private capital formation as percentage of GDP for each individual SADC country as well as the SADC group.

Table 2.3:Economic growth and private capital formation for SADC countries

	1980 – 1989		1990 – 1999		2000 – 2009		2010 – 2015	
	RGDP(%)	PCF	RGDP(%)	PCF	RGDP(%)	PCF	RGDP(%)	PCF
Angola	2.495	13.445	2.499	26.363	12.251	4.461	5.112	1.910
Botswana	11.219	20.306	6.028	18.326	4.318	19.115	5.075	27.174
Lesotho	4.337	25.088	4.011	40.810	2.657	21.320	4.337	17.181
Madagascar	0.304	0.648	1.620	5.446	3.188	16.345	2.425	12.947
Malawi	1.871	8.876	4.147	8.192	4.128	12.520	5.481	13.614
Mauritius	4.929	16.451	5.111	20.038	4.474	17.431	3.851	19.464
Mozambique	0.444	5.475	3.345	11.024	8.803	8.907	7.473	27.092
Namibia	0.000	6.235	4.165	13.246	5.847	15.093	5.017	17.784
Swaziland	8.147	7.223	3.756	9.291	3.318	9.570	0.518	5.326
South Africa	1.748	15.853	1.394	12.636	3.664	12.750	2.871	15.787
Zambia	1.211	11.059	0.371	7.721	5.217	14.384	6.681	25.596
Zimbabwe	4.200	7.432	2.138	17.878	-8.700	6.735	6.649	20.998
Tanzania	2.928	14.599	3.135	12.208	8.048	15.970	6.916	28.640
Seychelles	3.254	12.127	4.865	13.896	4.120	26.546	4.091	26.916
Congo, DR.	1.534	25.737	-5.469	18.825	3.616	10.423	7.999	16.661
SADC	**2.043**	**14.886**	**1.658**	**13.605**	**4.799**	**12.161**	**4.021**	**14.781**

Source: African Development Bank

RGDP = real gross domestic product , PCF = capital formation by private sector

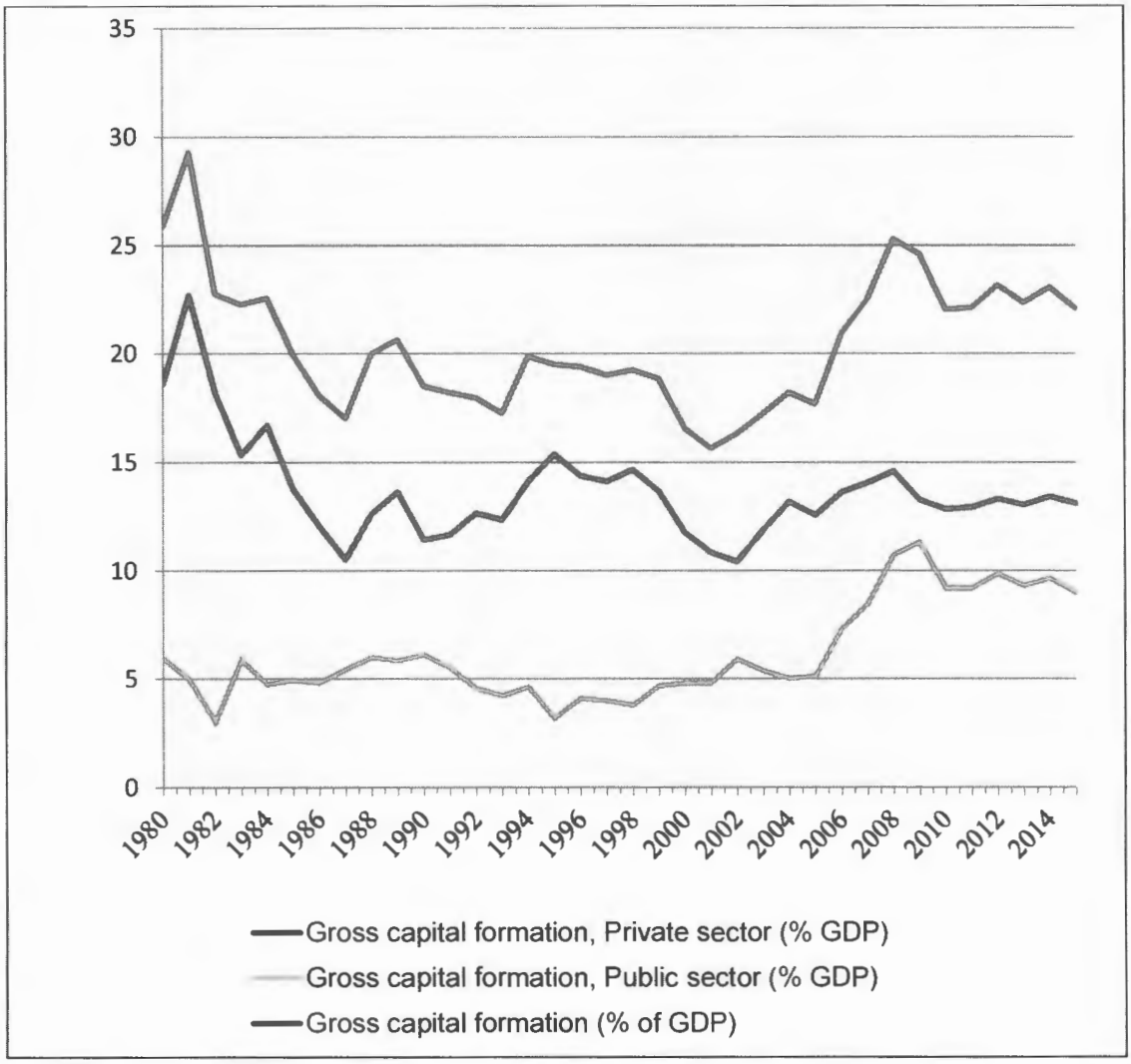
There are indications that economic growth has been stagnant for most nations, in the first two decades, while at the same time private capital formation was at its highest. This however changed in the subsequent decade with private capital formation starting to show decreases. The statistics for individual countries seem to reveal that capital formation increased with positive changes in GDP but at

group level both the private capital formation and real economic growth were low. The variations in economic performance could be attributed to a number of factors at individual level such as poor policy decisions, internal factions such as regional peace and infrastructure.

2.2.1 Capital formation and public capital formation

It is widely expected that public capital formation will increase capital formation of the private sector. Figure 2.3 below depicts the trend in both the public and private capital formation from 1980 to 2015. It is not clearly visible from graphs if public capital formation and private capital formation exert positive relationship. Public capital formation has been hovering around about 5 percent of GDP between 1980 and 2005, after which it increased to over 10 percent in year 2008.

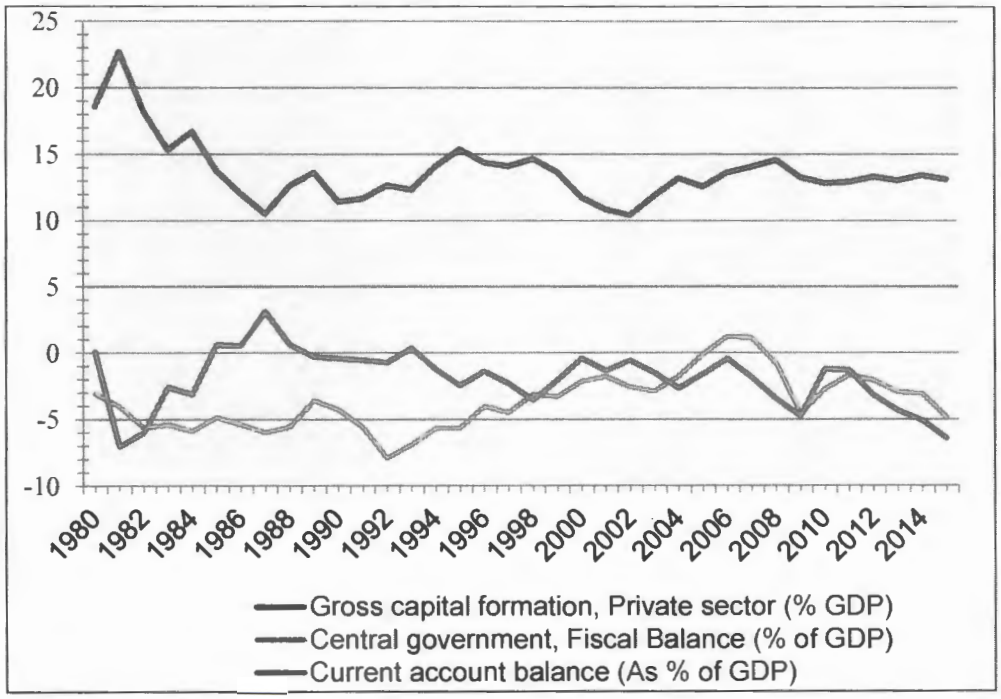
Figure 2.3: Historic patterns of SADC's private and public capital formation



A fall in gross capital formation could be due to falling trends of public expenditure, which might have also incited a decline in private capital formation between the years 1981 and 2003. Private capital formation also shows a declining trend within the same period and this is worrisome especially if the private sector is to be an engine of economic growth in the SADC region. Other factors that could be leading to such falling patterns in private capital formation are the fiscal and current

account balances. For most periods of the analysis, the SADC nations have been experiencing the twin-deficit hypothesis. See figure 2.4 below.

Figure 2.4: Private capital formation, fiscal and current account balance



The current account balance seems to have a negative relationship with private capital formation based on figure 2.4. The CAB declined in 1981 and at the same time private capital formation increased to about 23 percent. An improvement was realised in 1982 through 1986 where a trade surplus was recorded. Overall, the relationship between these variables is to be determined I this study.

2.3 Summary and Conclusion

The background to the SADC bloc has highlighted some features of the region ranging from its structural framework to the historical, as well as the policy stance. It has delineated that there has been declining trends in the overall capital

formation coupled with increasing economic debt. The fall in private capital formation is attributed to several factors, including the low interest rates, low public capital formation and slow economic growth. The policy history and stance demonstrated several structural rigidities, which were tackled by macroeconomic policy, although, no analysis of the policy impacts on real variables in the region is given or was done before using the panel analysis. The decline in private capital formation could be attributed to any policy changes inherent in the individual. It is on this background that this paper relies, so to identify some of the relevant variables to include in the variant of the private capital formation model to adapt in order to capture the impact of the macroeconomic policy, particularly the effects of economic debt and public capital formation on private capital formation for the period under consideration.

Chapter 3

LITERATURE REVIEW

3.0 Introduction

This chapter discusses some fundamental theoretical foundations on private capital formation. The first section of this chapter gives a synopsis of some conventional theories of investment and then presents variants of such models. The relationship between macroeconomic policies as determinants of investment is touched upon in the second section. Other determinants of private capital formation are reviewed in the same section, with emphasis laid on factors of private capital formation in the SADC countries. Section three presents the empirical evidence between private capital formation and macroeconomic variables, with special attention given to studies that are relevant to the current study. The final section curtails the theory and empirical literature reviewed in the previous two sections and presents some synthesis of such literature.

3.1 Theoretical Literature

This section discusses some theories of investment relevant to this study and explores how the respective variables enter the model or regression equation and help in determining the main factors that drive private capital formation.

3.1.1 Conventional Theories of Investment

The empirical analysis of investment behaviour follows from a number of theoretical models proposed within various schools of thought. Most of the analyses based on these orthodox theoretical models were done for industrialised and developed countries. Even though these theoretical models distinguished a set of various factors determining firms' investment decisions for developed countries, when adopted in developing nations such as the Sub-Saharan Africa (SSA) countries in their original forms, many theoretical and empirical problems arose. These problems were essentially related to the peculiar characteristics of institutions, markets, and technologies in these countries. The realisations of these pertinent problems gave birth to numerous variants of such models in order to suit developing countries, and identify and quantify the relevant determinants of private investment, as well as to close the gap between pure investment theory and the unique structural and institutional characteristics of developing nations (see for example McKinnon and Shaw 1973; Sundararajan and Thakur, 1980). These variants and empirical query synthesised a new basis which presents a new set of forces that were overlooked in the orthodox theories of investment, while arguing for the importance of orthodox factors such as economic growth, prices and the rate of interest (Badawi, 2004). In the following sections, the study presents the orthodox theories and different models that have been applied in previous studies, particularly those aimed at developing countries.

3.1.2 Keynesian Theory of Investment

Keynesian theory of Investment was propounded by Keynes (1936) and suggested that nations should have independent investment functions. The main characteristic of the Keynesian investment model was an observation that, investment and savings decision in the firm are taken by different decision makers and therefore there is no reason why ex-ante investment should be equivalent to ex-ante investment. In a Keynesian investment framework, marginal efficiency of capital is found to be very crucial in determining investment and this criteria traces investment from a profit maximization behaviour of firms. Keynes however disagreed that investment is primarily a function of interest rates but rather shows that even if interest rates are very low, investment spending by firms may not increase. Thus private investment is determined by expectations about future profits and only slightly by the level of interest rate. Therefore, when the economy is in trouble, even if the central bank succeeds in reducing interest rates, the businesses may be so pessimistic that they may not boost investment spending (Keynes, 1936). By emphasizing the role of uncertainty, Keynes implied that firms and political stability will stimulate investment.

3.1.3 Accelerator Theory of Investment

The accelerator model is based on the premise that investment depends solely on the fixed capital/output ratio. This theory of investment finds its roots in the work of Carver (1903), Aftalion (1909), Bickerdike (1914) and Clark (1917). This theory posits that investment reacts directly to different demand conditions in that the

excess demand will induce firms to either increase prices or to meet that demand by raising supply. Clark (1917), however argues that, in more Keynesian perspectives, quantity adjustment takes precedence. Therefore in order to meet higher demand, a firm will increase its output capacity by investing in plant and equipment provided that it has been operating at full capacity (Clark, 1917; Tinbergen, 1939; Manne, 1946). The accelerator theory of investment defines capital stock K_t^* as a fixed proportion of output. This can be written as:

$$K_t^* = \phi Y_t \qquad (3.1)$$

where ϕ denotes the fixed capital/output ratio. But since the capital stock is always optimally adjusted, this implies that $K_t^* = K_t$, investment at period t will be given by:

$$I_t = K_t - K_{t-1} = Y_t - Y_{t-1} \qquad (3.2)$$

where Y_t is the aggregate demand, K_t : capital stock and I_t represents investment at period t and Y_{t-1} is the previous level of aggregate demand and K_{t-1} is preious level of capital stock. This theory is also known as the Naïve Accelerator Theory of Investment (NATI).

3.1.4 The Flexible Accelerator Model of investment

Nevertheless, the assumption of full capacity and rapid adjustment underlying the NATI were revised, and a new model of investment known as the flexible accelerator model (FAM) or capacity utilisation model (CUM) was advocated by Clack (1917). This model was later developed by Chenery (1952) and Koyck (1954) and it argues for the time structure of investment process. In this model, the desired level of capital is determined by long run considerations and the

consideration of demand shocks, which however, are not all permanent. Therefore, changes in the desired capital are transformed gradually into actual investment expenditures by a geometric distributed lag function. Thus when gap between the existing capital stock and the desired capital stock is huge, firms will experience high level of capital formation. The hypothesis of this model is that firms attempt minimise the gap between the desired level of capital stock, K^* and the actual capital stock, K. This gives rise to investment equation of the form:

$$K_t - K_{t-1} = (1-\lambda)[K_t^* - K_{t-1}]. \qquad (3.3)$$

Where K_t = investment at present period, K_{t-1} = desired level of capital stock over the past several period.

Alternatively equation 3.3 can be expressed as follows:

$$I_t = \delta(K_t^* - K_{t-1}) \qquad (3.4)$$

or $I_t = \delta(Y_t^* - Y_{t-1})$ (3.5)

where $I_t = K_t - K_{t-1}$ and $Y_t^* - Y_{t-1}$ = $K_t^* - K_{t-1}$, $\delta = (1-\lambda)$ denotes the co-efficient of adjustment and $0 \prec \lambda \prec 1$ and Y is aggregate demand.

For that reason, within the framework of FA model of investment, economic output, internal funds, cost of external funds and other variables may be included as factors of K* (Yaw,2000). On the other hand, this model was criticised for overlooking the effect that interest rates might have on investment and other weaknesses of conventional models. Therefore, these critiques of the model led to the development of the neo classical theory of investment.

3.1.5 The Neoclassical Theory of Investment

Jorgensen (1963) was not comfortable with the flexible accelerator model of investment and as a result proposed a different investment theory. In this theory of investment, Jorgenson (1963,1967,1971), postulate that investment or desired level/optimal capital stock, could be stimulated, in addition to changes in output, by the user cost of capital. Although this model has been generalised in a number of ways during the estimation process, Jorgenson had initially proposed the following specification:

$$I_{net} = \sum_{j=0}^{\infty} \alpha\phi_j (P.Y / C)_{t-j} + \delta.K_{t-1} \qquad (3.6)$$

where I_{net} = net investment, Y= output level, C= user cost of capital, K_{t-1} = previous level of capital stock and α, ϕ and δ are parameters to be estimated. This investment theory, like the previous orthodox theories presented in the earlier sections seemed to have deficiencies in the form of not incorporating macroeconomic variables that may influence net investment. As a result, more theories were developed.

3.1.6 Cash Flow Theory of Investment

Another conventional theory is the cash flow investment theory which was promulgated by Meyer and Kuh (1957) and protracted in the works of Duesenberry (1958); Grunfeld (1960); Eisner (1963). This theory emphasises the role that retained earnings (profit) by firms play in influencing investment. This theory asserts that retained earnings are a major incentive for private investment. The

model is built on the assumption that external funds are preferred over the internal funds and therefore argues for the inclusion of profits or expected profits in determining investment outlays of firms. Grunfeld (1960), assumed that optimal capital stock is a linear function of expected profits, as proxied by market value of the firm, V_t:

$$K_t^* = \alpha + \beta V_t \qquad (3.7)$$

Substituting equation 3.7 in the general framework given by equation 3.8 Grunfeld (1960) obtained an investment equation (3.10) with an intercept term and V_t replacing Y_t.

$$I_t = \lambda_t (K_t^* - K_{t-1}) + \delta K_{t-1} = \lambda_t K_t^* + (\delta - \lambda_t) K_{t-1} \qquad (3.8)$$

$$I_t = \lambda\alpha + \lambda\beta V_t + (\delta - \lambda) K_{t-1} \qquad (3.9)$$

where I_t = net investment, K_t^* = desired level of capital stock, K_{t-1} = level of capital stock at time t-1, V_t = market value of the firm, δ = speed of adjustment coefficient.

This suggests that according to cash flow model of investment, a firm first commits its profit to financing its capital formation. In empirical evaluation of this model, a distributed lag of cash flow is specified, for instance, the general form of an empirical model employed by Kopcke (1985) is given as:

$$I_t = \alpha + \sum_{i=0}^{m-1} \beta (F/J)_{t-1} + \phi K_{t-1} + \mu \qquad (3.10)$$

where α, β, and ϕ are the unknown parameters to be estimated. F= internal cash flow in current prices and J = price index for new capital.

3.1.7 Tobin *q* Theory of Investment

The firm's investment decisions are not only determined within the firm's operations but it is also open to some external factors (financial) in the form of capital markets valuation of the firm's assets relative to the depreciation. Brainard and Tobin (1968) and Tobin (1969) developed what is popularly known as the Tobin's *q* theory of investment, which transmits the effect of changes in the capital and financial markets on investment by the private sector. Thus Tobin *q* theory generalizes the cash flow theory of investment and compliments the accelerator theory (Sundararajan and Thakur 1980:825; Hayashi 1982), and therefore, provides the framework for an investment model in which net investment depends on the ratio of the market value of business capital assets to their replacement value. Thus whenever marginal *q* is greater than unity, there are incentives for net investment in plant and equipment (capital formation). Such reasoning has led to the specification of investment equation of the form:

$$I_t = \beta + \sum_{j=0}^{m-1} \lambda (q-1)_{t-j} K_{t-j-1} + \phi_k K_{t-1} + \mu_t \qquad (3.11)$$

where I_t= net investment, K_t = market value of the firm and q = Tobin "q" as defined above and the rest are parameters to be estimated. However, it has been observed in empirical literature that aggregate investment does not always respond to changes in market value consistent with the simple *q* theory.

3.1.8 Theory of Investment under uncertainty

The previously mentioned theories of investment behaviour had assumed that the determinants of investment are known with certainty. Nevertheless, this is often not the case as some studies (Hartman, 1972; Abel, 1983; Bernanke, 1983; Dixit, 1989; Huizinga, 1993) have introduced uncertainty in an attempt to further expound the determinants of private investment. According to these studies, firms are not aware of the orthodox variables and as a result attempt to maximise expected profits. Deliberations on the vagueness highlight how the firms choose their optimal capital stock and how this selected optimal stock is influenced by changes in the degree of uncertainty about future prospects.

3.1.9 Variants of the conventional theories of investment

Variants of these theories therefore, have been proposed by different studies which applied such studies to suit various circumstances in developing nations. Bhattacharya *et al*, (2004), Fazzari and Petersen (1988), King and Levine (1993), Tybout (1993), and Wai and Wong, (1982), Acosta and Loza (2005) in their variant of the neoclassical theory of investment, propose inclusion of the financial sector credit and the size of the financial intermediation as some of the important factors that determine private investment. Within this context, interest rates can be regarded as transmission mechanism through which bad borrowers are separated from the good ones is a reflection of capital scarcity. However, Stiglitz and Weiss (1981) oppose this circumstantial confine of interest rates, arguing that some

fraction of borrowers is credit rationed despite some credit being relevant for investment equations.

Another important factor introduced in the variants of conventional theories of investment when dealing with developing countries, is government or public sector investment. This basically was due to recognition of sizable government and public enterprises in less developed countries (LDCs). A large volume of empirical literature has explored the impacts of government expenditures on private capital formation, mainly for developing nations, (see Badawi, 2004; Bejer and Khan, 1984; Chibber and Van Wijnbergen, 1988; Galbis, 1979; Sundararajan and Thukur, 1980; Yaw, 2000; Ouattara, 2002; Moshi and Kilindo, 1999. While crowding-out effect seems possible in countries marked by the state participation in various economic activities, generalisation of such results is tedious. This is due to lack of clear-cut empirical evidence, which appears to be mixed and country specific, for instance, in their comparative study for India and Korea, Sundararajan and Thukur (1980), provide conflicting scenarios. Their results suggest a negative long-run effect for India and a positive effect for Korea. In some countries, public capital formation proved to be crucial in removing the impediments and enhance private sector development and growth, thereby supporting the complementarity hypothesis (see Shifik (1990) for Egypt, Ermisch and Huff (1999) for Singapore, and Wai and Wong (1982) for Greece).

Dooley, (1986); Iyoha, (2000); and Sach, (1990), extend the set of external constraints to private capital formation in developing countries. These studies

included among the explanatory variables in the variants of investment, the nation's indebtedness (measured as a percentage of GDP). The essence of doing so was to determine if rising debt and service "overhang" discourages private initiatives and hinders productivity growth and the prospects for future economic growth.

3.2 Fiscal Policy and Private Capital Formation

Much of the traditional discussion of fiscal policy centres on public sector deficit, debt and government expenditure and, the importance of the fiscal authority to issue debt rather than utilize contemporaneous taxes to cover a particular level of expenditure are believed to have a variety of effects on the private sector (Eisner, 1986). Fiscal policy can affect private investment through three channels: public investment, budget deficits and user cost of capital.

High fiscal deficits push interest rates up or reduce the availability of credit to the private sector. This may crowd out private investment. Hence a reduction of the public deficit should allow private investment to expand. The reduction of public debt also during the adjustment period should also allow private investment to expand. When public capital is a close substitute for private capital, an increase in public investment can lower private investment by lowering the rate of return. However public investment could be in activities that do attract private investment. When there is complementarity between public and private investment, an increase in public investment can raise private investment.

Similarly, when the financial sector is repressed and the public sector has preferential access to credits, public investment may crowd out private investment. When interest rates are not regulated, large budget deficits, financed through domestic borrowing, can raise the real interest rates and lower private investment by raising the user cost of capital.

3.3 Debt and Capital Formation

Excessive debt, both public and private can lead to debt overhang and the effect of such debt can discourage capital formation. The debt overhang hypothesis posits that if a country's debt exceeds its repayment ability in the future, expected debt service is likely to be an overhang function of the country's output level. Consequently some of the returns from investing in the domestic economy are effectively taxed away by existing foreign creditors and investment by domestic and new foreign creditors is discouraged (Claessens, 1996). This implies that low debt will eventually lead to increased investment. However, the mechanism through which, debt overhang discourages private investment depends on how government is expected to raise the fiscal revenue needed to finance external debt service, thereby creating uncertainty among private investors. This uncertainty ultimately leads to a reduced capital formation as the investors are risk averse. Sachs (1989b) had the same view with Claessens (1996) about the contributory effect of debt on investment.

3.4 Monetary Policy and Private Capital Formation

The connection between monetary policy variables and private capital formation dates back from 1930s from the works of Schumpeter (1934) as well as Keynes (1936). These studies argue for the role of credit in the development process. Schumpeter (1934) claims that development is only possible if innovative entrepreneurs get credit to invest, that is, what is necessary is new credit created by the banking system with the help of central banks, while Keynes (1936) sees commercial banks as necessary "circuits starters" for investment and production (Bossone and Abdourahmane, 2002). There are three channels through which monetary policy variables can affect private investment or private capital formation and these are the credit, interest rate and the money supply channels.

In recent literature, the credit channel effect on private investment is addressed within the framework of financial repression hypothesis. Galbis (1979) emphasizes the importance of high interest (deposit) rates that would induce savings, thereby enhancing loaning capacity of the financial intermediaries (increased credit), which would then stimulate investment and growth. The emphasis in both the complementarity and debt-intermediation hypotheses is in the use of high interest rates to increase investment either through own funds or in part through credit borrowing. McKinnon (1973) and Shaw (1973) hypothesis advocates that private capital formation cannot be affected by neither credit channel nor low interest rates. Stiglitz and Wiess (1992) however argue that even if there are no laws or government restrictions, banks can still supply credit and that the high interest

rates may lead to a distorted credit allocation as good debtors drop out and risk prone debtors are selected.

3.5 Empirical Literature Review

A number of studies have attempted to assess empirically the link between private capital formation and its determinants in both developed and developing countries. Although, the empirical results vary from one study to another, in other cases general conclusions are drawn. A group of studies focused on the link between total public investment (as a proxy for fiscal policy) and private capital formation, using both individual-country based regressions (in some cases based on cointegration techniques) and dynamic panel regressions. The most recent of these, to name but a few, are the studies by Kukeli (2012), Moore (2010), Waheed (2015), Cann-Tamakloe (2008), Frimpong and Marbuah (2010), Xu and Yan (2014), Chibuye (2013) Bayai and Nyangara (2013), Akkina and Celebi (2002), Apergis (2000), Erenburg (1995), Laopodis (2001), Dhumale (2000), Ramirez (2000), and Narayan (2004). For instance, Apergis (2000), using cointegration techniques, found that the relationship between public and private investment in Greece was positive during the period 1948-80 but negative during the period 1981-86. The latter sample coincided with a period during which the share of public investment in total investment increased sharply. In a study of 8 Latin American countries during the period 1980-95, Ramirez (2000) found that public investment had a positive effect on private capital formation, suggesting a "crowding in" effect. A similar conclusion was reached by Narayan (2004), using a bivariate VAR framework established that public and private investment were a long-run

relationship in Fiji during the period 1950 – 1975 and that a 1 percent increase in government investment led to an increase in private investment of between 1.1 and 1.6 percent.

Panel studies focusing on the same link, include Ghura and Goodwin (2000), Miller and Tsoukis (2001), and Everhart and Sumlinski (2001). For stance, Ghura and Goodwin (2000), using a panel regression techniques, studied the determinants of private investment in a group of 31 countries in Asia, Latin America, and Sub-Saharan Africa. They found that, while total public investment had a positive and significant impact on private capital formation in Sub-Saharan Africa; it had the opposite effect in Asia and Latin America. Similar results were obtained by Everhart and Sumlinski (2001), using a broader sample.

Another group of studies have attempted to quantify the effects of various components of public investment on private capital formation. A first set of contribution in that literature has focused on the effects of changes in public capital in infrastructure on factor demand and output (thus indirectly on private investment, assuming that the accelerator effect is sufficiently strong). For instance, Demetriades and Mamuneas (2000) found that public infrastructure capital has a significant and positive effect on demand for private inputs and supply of output in a sample of 12 industrialized countries. The elasticity of output with respect to public capital ranged from 0.4 for the United Kingdom and to about 2 for Norway, with estimates of about 1 for the United States and 0.5 for Japan.

A second set of contributions has focused more directly on the effects of components of public investment on private capital formation. Ahmed and Miller (2000), using a sample of 39 industrial and developing countries for the period 1975-84, found that expenditures on social security and welfare reduce private investment (through crowding out effects) in both groups of countries, whereas expenditure on transport and communication raised aggregate investment in developing countries. In their study focusing on Latin America, Calderon and Serven (2002) argued that lack of investment infrastructure (most notably roads, telecommunications, and power generation capacity) relative to other developing regions during the past two decades had an adverse effect on productivity, production costs, and investment by private sector, and a dampened output growth in the region. Pereira (2000), using the breakdown of public investment in core infrastructure, found in United States that all types of public investment have a positive and significant effect on private capital formation.

However, most of these results, based on either individual-country or dynamic panel regressions, suffer from two fundamental limitations. First, they do not account for the simultaneous interaction between public investment, private investment and other variables such as real interest rate and exchange rate. Second and related to the first point, they do not account for government budget constraint, which depends on how increase in public spending is financed. Therefore they provide unreliable estimates of the impact of fiscal policy (measured by government expenditure) on private capital formation.

In so far as the impact of debt on private capital formation is concerned, most empirical findings suggest that more of debt variables are significant and negatively correlated to private capital formation. Waheed (2015) investigated the determinants of private investment for Pakistan and the results revealed that the rate of interest had a significant negative effect on private investment. The study also established the validity of crowding in hypothesis. Elbadawi, *et al* (1996), investigated the effect of debt overhang on private investment hence growth, using a cross-country regression for ninety-nine developing countries. The study identifies three channels through which indebtness in Sub-Saharan Africa affect growth: current debt flows as a ratio of GDP stimulates growth, while past debt accumulation (debt overhang) impacts negatively on private investment hence on growth. These two channels produce a Laffer curve showing the limit at which debt accumulation stimulates private capital formation and growth, beyond which, further debt accumulation impacts negatively on private capital formation and growth. The third channel manifests through liquidity constraint where debt service repayment obligations reduce export earnings and this negatively impacts on private investment. A similar conclusion was reached in a study by Cohen (1993), who analysed the correlation between developing countries debts and private investment in the 1980s. In a study "External Debt and Private Investment in Sub-Saharan Africa", Iyoha (1999), reaches a similar conclusion that debt overhang discourages private investment. In this study, private investment was regressed on the lag of debt overhang and lag of interest rates and other relevant variables.

Okafor and Tyrowicz (2008) attempted to establish the link between foreign debt and savings in developing countries, particularly the Latin America and the sub-Saharan Africa using a panel and instrumental variable approach. The results revealed a negative relationship, which suggested that if foreign debt increased by 1 percent, this would see domestic savings falling by at least 7 percent for both set of countries. Since savings provide funds for investment purposes, low rates of savings would imply that domestic borrowing for investment purposes will also decline. In addition, the results indicate a positive relationship between fixed capital formation and domestic savings in these countries.

Moore (2010)'s critical appraisal of McKinnon's complementarity hypothesis using panel analysis of 107 developing nations established that money and investment are complementary and that the deposit rate was the main determinant of capital formation in developing countries. Motelle and Masenyetse (2012) also could not find the non-existence of the McKinnon;s hypothesis for Lesotho. The validity of the McKinnon's hypothesis justifies the effect of the monetary policy in enhancing investment through the credit channel. Montes and Monteiro (2014) in an attempt to analyse the influence of monetary policy on aggregate investment in Brazil found that aggregate investment is sensitive to business confidence as well as credit supply. Another element that most studies on investment ignore is the contributory effect of democracy on private investment.

The empirical analysis of investment behaviour follows from a number of theoretical models proposed within various schools of thought. Most of the analyses based on these orthodox theoretical models were done for industrialised and developed countries. Even though these theoretical models distinguished a set of various factors determining firms' investment decisions for developed countries, when applied to developing countries in their original forms, many theoretical and empirical problems arose (Badawi, 2004). The realisations of these pertinent problems gave birth to numerous variants of such models in order to suit developing countries, and identify and quantify the relevant determinants of private investment. These variants and empirical query synthesised a new framework, which presents a new set of factors ignored in the orthodox theories of investment, while arguing for the importance of orthodox determinants such as economic output, prices and the rate of interest (Badawi, 2004).

In an attempt to establish the determinants of capital formation in transition economies, Kukeli (2012) uses the Cobb-Douglas production-type of capital formation model. In that study, capital accumulation is regarded as a product of multiple factors such trade openness, rate of return, savings rate, cost of acquiring new capital stock, economic growth, credit availability and inflation. The panel fixed effects model highlighted the significance of savings, growth of GDP as well as inflation and trade openness for the 13 countries. Interestingly, interest rate variable was found to be insignificant and was eventually dropped. This exclusion was motivated by the fact that nominal interest rate could have been eroded by

high inflation. The estimated coefficient was not only insignificant but was also had a very marginal effect on capital formation. Kukeli (2012) does indicate the importance of sustainable growth of GDP as a catalyst for capital accumulation.

Gjini and Kukeli (2012) used a panel a data analysis to test if investment by the public sector does crowd-out private investment for the eleven selected East European economies. The pooled cross sectional analysis of these European countries could not justify the crowding-out of the public investments on private investments as the marginal effect was positive and this effect diminished as countries get more developed. Xu and Yan (2014) on the other hand, found two scenarios, firstly, one where the crowding-in was supported for the Chinese economy when public investments in the form of public goods and infrastructure were erected and secondly, a scenario where the complementary hypothesis could not be supported when public investment in private goods, industry and commerce through state-owned enterprises (SOE) was injected. This classification of public investment into investment in public goods and investment in through SOE gives a direction as to where the public investment is most needed and the impact it has. Another country-specific study was conducted for the Indian economy by Bahal *et al* (2015) where the results suggested crowding-out of private investment for the period 1950 to 2012, while the same could not be said if the data is split into the period prior to 1991 crises and the post crises.

In the literature, three major sources of risk appear to be particularly relevant: macroeconomic instability; inadequate legal systems for most of developing

countries in particular, the difficulty of enforcing contracts; and political risk. With particular relevance to developing countries, Barro (1997) shows that private capital formation in developing countries is affected by the level of output (GDP), foreign direct investment(FDI), real exchange rates, fiscal balance, interest rates and uncertainty. Bleaney (1994) echoed that uncertainty would reduce investment either temporarily or permanently and the probable effects of fiscal and monetary austerities on the private sector's ability to commit substantial capital outlays and various institutions to mobilise required savings had not been fully established. Cann-Tamakloe (2008) alludes that it is critical to analyse the forces that promote or discourage private investment since the sector plays a very pivotal role towards economic development that has taken centre stage in policy deliberations in Sub- Saharan Africa and developing countries.

The literature on capital formation had been focusing on developed countries and other OECD countries and often yielded some conflicting results or generally inconclusive results (Boopen and Khadaroo, 2009). A handful of studies about investment and or capital formation on the individual SADC member states had been conducted before and the most notable ones are du Toit and Moolman (2004), Fielding (1997), Teal (1999), Naudé, Oostendorp and Serumaga-Zake (2000), Meyenburg (2013) and Mokete (2009), Molapo and Damane (2015), Jenkins (1998), Nyoni (2014), Chibuye: 2013; Bayai and Nyangara:2013; Kaputo: 2011; Moshi and Kilindo: 1999; Michael and Aikaeli: 2014; Sobhee: 1999; Boopen and Khadaroo: 2009) . These studies, however used different methodologies, which suggest that modeling investment is somehow complex as the researchers

often have to make certain assumptions regarding their choices of methods. Du Toit and Moolman (2004), for example, estimated a neoclassical investment function of supply side-factors as well as both internal and external financial constraints. The financial constraints as specified by cash-flow model at aggregate levels in Du Toit and Moolman (2004) revealed that investment in South Africa was driven by the rate of interest and the marginal productivity of capital. Investment was, however found to be driven by financial constraints, the user cost of capital, the international position as well as the international sanctions that were imposed on South Africa during the 1980s. This finding was no different from Ajide and Lawanson(2012) for the Nigerian economy. Despite the well documented analysis of investment, these studies have overlooked or disregarded the contributory effect of external debt overhang on investment. This excluded factor is ought to have an impact especially if the country's debt exceeds its repayment ability with some probability, in the future, expected debt service is likely to be an overhang function of the country's economic output. As a consequence some of the returns from investing in a domestic economy are effectively taxed away by existing foreign creditors and investment by domestic and new foreign creditors is discouraged (Claessens, 1996:17). This hypothesis, by implication means that reduction in the country's debt will lead to increases in investment and further increased payment capacity. The above sentiment was also emphasized by Krugman (1988) and Sachs (1990) and shared by Solimano (1990a, 1990b), meaning that large external debt burden will constraint investment.

Mokete (2009) was interested in establishing the determinants of private investment, with emphasis placed on financial markets constraints, public investment as well as government investment in South Africa. Using both the canonical correlation analysis and the principal factor analysis, he found that there was a strong relationship between economic markets and private investment. Bleaney (1994) investigated the determinants of private investment for South Africa using an annual data covering three decades and found that terms of trade, political uncertainty and the cost of borrowing were not significant in explaining private investment. However such variables were influential in explaining output growth instead. Meyenburg (2013) on the other hand explored the determinants of investment in South Africa using the general-to-specific methodology (GETS) assuming that gross fixed capital formation was dependent on economic growth, inflation, savings rate, interest rates and effective exchange rate. The results suggested that investment in SA is driven by real income, real prices and interest rate. Using economic models to model some economic behaviour by twisting economic theory with statistical evidence has proved to be a strenuous task as stated Campos, Ericsson and Hendry (2005).

Du Toit and Moolman (2004) and Fielding (1997) were the prevalent studies that attempted to model investment in South Africa. These studies, however used different approaches, with Fielding (1997) using the 2SLS[3] when investment does not only depend on public investment and the real user cost of capital but also on

[3] Two Stage Least Squares

the type of capital good and the relative output prices for both traded and nontraded capital goods. Du Toit and Moolman (2004) on the other hand utilised the Johansen cointegration technique to establish if there was any long run relationship between the user cost of capital and output/capital ratio. The ambiguity in investment literature suggests different alternatives to investment modelling particularly with regard to the developing countries in general.

Molapo and Damane (2015) in the case of Lesotho found that private investment is highly influenced by economic growth, public investment, macroeconomic instability and inflation. Jenkins (1998) for Zimbabwe using the two-step approach to investigate what really determines investment in Zimbabwe observed that private investment has been constrained by the availability of finance and that it is discouraged by the external debt/GDP ratio. Similarly, Nyoni (2014) applied OLS to empirically investigate the determinants of private investment and his inference was that only public investment, foreign direct investment (FDI) as well as economic growth explained investment in Zimbabwe. Similar studies for other SADC countries were also conducted and yielded differing results (see Chibuye: 2013; Bayai and Nyangara:2013; Kaputo: 2011; Moshi and Kilindo: 1999; Michael and Aikaeli: 2014; Sobhee: 1999; Boopen and Khadaroo: 2009).

The said studies utilised different methodologies and even incorporated differing variables and failed to incorporate debt as one of the determinants of investment. This study views the effect of debt on private investment as a crucial factor in

addressing the problem of low investment by the private sector. Debt is therefore viewed as a source of macroeconomic instability that affects domestic policies. From the general point of view, this study seeks to systematically study and extend the empirical literature by providing new evidence on the forces that can promote private investment in the SADC region and help boost economic growth and development. By incorporating variables such as country's measure of indebtedness within the investment function and testing if indeed investment is irreversible, the study will help in addressing the many economic challenges such as unemployment.

3.6 Summary and synthesis of literature

The literature underpinnings covered under this chapter show that investment determinants exhibit many diverse features. The literature survey of relevant reviewed has helped us identify some important factors that affect capital formation, although this does not guarantee that such list provides an exhaustive list of investment determinants. It had as well been indicated that most studies covered under the review had either one or more problems such as the failure to take into account the simultaneity among variables, therefore leading to unreliable estimates. The choice of variables to include in the investment equation, depends entirely on the existing institutional and structural characteristics of each and particular developing country and there is no real convergence regarding the sign and magnitude of the perceived determinants of private capital formation in developing countries. There seems to be no consensus regarding the method

applicable when modeling private investment as different studies used differing methods and even came to differing results.

The sign of impact of macroeconomic policy variables on private capital formation is also uncertain. It is therefore anticipated that this study will incorporate among other variables the debt variable and determine what impact it has on private capital formation in the SADC region. The failure of the previous studies to incorporate debt as one of the determinants of investment has brought interest in furthering such literature by only incorporating such variable within the investment function, but also to test the non-reversibility of investment. External debt is therefore viewed as a source of macroeconomic instability that affects domestic policies.

Chapter 4

METHODOLOGY

4.0 Introduction

This chapter specifies and presents the econometric model applied in this study. The chapter draws heavily on the literature reviewed in chapter three, especially on issues of specification and estimation techniques. It also draws on review of the macroeconomic performance of the SADC region discussed in chapter two for guidance on capturing the specific features and distinctiveness of the SADC countries. First, the chapter presents the conceptual framework, from which the specification of the model applied in the study is derived. The variant of the empirical model proposed is presented in section 4.2, section 4.3 explains the reversibility concept, section 4.4 gives a description and measurement of variables as well as the data sources; some expected signs or *apriori* expectations. Section 4.5 succinctly presents general discussion on the estimation techniques applied, the stationary panel data, and the different models applicable within the stationary panels such as the pooled, fixed and random effects. This section is aimed at providing some background to panel data analysis, the fixed and random effects. To determine which of the two models, between the fixed and random effects is appropriate, we present the Hausman test in section 4.6. The properties of data (nonstationary panels) are emphasised in section 4.7, followed by the panel cointegration analysis in section 4.8. The final section, 4.9 lays down the main hypotheses of the study which are tested in the next chapter (chapter five).

4.1 The conceptual framework and the theoretical model

The development of the model is vested in both the theoretical and empirical underpinnings having looked at the previous model applied on investment particularly the investment theory formulated by Jorgensen (1967) and Hall and Jorgensen (1973) has been the starting point for early studies on investment behaviour in the developing nations.

Following Blejer and Khan (1984) and Greene and Villanueva (1991), an investment framework, (variant of the flexible accelerator model) that incorporates some of the institutional and structural characteristics of developing countries, as well as the explicit role of monetary and fiscal policies is derived below. This model becomes the ground for the empirical model that is applied in the study. The investment framework takes off from the long-run representation of the accelerator model of investment, where the desired level of capital is assumed to be proportional to expected output:

$$KP_t^* = \omega YR_t^e \qquad (4.1)$$

where KP_t^* is the capital stock that the private sector desires to have in place in future periods, and YR_t^e is the corresponding expected level of output. This formulation assumes the underlying production function has fixed proportions among factor inputs, so that the factor prices do not enter into the specification. Whereas the parameter ω is assumed fixed, KP_t^* is assumed to be affected by economic conditions, so that the model deviates from the standard accelerator

model. However, due to time lag that firms take to respond to increased demand, lags are introduced in the above equation through partial adjustment mechanism for the capital stock, whereby the actual stock of capital is assumed to adjust to the difference between the desired stock in period *t* and the actual stock in the previous period. Formally stated, the model becomes;

$$\Delta KP_t = \beta(KP_t^* - KP_{t-1}) \text{ or } KP_t = \beta KP_t^* + (1-\beta)KP_{t-1} \qquad (4.2)$$

where *KP* is the actual private capital stock, so that ΔKP_t is net private investment, and β is the coefficient of adjustment and its range is given by $0 \leq \beta \leq 1$.

Equation (4.2) is in terms of net investment, whereas the data on investment are available only in gross terms, including depreciation. Therefore, transforming equation (4.2) into gross capital formation terms to enable derivation of an equation that can be empirically estimated and econometrically tested confers:

$$PCF_t = \Delta KP_t + \varphi KP_{t-1} \qquad (4.3)$$

where gross private investment/capital formation (PCF_t) equals net investment (ΔKP_t) plus depreciation (φKP_{t-1}) of the previous capital stock and φ is the rate of depreciation. In standard lag-operator notation, equation (4.3) can conveniently be written as:

$$PCF_t = [1-(1-\varphi)L]KP_t \qquad (4.4)$$

where *L* is a lag operator, $LKP_t = KP_{t-1}$.

To relate private capital stock to gross investment, equation (4.4) is simply inverted to obtain:

$$KP_t = \frac{PCF_t}{[1-(1-\varphi)L]} \tag{4.5}$$

Substituting for KP_t and KP_{t-1} in equation (4.2), equation (4.6) is obtained:

$$\frac{PCF_t}{[1-(1-\varphi)L]} = \beta K_t^* + (1-\beta)\frac{PCF_{t-1}}{[1-(1-\varphi)L]} \tag{4.6}$$

which has the solution given by equation (4.7) below. $KP_{t-1} = [1-(1-\delta)L]^{-1} KP_{t-1}$

$$PCF_t = [1-(1-\varphi)L]\beta K_t^* + (1-\beta)PCF_{t-1} \tag{4.7}$$

But K_t^* is not observable, so its equivalence from equation (4.1) is substituted into (4.7) to give (4.8):

$$PCF_t = \omega\beta[1-(1-\varphi)L]YR_t^e + (1-\beta)PCF_{t-1} \tag{4.8}$$

Equation (4.8), gives the basic dynamic accelerator model for gross private investment and has an advantage that, although, is completely consistent with equation (4.1) and (4.2), it does not require information on net investment or on the stock of capital. Therefore, it can be readily applied to gross investment data in developing countries.

However, to make private investment vary with underlying economic conditions, and thus make the model consistent with the flexible accelerator model, the approach suggested by Coen (1971) is followed. In essence, the response of private investment to the gap between desired and actual investment, given by equation (4.9):

$$\Delta PCF = \beta(PCF_t^* - PCF_{t-1}) \qquad (4.9)$$

is measured by the coefficient β, which is assumed to vary systematically with economic factors influencing the ability of private investors to achieve the desired level of investment. Hypothesising that such response depends on three main factors: (1) the stage of the cycle, (2) the availability of financing and (3) the level of public sector investment, then the phenomenon of crowding out, therefore, is captured through affecting the speed of adjustment rather than directly through changing the desired level of real investment. Then, expressing the coefficient of adjustment as a function of cyclical factors, monetary and fiscal policy variables, a linear representation of this relationship is obtained in equation (4.10):

$$\beta = \frac{\Delta PCF_t}{PCF_t^* - PCF_{t-1}},$$

$$\beta = \gamma_0 + \frac{1}{(PCF_t^* - PCF_{t-1})}(\gamma_1 GAP_t + \gamma_2 \Delta DCR_t + \gamma_3 PuCF_t) \qquad (4.10)$$

where β = coefficient of adjustment, γ_0 = shift parameter

$$\Delta PCF = \gamma_1 GAP_t + \gamma_2 \Delta DCR_t + \gamma_3 PuCF_t$$

GAP_t = cyclical factors, given by the difference between actual and trend output,

ΔDCR_t = change in real bank credit to the private sector plus real net capital flows,

$PuCF_t$ is the public capital formation.

Equation (4.10) states that the response of private capital formation depends on the magnitude of these three factors, measured in relative terms with respect to size of the discrepancy between desired and actual investment, and γ_1 and γ_3 can carry either positive or negative signs, $\gamma_2>0$,. Therefore to obtain a dynamic reduced form equation of gross private investment that includes cyclical factors, the change in real bank credit and real public sector investment as explanatory variables, replace β in equation (4.9) by β in equation (4.10) to give equation (4.11):

$$\Delta PCF = \gamma_0(PCF_t^* - PCF_{t-1}) + \gamma_1 GAP_t + \gamma_2 \Delta DCR_t + \gamma_3 PuCF_t \qquad (4.11)$$

The steady state level of desired capital given

$PCF_t^* = [1-(1-\delta)L]KP_t^*$ = $[1-(1-\delta)L]\omega YR_t^e$ gives:

$$PCF_t = \omega\gamma_0[1-(1-\varphi)L]YR_t^e + (1-\gamma_0)PCF_{t-1} + \gamma_1 GAP_t + \gamma_2 \Delta DCR_t + \gamma_3 PuCF_t \qquad (4.12)$$

The dynamic reduced form model of gross private capital formation shown in equation (4.12), could be extended to include any other variable perceived important in explaining the coefficient of adjustment (β shown in equation (4.10)), for instance assuming this coefficient depends on both the level and the change in

public sector investment ($\Delta PuCF_t$), with the change in public investment considered to be ambiguous, this extension would yield the following equation:

$$PCF_t = \omega\gamma_0[1-(1-\varphi)L]YR_t^e + (1-\gamma_0)PCF_{t-1} + \gamma_1 GAP_t + \gamma_2 \Delta DCR_t + \gamma_3 PuCF_t + \gamma_4 \Delta PuCF_t \quad (4.13)$$

where $\omega\gamma_0 > 0$, and the long-run coefficient (ω) is expected to be close to unity. These results would ensure that in the steady state, the capital-output ratio is constant. The effects of government policy on private capital formation can be directly obtained from the estimates of γ_2, γ_3 and γ_4 respectively. Whereas there is some empirical evidence that an increase in the flow of credit to the private sector will benefit the private investment, the sign of the result for the effect of government expenditure is indeterminate.

However, from equation (4.13), the term YR_t^e, which measures the expected output, is the only one that still remains unobservable. There is variety of ways of generating it. Hall (1977) and Bischoff (1971), for example, use a general distributed-lag formulation that relates the current level of output to its past values. An alternative approach would be to use the adaptive expectations model of Cagan (1956), in which, expected output is assumed to respond to the error between the actual and the output that was expected in the previous period:

$$\Delta YR_t^e = \lambda[YR_{t-1} - (1+\Phi)YR_{t-1}^e] \quad (4.14)$$

where λ is the coefficient of expectations, $0 \leq \lambda \leq 1$, Φ is the growth rate of output. Using the lag operator notation, equation (4.14) can simply be written in form of YR_t^e as follows:

$$YR_t^e = \frac{\lambda YR_{t-1}}{[1-(1-\lambda)(1+\Phi)L]} \tag{4.15}$$

Finally, substituting for YR_t^e from equation (4.15) into equation (4.13) and then simplifying gives an estimable equation with all variables observable:

$$PCF_t[1-(1-\lambda)(1+\Phi)L] = \lambda\omega\gamma_0[YR_{t-1}-(1-\varphi)YR_{t-2}]+[(1-(1-\lambda)(1+\Phi)L)]+ (1-\gamma_0)PCF_{t-1}+\gamma_1 GAP_t+\gamma_2\Delta DCR_t+\gamma_3 PuCF_t+\Delta PuCF_t+\varepsilon_t \tag{4.16}$$

Nevertheless, the dynamic equation shown in (4.16) above, although captures explicitly the impact of macroeconomic policy on private capital formation, it does not account for endogeneity between variables of interest. It is also niggling in that it requires imposing strong restriction on specification and the direction of causality among variables and as result is prone to misspecification errors resulting from specification bias, exogeneity bias and neglect of dynamic feedbacks, especially important when dealing with analysis of the effects of policy on other economic variables, (Mustapha and Tarik, 2005).

Without disregarding some theory on investment, the specification of the model will be based on the assumption that investment depends on the user cost of capital and the output level such that the steady state capital stock is given by;

$K_t = f(Y_t/UCC_t)$, such that gross investment is given by changes in capital stock at period t and the depreciation as in (1) below:

$$I_t = \Delta K_t + \theta K_{t-1} \qquad (4.17)$$

Since investment in this study is defined as the process of adding to a given capital stock within a specified period, such that if the amount of capital stock is represented by $K(t)$, the rate of capital formation will be given by $\partial K/\partial t$. Chiang and Wainwright (2005) indicated that this rate of capital formation is identical to the rate of net investment flow at time t. This implies that $\partial K/\partial t \equiv I(t)$. Jorgenson's approach presented by du Toit and Moolman (2004) shows that the algebraic presentation of the marginal physical products (MPP) of K and L using the multiplier method suggests that the marginal physical product of K is equivalent to the user cost of capital. The profit optimisation problem was represented as;

$$\begin{aligned} Max_{K,L}\Pi_t &= f(TR, K, L; p_t, r_t, w_t) = p_t Q_t - w_t L_t - r_t K_t \\ &= p_t f(K_t, L_t) - w_t L_t - r_t K \end{aligned} \qquad (4.18)$$

Where TR is the total revenue (P*Q), and the output level (Q) being a function of both inputs.

In order to achieve the objectives of this study, the study assumes a linear multivariate model that incorporates debt and the public investment as the explanatory variables. The model takes the form:

$$\Gamma_t = \sum_{i=1}^{k} \delta_i \Gamma_{t-i} + \pi_t \qquad (4.19)$$

$\sum_{i=1}^{k} \delta_i \Gamma_t$ is the summation of explanatory variables in the system. Γ_t is a (nx1) column vector of all variables that enter system, including the group's total debt, public capital formation, interest rate, polity, gross savings, measure of economic growth, inflation, trade balance as well as fiscal balance.

4.2 Empirical Model

The study assumes the empirical model of the form presented below, with the variables determined through theoretical consideration. This empirical model is based on the neoclassical model associated with Jorgenson (1967, 1971) due to the fact that no convergence is obvious in the case of the private capital formation model between the developing and developed nations are vigorously clarified under the different investment theories. There is no formal derivation of the private capital formation model that best captures the role that macroeconomic policies in developing countries have in relation to private capital formation. Therefore, in view of the variants of the conventional theories touched in the previous chapter of this study, the general dynamic form of the econometric model to be used in this study is:

$$PCF_{it} = b_0 + b_{1i} D_{it} + b_{2it} PuCF_{it} + \sum_{i=0}^{k} b_{it} Y_{it} + \varepsilon_{it} \qquad (4.20)$$

Where PCF_t is the dependent variable that measures the level of private capital formation, D_{it} is the debt variable, PuCF represents public capital formation. Y_{it} represents a set of all exogenous variables included in the model. The dependent variable here is measured as the ratio of private capital formation to gross domestic product (% of GDP). The other macroeconomic variables include growth of real gross domestic (RGDP), inflation (CPI), public capital formation (PuFC), fiscal balance (FB) (deficit if it is negative and a surplus if it is positive), gross national savings (GNS), trade balance (current account balance) (CAB), total debt to GDP (Tdebt), debt service ratio (Debts) and polity (Pol) as a measure of democracy or political stability (Pol), real interst rate (RIR) as well as foreign aid. The random error term ε fulfils all the classical assumptions and the bs represent the coefficients to be estimated.

4.3 The reversibility model explained

One of the research objectives of this study is to test the reversibility/non-reversibility condition on the model for private capital formation in the SADC region and to attain this objective; a fully explained derivation of the model is presented. The concept of reversibility or non – reversibility is borrowed from the works of Tweeten and Quance (1969), Wolffram (1971) as well as Houck (1977). This theorem or approach postulates the following: we envisage that the dependent variable Γ depends upon the values taken by X and that both these variables are time series variables. The hypothesis will then be that one unit increase in X from one period to the next has a different contribution on Γ than a one unit decrease in X does. This written algebraically as:

$$\Delta\Gamma_i = \varphi_0 + \varphi_1 \Delta X_i^{'} + \varphi_2 \Delta X_i^{''} \qquad (4.21)$$

For i = 1 , 2, 3, ……, t; where $\Delta\Gamma_i = \Gamma_i - \Gamma_{i-1}$, $\Delta X_i^{'} = X_i - X_{i-1}$ **if** $X_i \succ X_{i-1}$ and zero otherwise; $\Delta X_i^{''} = X_i - X_{i-1}$ if $X_i \prec X_{i-1}$ and zero otherwise; X_0 is the initial value of X and Γ_0 is the initial value of Γ. The value of Γ at any time t is given by:

$$\Gamma_t = \Gamma_0 + \sum_{i=1}^{T} \Delta\Gamma_i \qquad (4.22)$$

For i = 1, 2, 3, ……, *t, t+1*, …..*T*; where *T* is the total number of observations beyond the initial value. The difference between the current and the initial value of Γ is the sum of period to period changes that have happened, such that:

$$\Gamma_t - \Gamma_0 = \sum_{i=1}^{t} \Delta\Gamma_i \qquad (4.23)$$

Inserting the first equation into the third equation and simplifying will yield:

$$\left.\begin{aligned} \Gamma_t - \Gamma_0 &= \sum_{i=1}^{t} [\varphi_0 + \varphi_1 \Delta X_i^{'} + \varphi_2 \Delta X_i^{''}] \\ &= \varphi_0 t + \varphi_1 (\sum \Delta X_i^{'}) + \varphi_2 (\sum \Delta X_i^{''}) \end{aligned}\right\} \qquad (4.24)$$

Let Γ_i^*, R_t^* and D_t^* be $\Gamma_t - \Gamma_0$, $\sum \Delta X_i^{'}$ and $\sum \Delta X_i^{''}$ respectively such that:

$$\Gamma_i^* = \varphi_0 t + \varphi_1 R_t^* + \varphi_2 D_t^* \qquad (4.25)$$

Where R_t^* is the sum of all period to period increases in X and D_t^* is the sum of all period to period decreases in X and φ_0 a trend coefficient. Variables R_t^* and D_t^*

are always positive and negative respectively. The non-reversible condition will hold only if $\varphi_1 \neq \varphi_2$. This model will thus be termed non-reversible model.

This model however seeks to find the contributory impact of the increases and decreases in the main independent variable, which in our case is debt and our endogenous variable is the private capital formation. Other exogenous variables to be considered include among others the public capital formation, gross savings, debt as listed in section 4.2. The study intends to diverge significantly with the reversibility theorem presented by Tweeten and Quance (1969), Wolffram (1971) and Houk (1977), which consider only the main determinant. The explanatory variables that are assumed to exert some contribution on private capital formation as postulated by theory are be used to create the D*s and R*s. From (4.25) the modified model is given as follows:

$$\Delta\Gamma_i = \varphi_0 + \varphi_1 \Delta X'_{1i} + \varphi_2 \Delta X''_{1i} + \varphi_3 \Delta X'_{2i} + \varphi_4 \Delta X''_{2i} + \ldots\ldots\ldots\ldots + \varphi_n \Delta X'_{(n-1)i} + \varphi_{n+1} \Delta X''_{(n-1)i}$$

(4.26)

This can also be re-written as equation (4.5) in the following:

$$\Gamma_i^* = \varphi_0 t + \varphi_1 R^*_{x_1,t} + \varphi_2 D^*_{x_1,t} + \varphi_3 R^*_{x_2,t} + \varphi_4 D^*_{x_2,t} + \ldots\ldots\ldots\ldots + \varphi_n R^*_{x_{n-1},t} + \varphi_{n+1} D^*_{x_{n-1},t} \quad (4.27)$$

For *i = 1 , 2, 3, ……., t*; where $R^*_{x_1,t}$ represents the incremental changes in the first explanatory variable at period *t*, up to variable $X_{n-1,t}$, $D^*_{x_1,t}$ up to $D^*_{x_{n-1},t}$ are all decrement changes in explanatory variables. The reversibility conditions are now $\varphi_1 \neq \varphi_2$, $\varphi_3 \neq \varphi_4$, ……., $\varphi_n \neq \varphi_{n+1}$ depending on the number of explanatory variables.

With the estimation of (4.11), the panel model will then be formulated and will include both the R^{*}s as D^{*}s as explanatory variables to test the contributory effect of the increments and decrements in debt and public capital formation as well as other explanatory variables that are included in the study.

4.4 Data description and measurement of variables

The annualised data set used covers the period between 1980 and 2015 for the 15 SADC countries, which are Angola, Botswana, Democratic Republic of Congo, Madagascar, Lesotho, Mozambique, Malawi, Mauritius, Namibia, Swaziland, South Africa, Seychelles, Tanzania, Zambia and Zimbabwe (t = 36 and n = 15). The data to used includes the capital formation private (PCF), public capital formation public (PuCF), debt service ratio (DSR), growth of real domestic product (RGDP), gross savings (GDS), current account balance (CAB), inflation (INF) and polity variable (POL), which enter the model to capture the impact political instability on private capital formation within the SADC bloc.

The polity variable is obtained the Polity IV manual as developed by Marshall, Gurr and Jaggers (2013) and describes different sets of data based on political regimes features and transitions. The polity measure in time series analysis uses the annualised polity scores of standard authority codes as prescribed by the Polity IV manual using the three scales for foreign interruption (-66), interregnum (-77), transition phase (-88) as well as democracy (ranges between -10 and +10. A score that captures the interruption period indicates a period at which a country was occupied by foreign power. The interregnum period on the other hand signifies a

period through which the country experiences a total collapse of the central political authority and this can be attributed to periods of political instability where the external intervention reduces the power of the central government. Another polity measure reflects on the period through which a country goes through a political transition, where new institutions are planned and constituted and effected. Another set of polity measure is the level of democracy that ranges from -10 (autocracy) to +10 (full democracy) and these are assigned to each period in the country. Therefore our polity variable in this study consists of four set of components, those measuring interruption, interregnum, transition and democracy as outline above.

4.4.1 Measurement of variables

This section of the study presents the description of the variables included in the empirical model. The theoretical expected signs are also discussed as per the theory and empirical literature presented in chapter three.

PCF = gross private capital formation, which is defined as an aggregate of private sectors' expenditures on construction, buildings, transport equipment, machinery and equipment. This is given as a ratio of private capital formation to gross domestic product (% GDP).

TDEBT = the region's indebtedness measured by total debt to GDP. This is given as a ratio of total debt to GDP. It is expected that debt will bear a negative sign towards PCF model.

DEBTS = debt service ratio, measured as a ratio of debt service to export earnings. The literature has shown that debt overhang discourages private initiatives and hinders productivity growth and the prospects of development. This variable is expected to affect PCF negatively (-).

PuCF = public capital formation, which is refers to net additions to capital stock by the government in the form of infrastructure projects, public enterprises and capital goods. This is given as a ratio of public capital formation to GDP. This expenditure could either crowd-in or crowed-out private capital formation, hence positive or negative sign expected (±).

RGDP = real growth of output, is the gross domestic product adjusted for inflation. This variable influences PCF positively since the private sector commits more funds as the country's / region's income increases (+).

GNS = gross national savings refers to the total savings by households as a percentage of GDP. This variable is expected to influence PCF positively since it is through increased savings that more investment is realised, hence capital formation (+).

PoI = polity variable that enters the model to capture the effect of political instability in the region. Politically stable nations attract more investment, as investors tend to have confidence in economy (±). If political instability is greater, there will be more uncertainty regarding the economic policies and as a result private investment will be reduced. On the other hand, if countries are stable politically, more private investment will be realised, hence a positive coefficient.

FB = fiscal balance refers to government's revenue less government spending. A positive fiscal balance indicates a surplus while a negative FB shows that the country is experiencing budget deficits. A deficit can reduce private capital formation through an increase in interest rates and through a reduction in the public capital formation as a result of increasing expenditure. Deficits tend to create a shortage in PCF by reducing the pool of savings available for private sector borrowers (Chirinko and Morris: 1994). Chiriko and Morris (1994) alluded that due to non-sensitivity of governments towards the level of interest rate for which they borrow, government can borrow whatever infrastructure projects. With a budget surplus on the other hand, taxes will remain low and more savings will be realised and funds from savings will increase private investment, hence private capital formation. It is therefore expected that the sign of the coefficient of FB be either negative or positive (±).

CAB = current account balance is expressed as the difference between the total value of exports of goods and services and the total value of imports of goods and services. CAB is usually referred to as trade balance and when exports are greater than imports, the economy experiences trade surplus and when imports are greater than exports, and then trade deficit is realised. The expected sign can either be negative or positive in the case of deficits or surplus (±).

CPI = inflation measured by the growth rate of CPI. High rates of inflation reduce the real rate of return for borrowers. This makes more people to be borrowers instead of savers and this discourages savings and investment. Investors will not

be interested in providing more loanable funds to people at lower rates due to uncertainty in the investment climate, hence private capital formation will be reduced (-).

FAID = foreign aid measured by total official development assistance (ODA) received as a percentage of GDP. Higher foreign aid (ODA) is expected to contribute positively towards private capital formation (+).

RIR = Real interest rate measured by lending rate adjusted for inflation. It is expected that this variable will affect private capital formation positively if the McKinnon hypothesis is justified and negative if the conversional theories of investment are supported (±).

The variables are sourced from the World Bank's World Development Indicators database, African Development Bank, International monetary fund (IMF), World Economic Outlook (WEO) as well as the Polity IV database. Table 4.1 below gives a summary of variables utilised in this study and the expected signs.

Table 4.1:Explanatory variables and their apriori expectations

Name of the variable	***Expected signs of the coefficients***
TDebt(TDebt)	*Negative (–)*
Public capital formation (PuCF)	*Positive or negative (±)*
Gross national savings (GNS)	*Positive (+)*
Real gross domestic product (RGDP)	*Positive (+)*
Measure of political instability (Pol)	*Positive or negative (±)*
Fiscal balance (FB)	*Positive or negative (±)*
Current account balance (CAB)	*Positive or negative (±)*
Inflation (CPI)	*Negative (–)*
Debt service ratio (Debts)	*Negative (–)*
Foreign aid (FAID)	*Positive (+)*
Real interest rate (RIR)	*Negative (±)*

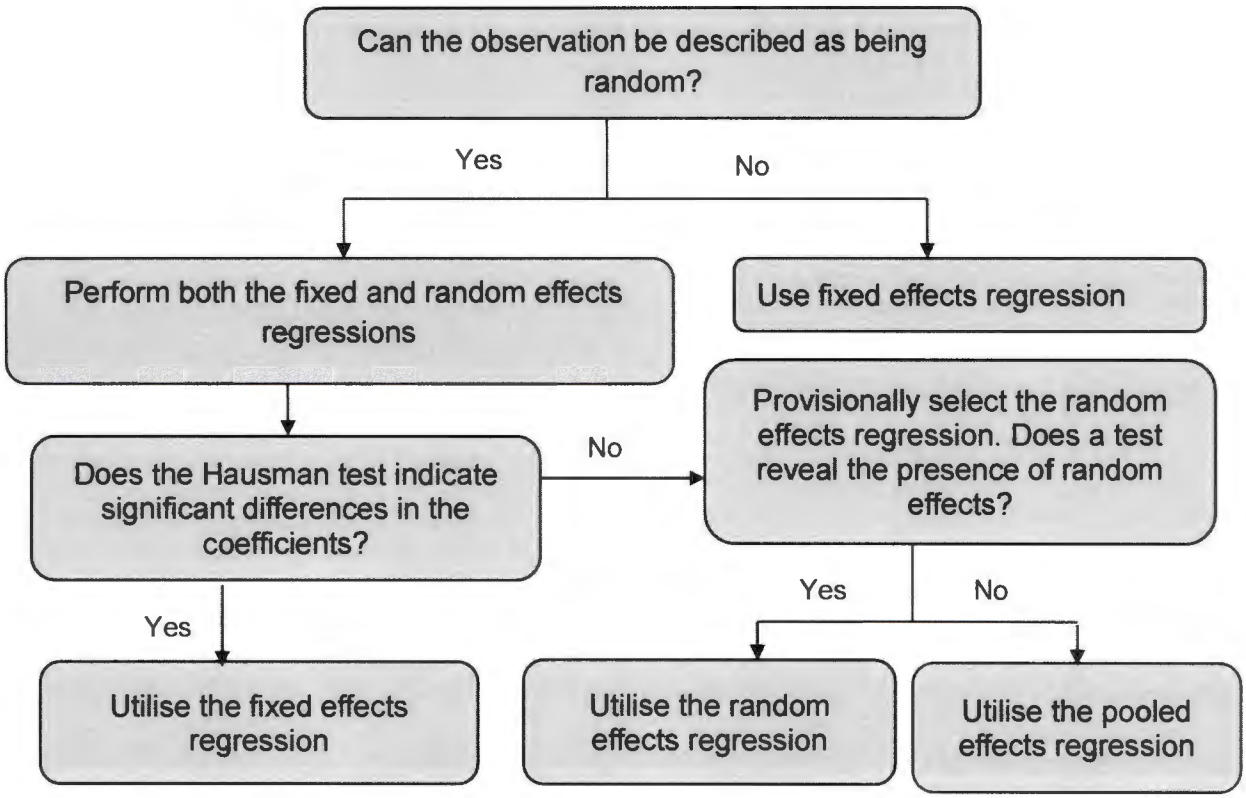
4.5 Estimation techniques

4.5.1 Stationary Panel data

The study utilises the panel data to examine the macroeconomic impact of debt and public capital formation on private capital formation for the period 1980 to 2015. This method is preferred over the cross – sectional and time series designs due to its ability to control heterogeneity among individual countries. The use of the panel analysis also minimises the collinearity among the study variables and provides more degrees of freedom as well as efficiency, while the cross-section and time series are prone to collinearity. The panel data analysis also allows the data to be collected for individual countries over time and as a result reduce the bias that could arise from aggregation. This method however, has its shortcomings such as the short span of time especially for annual data.

In an attempt to achieve the main objectives of this study and determine which estimation is appropriate, particularly when using either the pooled, fixed or random effects, the study follows the Dougherty (2011) graphical presentation of the choice of regression model.

Figure 4.1:Choice of the regression model for panel data



Source: Adopted from Dougherty (2011)

Figure 4.1 will be followed when estimating the model in order to reach the goal of the study. The next section (4.5.1) gives an overview of the regression approaches that will be used and these stem from Dougherty (2011) as per figure 4.1.Since the empirical model assumes a balanced panel that consists of $N \times T$ observations, the model would contain $K \times N \times T$ coefficients. Due to this number of coefficients, it may not be possible to estimate such model from the data. It is therefore imperative to consider the pooled ordinary least squares (OLS). Unlike Dougherty's (2011)

graphical presentation of the process of choosing the appropriate model, the study starts with the pooled OLS.

4.5.2 Pooled Effects Model and Fixed Effects versus the Random Effects model

The preliminary estimation of model 4.4 will start with the application of panel least squares (pooled effects) for the data covering the period 1980 to 2015 for the SADC countries in order to establish the influence of various explanatory variables on private capital formation. This method is justified on the grounds of the Gauss-Markov theorem, which states that estimators are best linear and unbiased. Following this preliminary estimation, the fixed and the random effects estimation techniques are used to capture country and time specific effects on the estimated coefficients (*bs*).

4.5.2.1 The Pooled Effects Model

A pooled effects approach pools all cross sectional and time series data together and assumes that all the SADC countries are homogeneous, meaning that all the slope coefficients and the constants are similar for all nations. This model is similar to the ordinary time series analysis that does not consider some cross specific differences within the group of countries. In this instance the parameters from the pooled regression are constrained to be equal across nations and the null hypothesis is that the countries are homogeneous, that is, there is a presence of homogeneity. The slope coefficients from the pooled effects approach represent the marginal effects of contributory effects of the predictor variables on the

dependent variable, which is the private capital formation in our case. The validity of the estimation results from the pooled effects model can be assessed through the standard errors or the t-statistics, in which case large standard errors or very small t-statistics would indicate that the countries are heterogeneous. The main problem with the pooled effects regression is that it does not take into account the country differences that might exist that could influence the correlation between the dependent and explanatory variables in the regression equation.

With the assumption of identical variances among the nations, this assumption may not always hold due to the unobserved different effects that arise as a result of some measurement errors. The restrictive nature of the pooled effects model and the likelihood that the error process could contain problems such as serial correlation within the panel data, heteroskedasticity across panel units, other advanced approaches such as the FE and RE are considered. The estimated coefficients from the pooled effects regression cannot be trusted as they may be inconsistent and as a result it will be appropriate to consider the more advanced regression approaches.

4.5.2.2 Fixed Effects model

In the fixed-effects (FE) model, we try to explore the relationship between explanatory variables and the dependent variable within the country since each country has its own individual features that may or may not impact the independent variables. The FE assumes that there could be factors within the individual country that need to be controlled that impact on the independent variables. In other words,

the FE assumes that the independent variable(s) could be correlated with some specific individual effect. The FE model tries to remove the effect of such time-invariant features so as to determine the net effect of the explanatory variables on private capital formation in the SADC countries. These time-invariant features are seen as unique to each country and therefore should not be correlated with other countries' individual features. Each country's error term should not be correlated with others. The FE model is presented as follow:

$$PCF_{it} = \beta_1 Y_{it} + ... + \beta_k Y_{kt} + \Phi_i + \Pi_{it} \qquad (4.44)$$

Where

Φ_i (i = 1...15) is the unknown intercept for each country (15 country-specific intercepts),

PCF_{it} is the dependent variable where i = country and t = period,

Y_{it} represents one independent variable,

β is the coefficient for independent variable Y and

Π_{it} is the error term

Given 4.44, the FE assumes that the constant Φ_i does not vary with *t* for each individual country within the panel. It uses the least squares dummy variable (LSDV) within its framework. In addition to the aforementioned assumptions, other assumptions include constant error variances and slopes, intercepts differ across nations and/or time. The FE uses the F-statistic to test the null hypothesis of all dummy variables except for one, equal to zero ($\Phi_1 = \Phi_2 + ... + \Phi_N = 0$) against the

alternative hypothesis of at least one dummy variable not equal to zero. It compares a fixed effect model with ordinary least squares (OLS) to see the extent to which the fixed effect improves the coefficient of determination (R-squared). Equation (4.44) is evaluated using the F-statistic:

$$F(n-1, nT-n-k) = \frac{\left(e'e_{pooled} - e'e_{LSDV}\right) / (n-1)}{\left(e'e_{LSDV}\right) / (nT-n-k)} \quad (4.45)$$

If the F-statistic is found to be statistically significant (i.e. the probability value is found to be less or equal to 5 percent), the null hypothesis is rejected and the FE model is considered. Equation (4.44) can be generally written as:

$$Y_{it} = (\Theta + u_i) + X_{it}'\beta + v_{it} \quad (4.46)$$

Where $\Theta = \Phi$, X is a vector of X by 1 independent variables, β is a vector of coefficients to be estimated, *u* and *v* are the error components. This model implies that if the unobserved variable does not vary over time, then any variation in the dependent variable must be due to influences other than the fixed features (Stock and Watson, 2015).

4.5.2.3 Random Effects model

The random effects (RE) model on the other hand assumes that the variation across the countries is random and uncorrelated with the repressors in the model. This type of model also assumes that the intercept and the slope coefficients are constant, while the error variances are randomly distributed across nations and/or

time. The RE model, unlike the FE, utilises the generalised least squares and the Feasible Generalised Least Squares of the estimated generalised least squares (EGLS) for estimation, while the FE uses the LSDV and within effect estimation. Baltagi and Chang (1994) give a list of various estimation methods for the FGLS that include the simulation and the maximum likelihood method. The RE model takes the form as presented in equation (4.47):

$$PCF_{it} = \beta_1 Y_{it} + ... + \beta_k Y_{kt} + \Phi + (u_{it} + \Pi_{it}) \qquad (4.47)$$

Where

$\Pi_{it} \sim IID(0, \sigma_{\Pi}^2), \Phi \sim IID(0, \sigma_{\Phi}^2)$

u_{it} is the error between countries and represents a time invariant intercept

Π_{it} is the error within the country

In addition, $u_{it} + \Pi_{it}$ is error term consisting of two error components. This is an individual specific component which does not vary over time and u_{it} and Π_{it} are assumed to be uncorrelated over time. The correlation of the error terms over time is attributed to the individual effects of u_{it} and u_{it} is assumed to be random factors that are independently and identically distributed over individuals but does not vary overtime, It is also assumed that the components $u_{it} + \Pi_{it}$ are mutually independent and independent of Y_{it} (for *i* and *t)*. The error component denotes that the composite error term $u_{it} + \Pi_{it}$ shows a particular autocorrelation unless the

variance of u_{it} is zero. This method tends to reduce the number of coefficients to be estimated while at the same time producing the inconsistent estimates if he specific random effect is correlated with the independent variables (see Green 2008). The random effects are tested using the Breusch-Pagan Lagrange multiplier (LM) test (Breusch and Pagan 1980) and this test contrasts the a RE model with OLS.

The LM statistic takes the form of a chi-square distribution with one degree of freedom; Baltagi (2001) presents it as:

$$LM = {nT}/{2(T-1)}\left[\frac{\sum(\sum e_{it})^2}{\sum\sum e_{it}^2} - 1\right]^2 \sim \chi^2(1) \qquad (4.48)$$

The null hypothesis under the LM test tries to establish if the individual or time specific variance components are equal to zero and is written as, $H_0 : \sigma_u^2 = 0$ against the alternative hypothesis $H_1 : \sigma_u^2 \neq 0$. If the LM statistic is statistically significant, we can reject the null and conclude that the RE model be used since there are some random effects in the panel data otherwise the FE model is preferred. This model allows us to generalise the inferences beyond the sample used.

4.5.2.4 Comparison of the Random and Fixed Effect models

The presentation of the RE and FE models in sections 4.5.2 and 4.5.3 highlight the assumptions, similarities and/or differences when the two test are applied in

econometrics analysis. Table 4.2 summarises the assumptions, similarities and/or differences as well the estimation methods applicable to each model.

Table 4.2: Comparison of the Random and Fixed Effects models

	Random Effects Model	**Fixed Effects Model**
Equation or functional form	$PCF_{it} = \sum_{i \neq j}^{k} \beta_i Y_{it} + \Phi + (u_{it} + \Pi_{it})$	$PCF_{it} = \sum_{i \neq j}^{k} \beta_i Y_{it} + \Phi_i + \Pi_{it}$
Assumption	Country's individual effects are not correlated with the repressors	-
Error Variances (EV)	EV are randomly distributed across group and/or time	EV are constant
Slopes	Slopes are constant	Slopes are constant
Intercepts	Constant	Differ across group and/or time
Method of estimation	GLS, EGLS	LSDV, Within effect
Hypothesis test	Breusch-Pagan LM test	F-test

Source: Park (2011)

The challenge will then be which of the two models is appropriate regarding the effects that are inherent in the FE and RE models. The next section (4.6) compares between the FE and RE models and helps to determine which model is appropriate in this study. This comparison is done using the Hausman (1978) test. This test informs us whether the dependent unobserved effects are correlated with the predictor or explanatory variables. The next section gives an overview of the Hausman test.

4.6 Hausman Test

The determination of the appropriate model between the FE and the RE is vested with the $E(\Phi_i \mid Y_{it})$[4]. If the $E(\Phi_i \mid Y_{it}) = 0$, then the RE is preferred and if $E(\Phi_i \mid Y_{it}) \neq 0$, the FE would be preferred. The test that informs us of the model to use is the Hausman's test. Hausman (1978) intends to indicate if the FE or the RE model is preferred and it is based on the premise of relation between the direct variable and the errors. This test provides the guidance on whether $E(\Phi_i \mid Y_{it}) \neq 0$. If the $E(\Phi_i \mid Y_{it}) \neq 0$, then the RE estimate is inconsistent and if the value is not equal to zero, then the FE estimator converges to different estimates (Murray, 2006). However, if $E(\Phi_i \mid Y_{it}) = 0$, then heterogeneity is not correlated with Y and this eliminates the biasness. In that case both the RE and FE estimates are consistent, although the FE estimator is not efficient. Table 4.3 presents the characteristics of the estimates of the RE and FE. If there is a relationship between

[4] See table 4.2

the estimated regression errors and the PCF, then the RE will be applicable but if there was no such relationship, then the appropriate model would be FE. The test results are obtained from running the Hausman test on the RE model and testing the hypotheses as stated below. The null and alternative hypotheses for the Hausman test are as follows:

Null (H_0): Random effects model is appropriate

Alternative (H_1): Fixed effects model is appropriate

Table 4.3 depicts the properties of the estimates under FE and RE models and the null and alternative hypotheses.

Table 4.3: Properties of estimates under Hausman test

Estimation model	Random Effects	Fixed Effects
Random Effects	Consistent and efficient	Inconsistent
Fixed Effects	Consistent and inefficient	Consistent and probably efficient

This test computes the chi-square statistic (Chi-sq) and if this statistic is significant, we reject the null hypothesis and conclude that the FE model is appropriate, otherwise the RE is preferred.

4.7 Nonstationary Panel data

For establishing a meaningful relationship between private capital formation in the SADC countries, it is imperative to determine the properties of data. In order to attain our second objective of long-run relation within the PCF model, inference on such test relies on the stationarity properties of the individual series. A stochastic process, correspondingly a time series, is stationary if the means and variances of such series are constant overtime and the covariances between the two time periods t and $t + k$, depend only on the distance k between these two time periods and not on the actual time period t at which these covariances are measured (Katos, Lawler and Seddighi: 2000). Theoretically, non-stationarity implies that the mean, variance and covariance of the distribution from which the series of observations were drawn is not constant, but depends on the time at which the observations were made (Harvey, 1990).

In empirical research, running a regression of one unit root series may lead to spurious regression, which will then affect the power of the standard statistical tests (F and t-tests). Numerous solutions are proposed on how to handle such data in case it contains unit root. This include taking the first differences of the series to in order to remove the unit root or sometimes by combining the different sets of data at level form if they are cointegrated. A data series that is to be differenced d times to achieve stationarity is said to be integrated of order d. The works of Levin, Lin and Chu (2002), Im, Pesaran and Shin (2003) and Breitung (2000) have

proposed the tests to be used when determining the stationarity of the time series data. The detailed description of each test is provided below.

4.7.1 The Levin-Lin-Chu(LLC) Panel Unit root test

Levin, Lin and Chu (2002) argue that stationarity tests based on individual series are prone to limited power and as a result extends the conventional augmented Dickey-Fuller test (ADF) of the form $\Delta Y_{it} = \phi_i Y_{i,t-1} + \varphi_i d + \sum_{L=1}^{p_i} \theta_{ij} \Delta Y_{i,t-j} + \pi_{it}$ (4.28)

where Δ is the first difference operator, Y_{it} is the variable to be tested for unit root, π_{it} is a white-noise disturbance with a variance of σ^2, and t = 1, 2,...., T. The null hypothesis of $\phi = 0$ (unit present in each time series) is tested against the one-side alternative hypothesis of $\phi < 0$ (each series is stationary), which corresponds to Y_{it}. The lag order p is allowed to vary across individuals. Levin, Lin and Chu (2002) attest that the panel approach increases power in fixed samples when compared to the ADF test and hence proposed a panel-based version of 4.28 that restricts $\hat{\phi}_i$. The steps involve the estimation of (4.28) with $\Delta Y_{i,t-j}$ and d as independent variables in order to obtain the residuals $\hat{e}_{it}$ and the estimate again $\Delta Y_{i,t-1}$ on $Y_{i,t-j}$ and d to obtain the residuals $\hat{v}_{i,t-1}$. Standardising these newly obtained residuals ($\hat{e}_{it}$ and $\hat{v}_{i,t-1}$) by dividing by the standard errors from the ADF, we have:

$$\tilde{e}_{it} = \hat{e}_{it} / \hat{\sigma}_{\varepsilon_i} \quad (4.29)$$

and

$$\tilde{v}_{i,t-1} = \hat{v}_{i,t} / \hat{\sigma}_{\varepsilon_i} \quad (4.30)$$

Finally (4.29) is regressed on (4.30) as :

$$\tilde{e}_{it} = \phi \tilde{v}_{i,t-1} + \tilde{\pi}_{it} \quad (4.31)$$

The null hypothesis is $\phi = 0$

4.7.2 The Im-Pesaran-Shin (IPS) panel unit root test

The IPS (Im, Pesaran and Shin, 2003), unlike the LLC test is not restrictive since it allows for heterogeneous parameters. It is based on the group mean approach and assumes heterogeneity of first order autoregressive estimates and utilises a standard t_bar statistic based on the individual ADF statistics. The null hypothesis is that each series contains unit root, while the alternative hypothesis allows for some of the individual series to have unit root. This statistic is given as:

$$\overline{Z} = \sqrt{N}[\bar{t} - E(\bar{t})] / \sqrt{Var(\bar{t})} \quad (4.32)$$

Where $\bar{t} = (1/N)\sum_{i=1}^{N} t_{\beta_i}$, $E(\bar{t})$ and $Var(\bar{t})$ are mean and variance of each t_{β_i} statistic and the $\bar{Z}$ converges a standard normal distribution. IPS also demonstrates that it is more powerful than the LLC test discussed in limited samples.

4.7.3 Breitung's panel unit test

This procedure came as a result of some deficiencies within both the LLC and IPS tests, especially one on size distortions as the number of countries (N) increases relative to the length of series (T). Breitung (2000) test is very much similar to the LLC test, except that it does not include the deterministic terms. Only $\Delta Y_{i,t-j}$ is the repressor on ΔY_{it} to get $\hat{e}_{it}$ and $Y_{i,t-j}$ is regressed on $\Delta Y_{i,t-1}$ to obtain $\hat{v}_{i,t-1}$. Transforming these two residuals using Arellano and Bower (1995) orthogonalisation to obtain:

$$e^{*}_{it} = \sqrt{\frac{T-t}{T-t+1}}\left(\tilde{e}_{it} - \frac{\tilde{e}_{i,t+1} + ...\tilde{e}_{i,T}}{T-t}\right) \qquad (4.33)$$

And

$$v^{*}_{i,t-1} = \begin{cases} \tilde{v}_{i,t-1} - \tilde{v}_{i,1} - \dfrac{t-1}{T}\tilde{v}_{iT} & \text{with intercept and trend;} \\ \tilde{v}_{i,t-1} - \tilde{v}_{i,1} & \text{with intercept, no trend ;} \\ \tilde{v}_{i,t-1} & \text{no intercept or trend.} \end{cases} \qquad (4.34)$$

The pooled regression will now be

$$e^*_{it} = \phi v^*_{i,t-1} + \pi^*_{it} \qquad (4.35)$$

The null hypothesis of presence of unit root ($H_0 : \phi = 0$) is tested against the alternative of no unit root in the series.

4.7.4 Fisher-type unit test

Maddala and Wu (1999) and Choi (2001) proposed a Fisher-type test which combines the probability values (p - values) from unit root tests for each cross-section and test for presence of unit root in panel data. The Fisher equation is given as

$$P = -2\sum_{i=1}^{N} \ln p_i \qquad (4.36)$$

Where the probability (p) is distributed as a Chi-square with $2N$ degrees of freedom as $T_i \to \infty$. Unlike the previously discussed tests, this test does not require a balanced panel.

4.8 Hypothesis Testing

In order to achieve the main objective of the study and respond to the research questions, it is imperative to state the hypotheses to be tested. The main hypothesis tested in this study is that a debt does not have any effect on private capital formation in the SADC countries. This is formally stated as:

Null $H_0 : \theta = 0$

where θ_i is a coefficient vector of predictor variables (debt and public capital formation in this case).

Alternative $H_1 : \theta \neq 0$

The null hypothesis is tested based on the significance of the F-statistics. If the probability value of the F-statistic is below 10 percent, we reject the null hypothesis in favour of the alternative hypothesis, and conclude that all variables significantly explain private capital formation in the SADC region.

Specific hypotheses tested are:

- Debt does not have any effect on PCF in the SADC countries.
- There is no relationship between private capital formation and public capital formation
- Private capital formation is not reversible in the SADC countries.

The hypothesis of non-reversibility will be based on the regression equation 4.27 against the alternative of reversibility. The empirical findings of this study will provide some new evidence on non-reversibility of capital formation in the SADC bloc, particularly with regard to private capital formation-debt and private capital formation-public capital formation relationships. The study extends the existing literature on private capital formation in developing countries in two directions: first, by moving away from the traditional modeling or from specific to general modeling,

to general to specific modeling, and also by utilizing both the panel estimation and the irreversible functions technique, the methods that are scantly used in developing countries to analyse the impact of public policy on private capital formation. The interpretation, credibility and reliability of the regression results as well as the recommendations are done cautiously bearing in mind the nature of the panel data applied in the study. The usefulness and the reliability of the regression results will be judged based of the statistical tests such as the goodness of fit of the model (R^2), the t-statistics and the F-statistics coupled with the corresponding probability values (p-value), the chi-square statistics where necessary.

Chapter 5

ESTIMATION RESULTS

5.0 Introduction

This chapter presents and discusses the panel data estimation results based on the econometric model presented in chapter 4 of this study. The chapter is divided into five sections, namely: section 5.1 which discusses the nature of data and variables used, secondly, section 5.2 presents and discusses the panel unit root tests results; thirdly, section 5.3 gives a synopsis of the regression results from the pooled effects regression, the random and fixed effects models as well as the Hausman test; fourthly, section 5.4 presents the cointegration regression results. The reversibility results are presented in section 5.5 followed by the summary of the chapter in section 5.6.

The reliability of the results is done on both *a priori* criterion as well as on statistical test criterion. The reliability of *a priori* criterion is determined by the principles of economic theory and refers to the sign of the coefficient as deemed by economic theory. If the estimate coefficient(s) turn(s) up with the wrong signs or magnitudes, they are rejected, meaning that the observations are not the true representatives of the data. On statistical criterion, the statistical theory aims at evaluating statistical reliability of estimates of parameters. The tests normally used include the t-ratios, the Chi-square statistics, coefficient of determination, and many more. The reliability of data is based on the probability value associated with the statistic

being examined. If the probability value is above 5 percent, the estimate in question is considered insignificant.

5.1 The Nature of Data and Variables

The nature of data for respective variables used in the study is summarized in Table 5.1 below. The residuals from some of the variables in level form do not satisfy the normality test. From the descriptive statistics, it is observed that the null hypothesis that residuals from fiscal balance(FB), real growth of GDP, gross national savings (GNS), current account balance (CAB), private capital formation (PCF), public capital formation (PuCF), polity measure (POL), the SADC's measure of debt (Debts and Tdebt), real interest rate (RIR), foreign aid (FAID) and inflation (CPI) variables are normally distributed is rejected at 1 percent level of significance (indicated by low p-value of Jarque-Bera statistic[5]). The non-normality of residuals from the variables could be attributed to the observed structural breaks and the presence of outliers present in the data.

[5] This statistic proposed by Jarque-Bera (1982) is used to test for normality of residuals and is computed as $JB = [n/6SK^2 + n/24(EK-3)^2]$, where n=number of observations, SK= a measure of skewedness of the distribution, and EK= measure of kurtosis of the distribution

Table 5.1:Descriptive statistics for variables used in the study

Variable:	*PCF*	*PUCF*	*RGDP*	*RIR*	*GNS*	*DEBTS*	*TDEBT*	*CPI*	*CAB*	*FB*	*FAID*	*POL*
Mean	15.75310	8.619536	4.205096	10.00799	14.74833	24.01193	74.86481	121.2892	-6.153774	-3.377105	10.21195	-3.622378
Median	14.88597	7.578981	4.200000	8.408556	15.41000	13.15600	13.15600	10.66100	-6.106000	-3.507000	6.884217	5.000000
Maximum	120.9498	136.9043	23.42000	238.0000	81.91300	333.9980	333.9980	23773.10	25.63500	36.98000	95.36068	10.00000
Minimum	-2.98450	-117.5922	-23.98300	-94.21994	-112.4530	0.000000	0.00000	-8.569000	-48.04400	-40.41900	-0.242571	-88.00000
Std. Dev.	10.25078	11.05204	4.973937	22.82544	29.90166	37.22946	37.26931	1195.982	10.85061	7.674699	10.98520	20.86012
Skewness	2.843594	1.563440	-0.438750	3.579923	-1.084478	3.859069	3.859069	18.25661	-0.398260	0.065025	2.626057	-3.089477
Kurtosis	27.67145	91.95590	7.414163	35.83263	5.953910	22.70403	22.70403	357.3516	4.677925	7.896476	14.73366	12.18260
J-Bera	137499.8	1699468.	4344.664	242223.1	2880.725	96057.03	8004.752	27219672	739.9986	5146.368	35449.04	26276.17
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	81096.95	44373.37	21647.83	51521.12	75924.40	123613.4	10301.12	624396.6	-31679.63	-17385.34	52571.09	-18648.00
Sum SqDev.	540839.3	628694.1	127337.1	2681592.	4601982.	7133912.	594492.7	7.36E+09	605986.0	303163.5	621112.7	2239690
Observations	5184	5184	5184	5184	5184	5184	5184	5184	5184	5184	5184	5184
Cro-sections	12	12	12	12	12	12	12	12	12	12	12	12

In addition to the normality information as indicated, the other summary statistics based on the mean, minimum, maximum as well as the standard deviation indicate that fiscal balance averages -3.38 while the maximum is recorded at 36.98 percent and the standard deviation sits at 7.67. The summary statistics also shows that the ratio of private capital formation to GDP (the dependent variable) ranged from -2.98 and 120.95 percent and averaged about 16 percent between 1980 and 2015. Debt service ratio on the other hand showed an average of 24.011 percent, which suggests that about 25 percent of the 12 SADC countries' export earnings are used to service the external debt and this value could be as high as 334 percent. Gross national savings averaged about 15 percent between 1980 and 2015 and this figure wavered in the region of -112.45 to 81.91 percent with the standard deviation of about 28 percent. The lack of savings by the SADC nationals poses a big risk for investment and development; as such savings could have provided funds for investment and for the betterment of the region in the form of capital formation and economic development.

Another variable of interest is the political instability (proxied by polity), which measures the extent of democracy and this variable averaged -3.622 and a median of 5. Most SADC nations are still faced with some political instability, especially with regard to political authority during the elections. This instability reduces the investor confidence and the business confidence, which leads to low rates of investment (foreign investment) by international investors. Tables 5.2 and 5.3 show the ranges of correlation coefficients and the correlation matrix respectively. The values -0.21 and -0.14 indicate that there is a negative association between

private capital formation and the debt variables (debt service and total debt). This suggests that private capital formation could be reduced by about 21 percent if debt service ratio is not reduced significantly and that 21 percent of income is used to service the debt. The correlation matrix table also shows that polity, inflation and current account balance exert negative influence on private capital formation. Real growth of GDP on the other hand indicates that when positive growth is experienced, private capital formation will increase by 16 percent. The study considers the following ranges for the correlation coefficient to determine the relationship between the variables and reveal if there is any multicollinearity between the explanatory variables

Table 5.2: Correlation coefficient ranges

Correlation	Strength of the linear relationship
$r < \pm 0.20$	None to extremely weak
$-0.20 \leq r < -0.40$ or $0.20 \leq r < 0.40$	Weak
$-0.40 \leq r < -0.60$ or $0.40 \leq r < 0.60$	Moderate
$-0.60 \leq r < -0.80$ or $0.60 \leq r < 0.80$	Strong
$-0.80 \leq r < -1$ or $0.80 \leq r < 1$	very strong
$r = \pm 1$	Perfect

Source: Arranged by author

Table 5.2 gives a synopsis of correlation coefficients and how to determine the relationship and direction between the variables. The relationship between most of the independent variables as shown in table 5.3 indicate that the relationship

ranges from extremely weak to weak as revealed by the values of the correlation coefficient that are below the 0.40. For more analyses, see table 5.3.

Table 5.3:Correlation Matrix in the 12 SADC countries (excluding South Africa)

Correlation	*PCF*	*PUCF*	*RGDP*	*RIR*	*GNS*	*DEBTS*	*TDEBT*	*CPI*	*CAB*	*FB*	*FAID*	*POL*
PCF	1.000000											
PUCF	-0.314774	1.000000										
RGDP	0.151741	0.019250	1.000000									
RIR	-0.153573	-0.236255	-0.055038	1.000000								
GNS	-0.138736	-0.257631	0.140440	0.141266	1.000000							
DEBTS	-0.207199	0.167594	-0.122239	-0.064485	-0.108569	1.000000						
TDEBT	-0.140818	0.094249	-0.178734	0.089537	-0.157591	0.242998	1.000000					
CPI	-0.017397	-0.054737	-0.080203	0.274559	0.052935	-0.030867	0.195975	1.000000				
CAB	-0.161643	-0.184450	0.124266	-0.081850	0.314556	-0.153389	-0.245935	-0.092729	1.000000			
FB	0.104529	-0.041170	0.311335	0.065386	0.241894	-0.168799	-0.324817	-0.113811	0.278939	1.000000		
FAID	-0.120976	0.354305	-0.010435	-0.062977	-0.314374	0.287053	0.448385	-0.038537	-0.246585	-0.079014	1.000000	
POL	-0.089181	0.190177	0.146341	-0.260512	0.025419	-0.099553	-0.359374	-0.297554	0.018819	0.261537	-0.056981	1.000000

Source: Author

Notes: This correlation matrix is for the SADC countries excluding South Africa, Zimbabwe and Namibia.

Public capital formation seems to be crowding out private capital formation in the 12 SADC countries, as higher government expenditures on capital projects seem to contribute negatively (-0.314). The correlation matrix (table 5.3) does not indicate the presence of linear association between the explanatory variables within the 12 SADC countries as based on the ranges presented in table 5.2, this suggests that the presence of multicollinearity is ruled out since most of the correlation coefficients are below the 40 percent, except for one between total debt and foreign aid, where it is recorded at about 44 percent.

Three other SADC countries (South Africa, Namibia and Zimbabwe) are excluded from the reported correlation matrix (table 5.3) for various reasons. Firstly, most macroeconomic data on Zimbabwe is not reported or available while in the case of the Namibian economy, most macroeconomic data is only available from the year 1990 (from year of independence from South Africa). Lastly, the South African economy does not necessarily rely on foreign aid for its capital formation. The inclusion of the foreign aid variable seeks to find the contribution that this variable has on private capital formation in the countries other than South Africa. Since the inclusion of South Africa in the second panel will give an indication of the impact this country has over the rest of the SADC countries. The linear association between the variables is likely to change and table 5.4 gives the correlation matrix for the 13 SADC countries. Using table 5.2 to make inferences on multicollinearity, the results indicate that there is extremely weak to weak linear association between the variables. This is shown by the correlation coefficients that range from zero to just less than 40 percent. It should also be noted that these correlation

matrices (tables 5.3 and 5.4) do not in any way represent a test for multicollinearity but serve as pre-tests.

Table 5.4:Correlation Matrix in the 13 SADC countries (excluding Namibia and Zimbabwe)

Correlation	*PCF*	*PUCF*	*RGDP*	*RIR*	*GNS*	*DEBTS*	*TDEBT*	*CPI*	*CAB*	*FB*	*POL*
PCF	1.000000										
PUCF	-0.304956	1.000000									
RGDP	0.154504	0.029942	1.000000								
RIR	-0.152543	-0.223673	-0.047069	1.000000							
GNS	-0.137173	-0.261000	0.131165	0.134011	1.000000						
DEBTS	-0.205780	0.147864	-0.132485	-0.069950	-0.098225	1.000000					
TDEBT	-0.100537	0.118002	-0.13922	0.111181	-0.229704	0.179362	1.000000				
CPI	-0.016036	-0.050547	-0.076230	0.275312	0.051282	-0.033077	0.187382	1.000000			
CAB	-0.170145	-0.197008	0.108146	-0.095136	0.313407	-0.134645	-0.217605	-0.096545	1.000000		
FB	0.107410	-0.043186	0.303840	0.060194	0.238642	-0.164626	-0.281927	-0.114002	0.274120	1.000000	
POL	-0.080147	0.169017	0.142729	-0.251744	0.028316	-0.081691	-0.333631	-0.286287	0.036982	0.260524	1.000000

Source: Author

5.2 Panel Unit root tests

5.2.1 Panel unit root tests for the 12 SADC countries excluding SA

The preliminary unit root test was done using the graphs and the autocorrelation functions (ACF), the results of which are presented in Appendix B. The results from this preliminary analysis showed that almost all the variables are integrated of order zero. It is worth noting to indicate that the graphical presentation of the unit root test is not sufficient to draw conclusions on the variables about their stationarity status. It is therefore imperative to perform the analysis using the tests outlined in chapter four, section 4.5.1. The results from these test criteria are presented in tables 5.5 through 5.9.

Table 5.5:Panel unit root test results using a model with individual intercept only

Name of variable	LLC t-statistic	IPS	ADF - Fisher Chi-square	PP - Fisher Chi-square	Lag length (SIC)
PCF	-2.75177***	-3.30774***	57.0331***	54.2325***	0-2
POL	-0.97922	-1.3471*	40.0976**	36.5688**	0-1
PUCF	-5.72265***	-7.2588***	108.105***	111.28***	0-3
RGDP	-10.6747***	-11.3078***	166.150***	187.096***	0-3
GNS	-3.07933***	-4.98353***	70.7723***	57.8890***	0-5
FB	-6.33520***	-6.25288***	86.3379***	82.1318***	0-1
DEBTS	-4.25176***	-4.95879***	73.1405***	92.0953***	0-1
CAB	-3.87696***	-5.18157***	73.3617***	76.0749***	0-1
CPI	-7.47105***	-7.58875***	107.817***	116.346***	0-3
FAID	-3.37447***	-3.11915***	46.8264***	47.3125***	0-3
RIR	-3.37447***	-3.11915***	46.8264***	47.3125***	0-3

Notes: All variables are at levels. Asterisks ***, ** and * indicate significant at 1%, 5%, and 10% level of significance respectively. The lag length is determined using the Schwarz Information Criterion (SIC)

The stationarity test (table 5.5) results revealed that the variables private capital formation, public capital formation, real gross domestic product, fiscal balance, current account balance, debt service ratio, inflation, foreign aid and real interest rate contain no unit root at 1 percent level of significance, while the instability measure (polity) and the gross national savings show no unit root at 5 percent level. Since debt variable (DEBTS) could be serially correlated with total debt (TDEBT), although the correlation matrix did not show any sign, the TDEBT variable was excluded in table 5.5. The panel unit root test results that have TDEBT but no DEBTS are reported in table 5.6 below.

Table 5.6:Panel unit root test results using a model with individual intercept only

Name of variable	LLC t-statistic	IPS	ADF - Fisher Chi-square	PP - Fisher Chi-square	Lag length (SIC)
PCF	-2.75177***	-3.30774***	57.0331***	54.2325***	0-2
POL	-0.97922	-1.3471*	40.0976**	36.5688**	0-1
PUCF	-5.72265***	-7.2588***	108.105***	111.28***	0-3
RGDP	-10.6747***	-11.3078***	166.150***	187.096***	0-3
GNS	-3.07933***	-4.98353***	70.7723***	57.8890***	0-5
FB	-6.33520***	-6.25288***	86.3379***	82.1318***	0-1
TDEBT	-0.12307	-0.82021	25.7423	21.5242	0-8
CAB	-3.87696***	-5.18157***	73.3617***	76.0749***	0-1
CPI	-7.47105***	-7.58875***	107.817***	116.346***	0-3
FAID	-3.37447***	-3.11915***	46.8264***	47.3125***	0-3
RIR	-3.37447***	-3.11915***	46.8264***	47.3125***	0-3

All variables are at levels. Asterisks ***, ** and * indicate significant at 1%, 5%, and 10% level of significance respectively. The lag length is determined using the Schwarz Information Criterion (SIC)

The results from table 5.6 show that total debt is non-stationary in the model with individual intercept only while the rest of the variables show no presence of unit root. The results from tables 5.5 were retrieved from a model with individual intercept only. In order to determine the significance of both the intercept and trend within the unit root test, a second model that has both the trend and intercept was estimated and the results are presented in table 5.6.

Table 5.7: Panel unit root test results using a model with individual intercept and trend

Name of variable	LLC t-statistic	IPS W-statistic	ADF - Fisher Chi-square	PP - Fisher Chi-square	Breitung t-statistic
PCF	-3.52847***	-4.11242***	60.2186***	53.2843***	-3.49337***
POL	-0.10337	-0.31436	24.8660	26.1140	-2.82382***
PUCF	-4.74122***	-6.00929***	85.5593***	105.573***	-4.79569***
RGDP	-11.9052***	-12.2208***	169.292***	274.649***	-8.01187***
GNS	-2.66220***	-3.70799***	52.7262***	40.7937**	-4.01506***
FB	-6.01221***	-6.15574***	85.0252***	68.9691***	-4.34860***
DEBTS	-6.94740***	-6.14762***	93.5820***	98.8684***	-2.41317***
CAB	-3.53236***	-6.14762***	96.1128***	60.0627***	-3.38992***
CPI	-8.37772***	-8.40862***	110.663***	357.566***	-6.31433***
FAID	-3.42333***	-1.26518	32.3288	30.9825	-2.88186***
RIR	-9.05581***	-8.52693***	126.451***	119.606***	-5.26151***

All variables are at levels. Asterisks ***, ** and * indicate significant at 1%, 5%, and 10% level of significance respectively. The lag length is determined using the Schwarz Information Criterion (SIC)

The results show that almost all variables are stationary at levels (table 5.6(a)), while table 5.6(b) shows that total debt is only stationary under the Levin, Lin and Chu test at 5 percent level of significance.

The unit root test results pertaining to the parameterised equations (4.28, 4.32, 4.33 and 4.36) where the intercept and the trend were included in the equations are presented in table 5.6, the appropriate lag length was determined using the Schwarz information criterion (SIC). The reported results reveal that the variables are stationary at levels and therefore integrated of order zero, I(0), whereas the polity variable is only stationary under the Breitung test. For this particular variable (polity), the presence of a trend within the model renders that trend insignificant as the variable was found to be stationary at levels using three other tests (IPS, ADF, PP). When the equations exclude both the intercept and the trend, the results reveal that the Fisher-type tests (ADF and PP) confirm stationarity at levels. However, the dependent variable now appears only stationary at levels under the LLC test. The rest of the variables remain integrated at order zero (See tables 5.7).

Table 5.8:Panel unit root test results without individual intercept and trend

Name of variable	LLC t-statistic	ADF - Fisher Chi-square	PP - Fisher Chi-square	Lag length (SIC)
PCF	-1.49361*	31.4704	31.6751	0-6
POL	-0.79642	57.7310***	59.0317***	0
PUCF	-2.77421***	52.5815***	56.2628***	0-2
RGDP	-5.76189***	99.1118***	122.796***	0-7
GNS	-2.4405***	36.9143**	34.8621*	0-1
FB	-7.06241***	93.0623***	94.0548***	0-1
DEBTS	-4.11304***	67.1584***	78.4835***	0-2
TDEBT	-1.50703***	21.0433	20.1591	0-3
CAB	-4.63101***	71.9120***	75.5574***	0-2
CPI	-5.59475***	95.5810***	117.689***	0-8
FAID	-3.66881***	45.8915***	50.3521***	0-1
RIR	-3.54717***	71.1763***	117.208***	0-2

Asterisks ***, ** and * indicate significant at 1%, 5%, and 10% level of significance respectively. The lag length is determined using the Schwarz Information Criterion (SIC)

Accordingly, the above discussions on the unit root lead to the application of stationarity panel data regression techniques (the pooled, fixed and random effects) since the variables are I(0).

5.2.2 Panel unit root tests for the 13 SADC countries (including South Africa)

Tables 5.9 and 5.10, display stationarity in private capital formation, polity variable (instability measure), public capital formation, real GDP, gross national savings, fiscal balance, debt service, current account balance, inflation as well as interest rates.

Table 5.9:Panel unit root test results using a model with individual intercept only

Name of variable	LLC t-statistic	IPS	ADF - Fisher Chi-square	PP - Fisher Chi-square	Lag length (SIC)
PCF	-2.83660***	-3.46662***	60.9994***	57.8855***	0-2
POL	-1.02086	-1.37596*	40.1461**	36.6178**	0-1
PUCF	-5.72310***	-7.25926***	108.112***	111.273***	0-3
RGDP	-11.1188***	-11.7528***	179.146***	187.094***	0-3
GNS	-4.24892***	-5.60978***	82.6901***	69.6746***	0-5
FB	-6.26662***	-6.24275***	89.6920***	86.1002***	0-1
DEBTS	-4.15098***	-5.12561***	77.9857***	96.9406***	0-1
TDEBT	2.7513**	-4.6102**	22.3546	20.9680	0-2
CAB	-3.46288***	-5.05216***	75.2829***	76.0755***	0-1
CPI	-7.28185***	-7.33295***	109.414***	117.335***	0-3
RIR	-8.57857***	-9.70920***	152.251***	152.352***	0-1

Asterisks ***, ** and * indicate significant at 1%, 5%, and 10% level of significance respectively. The lag length is determined using the Schwarz Information Criterion (SIC)

Table 5.10:Panel unit root test results using a model with individual intercept and trend

Name of variable	LLC t-statistic	IPS	ADF - Fisher Chi-square	PP - Fisher Chi-square	Breitung t-statistic
PCF	-3.47646***	-4.06430***	62.4343***	55.2808***	-3.50386
POL	-0.98068	-1.07032	34.2028**	30.6712	3.26709***
PUCF	-4.04300***	-5.67682***	86.4211***	105.614***	-1.50322*
RGDP	-12.2069***	-12.5483***	180.039***	285.205***	-8.21513***
GNS	-1.08384	-3.25459***	52.9265***	51.4221***	-3.71798***
FB	-5.82813***	-6.02774***	87.2592***	71.6708***	-4.46707***
DEBTS	-6.48012***	-6.06401***	96.1895***	102.008***	-2.48999***
TDEBT	-1.68805**	-1.8762**	71.0011**	25.0124	-1.3628
CAB	-3.53229***	-4.67244***	73.1125***	60.0637***	-3.38987***
CPI	-8.54263***	-8.28405***	113.707***	360.614***	-6.62476***
RIR	-9.18793***	-9.19037***	140.195***	132.955***	-4.98646***

Asterisks ***, ** and * indicate significant at 1%, 5%, and 10% level of significance respectively.

The data for the 13 country group reveal that the variables are stationary at levels, in other words they are integrated of order zero. The two panels (12 country and 13 country groups) showed mixed results with regard to stationary on the debt variables, while total debt was only stationary in at most one test in a group that excluded South Africa, this was not the case with a 13-country group (where South Africa was included).

5.3 Regression Analysis

The regression results of this study are presented under this section and the various models of private capital formation are estimated. The private capital

formation is estimated into two variations, one variation with South Africa and the other variation without South Africa. The distinction between these variations is grounded on the source of capital formation for each of the countries bearing in mind that the other countries other than South Africa rely on foreign aid for their capital formation. The two main variations are named the Neoclassical – foreign aid model of private capital formation as well as the Neoclassical – model of private capital formation. The former involves only 12 SADC countries (exclude South Africa) and the latter includes the 13 countries (includes South Africa). The next section reports the results following Dougherty's (2011) graphical presentation of the choice of regression model[6].

5.3.1 Pooled effects model

5.3.1.1 Pooled regression results from neoclassical model for 12-SADC countries

This section presents the regression results of a pooled effects model. This model assumes that differences among cross sectional units can be captured in a single intercept. The regression performed included all the explanatory variables as outlined in the methodology chapter, except that due to presence of serial correlation, the lagged private capital formation was also included as an explanatory variable. Table 5.10 presents the results from the pooled effects model where total debt was excluded in the regression. The relationship between private capital formation and debt service is found to be negative and statistically

[6] See section 4.5 of chapter 4

significant at 1 percent level. However, there seems to be a problem of serial correlation and to control this problem, the lagged PCF is included as part of explanatory variables in the model and the DW-statistic improves from 0.873307 to 1.897344. The coefficient of PCF(-1) suggest that the past values of private capital formation are positively related to current private capital formation. The variable, public capital formation (PuCF) on the other hand bears a negative sign and it is statistically significant at 1 percent. The results reveal that debt service and public capital formation discourage private formation in the 12 countries.

A similar conclusion is drawn from the total debt regression, where only total debt is included as the debt variable and the regression results indicate that when total debt increases by 1 percent, private capital formation will decrease by about 0.6 percent in the 12 countries. The low DW-statistic indicates the presence of serial correlation, which was corrected by estimating PCF with its lagged values (see table 5.10). The coefficient of total debt in the new estimation (-0.003114) implies that private capital formation will decline by approximately 0.3 percent. The other variables (public capital formation, current account balance, polity (political instability) and inflation all exert negative contribution on private capital formation in the 12 SADC countries. It is noted however, that the polity and total debt variables are significant at 10 percent level and are therefore rendered insignificant at a 5 percent level (p-values of 0.0622 and 0.0559 respectively). The fiscal balance and the current account balance variables show positive and negative contributory effects on private capital formation and they are significant at 1 percent. Thus, the contribution of these variables cannot be ignored, as it

impacts on the private sector investment in the 12 SADC countries. The sign of the FB term depends on the nature of the balance and if on average the 12 countries record fiscal deficits, and then a negative sign would be observed. But if the sign is positive as it is the case in this study, then the average fiscal balance for the 12 SADC countries has been a surplus.

Real GDP and gross national savings have positive signs respectively and are both statistically significant at 1 percent and 5 percent (see table 5.11) and both these variables bear the correct signs as postulated by economic theory. This contradicts the *apriori* expectation and the fact that savings are regarded as the main source of investment in any economy. Lastly, the price level has a negative sign, which supports the theoretical expectation.

Table 5.11:Results from Neoclassical – Foreign aid pooled effects model (debt service)

Dependent variable: PCF

Variables	Coefficient (tdebt)	Coefficient (tdebt) PCF(-1)	Coefficient (debts)	Coefficient (debts) PCF(-1)
Constant	8.688290*** (0.29958)	4.021889*** (0.27412)	9.047218*** (0.280576)	4.188404*** (0.265015)
PCF(-1)		0.478443*** (0.01047)		0.466590*** (0.010691)
PUCF	-0.375637*** (0.01131)	-0.341180*** (0.00955)	-0.364779*** (0.011165)	-0.338456*** (0.009546)
RGDP	0.176480*** (0.023550)	0.136786*** (0.02014)	0.156446*** (0.023216)	0.131450*** (0.020111)
GNS	0.409374*** (0.00989)	0.257272*** (0.00911)	0.045301*** (0.001075)	0.261530*** (0.009061)
FB	0.030830* (0.01676)	0.008911 (0.01460)	0.022195 (0.016352)	0.008211 (0.014438)
TDEBT	-0.005546*** (0.00191)	-0.003114* (0.00163)		
DEBTS			-0.041150*** (0.003091)	-0.014378*** (0.002706)
CAB	-0.390572*** (0.01135)	-0.247480*** (0.01035)	-0.396868*** (0.011183)	-0.253456*** (0.010389)
POL	-0.042153*** (0.00616)	-0.009806* (0.00526)	-0.044792*** (0.005898)	-0.044792*** (0.005899)
CPI	-0.000652*** (0.00010)	-0.000457*** (0.00008)	-0.000753*** (0.00097)	-0.000504*** (0.0001)
FAID	-0.010237 (0.01202)	0.052731*** (0.01028)	0.007108 (0.011086)	0.054153*** (0.009573)
RIR	-0.049283*** (0.00532)	-0.021836*** (0.00453)	-0.045301 (0.005236)	-0.020970*** (0.004517)
R^2 =	0.413354	0.591425	0.431868	0.593410
F stat	*364.4924****	*661.6531*	*393.2275****	*667.1155****
DW- stat	*0.800854*	*1.892661*	*0.873307*	*1.897344*

Asterisks *** and ** and indicate significance at 1% and 5% level of significance respectively.
Standard errors are in parentheses.

The foreign aid variable has a positive effect on private capital formation in the 12 SADC countries and it is statistically significant at 1 percent. The coefficient 0.052731 implies that foreign aid contributes around 5 percent in private capital formation.

5.3.1.2 Pooled regression results of 13-SADC countries (South Africa included)

Section 5.3.1.1 above presented the pooled estimation results for the 12 SADC countries, which are assumed to depend more on foreign aid for private capital formation. The next section (5.3.1.2) seeks to present the results from the pooled regression of the 13 SADC countries and the results are shown in table 5.12.

Table 5.12:Results from Neoclassical – pooled effects model (13 Country panel)

Dependent variable: Private capital formation

Variables	Coefficient (tdebt)	Coefficient (tdebt) PCF(-1)	Coefficient (debts)	Coefficient (debts) PCF(-1)
Constant	8.376570*** (0.25539)	4.027571*** (0.23258)	9.056527*** (0.23830)	4.511862*** (0.22397)
PCF(-1)		0.742092*** (0.01447)		0.460081*** (0.00942)
PUCF	-0.378716*** (0.00956)	-0.325820*** (0.00812)	-0.365421*** (0.00934)	-0.320439*** (0.00803)
RGDP	0.188724*** (0.02069)	0.156578*** (0.01766)	0.162995*** (0.02043)	0.148672*** (0.01769)
GNS	0.410576*** (0.00877)	0.256220*** (0.00811)	0.407758*** (0.00856)	0.257510*** (0.00806)
FB	0.030114** (0.01485)	0.018277 (0.01292)	0.020903 (0.01453)	0.013195 (0.01283)
TDEBT	-0.004817*** (0.00154)	0.001030 (0.00131)		
DEBTS			-0.040008*** (0.00265)	-0.012244*** (0.00233)
CAB	-0.395534*** (0.00997)	-0.261379*** (0.00905)	-0.401849*** (0.00979)	-0.268524*** (0.00905)
POL	-0.035208*** (0.00519)	-0.009413*** (0.00442)	-0.037401*** (0.00493)	-0.012993*** (0.00425)
CPI	-0.000627*** (0.00009)	-0.000506*** (0.00007)	-0.000727*** (0.00009)	-0.000530*** (0.00007)
RIR	-0.051275*** (0.00472)	-0.021987*** (0.00403)	-0.046561*** (0.00465)	-0.021427*** (0.00402)
R^2	*0.412787*	*0.590406*	*0.431723*	*0.592135*
F stat	*510.9743****	*916.6145****	*552.2208****	*923.1949****
DW- stat	*0.798252*	*1.910686*	*0.870400*	*1.910870*

Asterisks *** and ** and indicate significance at 1% and 5% level of significance respectively. Standard errors are in parentheses.

The results in table 5:12 reveal that the variables PUCF, TDEBT, CAB, POL, CPI and RIR contribute negatively towards private capital formation and the coefficient of TDEBT (-0.004817) implies that total debt reduces private capital formation by about 0.5 percent. The results however showed the presence of serial correlation (low DW-stat) and this problem was remedied by including lagged PCF as part of the explanatory variables. With the use of the lagged values of the dependent variable (PCF) in the regression the DW-statistic improved from 0.798252 to 1.910686. It is however noted that the variables fiscal balance and the total debt have now become insignificant, while at the same time.

The estimation results of the pfc model with exclusion of debt service ratio variable are reported in columns 3 and 4 in table 5. It should also be noted that the foreign aid variable was dropped in this regression since it was assumed that the South African economy do not necessarily rely on foreign aid for its private investment. The results show negative relationship between private capital formation and public capital formation, debt service, current account balance, polity (measure of political instability), inflation as well as interest rate. On one hand, real growth of GDP, gross national savings and fiscal balance exerted positive contribution on private capital formation, despite the insignificance of the fiscal balance variable. The R - squared (0.431723) implies that about 43 percent of variation in private capital formation in the 13 SADC countries is due to changes in the explanatory variables included in the model. The inclusion of lagged values of private capital formation has resulted in an improved DW –statistic from 0.870400 to 1.910870.

The coefficients of the variables still bear the similar signs as in column 2 and 4 of table 5:11, with the fiscal balance being insignificant.

5.3.2 Fixed and Random Effects models results

This section presents the regression results from the panel fixed effects model (4.46) as well as the random effects model (4.47). The FE model assumes that there could be unobserved factors within the individual countries that need to be controlled, which may impact on the explanatory variables. The RE model assumes that the differences across the nations is random and uncorrelated with the regressors. The results of the debt and total debt FE model for a 12-country panel are presented in table 5.13.

Table 5.13:Results from the panel fixed effects model (total debt and debts) of 12 nations

Dependent variable = PCF

Variables	Coefficient (tdebt)	Coefficient (tdebt) PCF(-1)	Coefficient (debts)	Coefficient (debts) PCF(-1)
Constant	11.51162*** (1.174643)	6.847649*** (1.187762)	11.37199*** (1.130918)	6.675683*** (1.156248)
PCF(-1)		0.385103*** (0.039998)		0.380962*** (0.040337)
PUCF	-0.354704*** (0.037545)	-0.344297*** (0.034138)	-0.356435*** (0.037427)	-0.345833*** (0.034139)
RGDP	0.187700** (0.076736)	0.147504** (0.070809)	0.184081** (0.076810)	0.142691** (0.071029)
RIR	-0.005098 (0.019309)	0.000151 (0.017659)	-0.000429 (0.019257)	-0.002710 (0.017688)
GNS	0.299219*** (0.044059)	0.221328*** (0.041012)	0.309273*** (0.043432)	0.229804*** (0.040630)
FB	-0.050153 (0.059197)	-0.030334 (0.055133)	-0.039020 (0.058809)	-0.022067 (0.054894)
TDEBT	-0.015945** (0.006652)	-0.010571* (0.006134)		
DEBTS			-0.032563*** (0.011400)	-0.017554* (0.010538)
CAB	-0.380739*** (0.040314)	-0.263770*** (0.039493)	-0.372865*** (0.040290)	-0.260761*** (0.039489)
POL	-0.030902 (0.023033)	-0.011853 (0.021115)	-0.033158 (0.022979)	-0.011931 (0.021163)
FAID	-0.014921 (0.047237)	0.037421 (0.043730)	-0.044558 (0.044495)	0.016122 (0.041634)
CPI	-0.000760** (0.000317)	-0.000543* (0.000288)	-0.000868*** (0.000315)	-0.000613** (0.000287)
R^2	*0.5308*	*0.622330*	*0.5335*	*0.6221*
F- stat	*22.088*	*29.73550*	*22.3298*	*29.71220*
DW-stat	*0.98918*	*1.80204*	*1.042237*	*1.82435*

Asterisks ***, ** and * indicate significant at 1%, 5%, and 10% level of significance respectively. Standard errors are in parentheses.

The results of the fixed effects model for the 12-country panel suggest that first, the effect of public capital formation is significant at 1 percent at both the neoclassical total debt and debt service models and these variables are found to have a negative impact on private capital formation. Secondly, the growth of GDP and the gross national savings are significant at 5 and 1 percent respectively and their impact on private capital formation is positive. Thirdly, the real rate of interest has a negative effect although insignificant at all levels. This is as the expected from the neoclassical investment theory. Fourth, the fiscal balance is positive but insignificant, which could justify that on average the SADC countries often register budget deficits. Fifth, the effect of both the total debt and the debt service ratio is negative and the variables are significant at 5 and 1 percent. sixth, the variables current account balance (CAB), polity (POL), foreign aid (FAID) and inflation (CPI) all have negative effect on private capital formation even though CAB and CPI are the only significant variables amongst the four. The R^2 in both regressions reveals that about 54 percent of variation in private capital formation is due to the included explanatory variables. Finally, the presence of serial correlation required the estimation of the PCF with lagged values of PCF as part of the explanatory variables. The results improved and the DW-statistics increased to 1.80204 and 1.82435 in both the total debt and debt service regressions. Wooldridge (2000) and Pindycke and Rubinfield (1999) proposed the inclusion of the lagged dependent variable as a way of correcting the serial correlation.

The next section presents the estimation results for the 13-country panel, where two separate models (total debt and debt service) are estimated. The results of these estimations are shown in table 5.14.

Table 5.14: Panel fixed effects results of total debt and debt service in 13- country panel

Variables	Coefficient (tdebt)	Coefficient (tdebt) PCF(-1)	Coefficient (debts)	Coefficient (debts) PCF(-1)
Constant	11.13881*** (1.08782)	16.08244*** (1.458684)	10.85715*** (1.028002)	6.654766*** (1.027248)
PCF(-1)		0.639618*** (0.038091)		0.381199*** (0.037915)
PUCF	-0.359170*** (0.03476)	-0.517360*** (0.030903)	-0.368467*** (0.034447)	-0.342314*** (0.031385)
RGDP	0.201297*** (0.073310)	0.091802 (0.058973)	0.187889*** (0.073461)	0.149440** (0.067656)
RIR	-0.006155 (0.0.018347)	-0.002488 (0.017539)	-0.002763 (0.018344)	-0.003334 (0.016794)
GNS	0.303779*** (0.041767)	0.212989*** (0.046223)	0.312470*** (0.041356)	0.231249*** (0.038681)
FB	-0.054966 (0.056522)	0.018529 (0.055602)	-0.046280 (0.056274)	-0.022530 (0.052356)
TDEBT	-0.015903*** (0.006012)	-0.021656** (0.009472)		
DEBTS			-0.032018*** (0.010860)	-0.016778* (0.010008)
CAB	-0.388068*** (0.038592)	-0.226007*** (0.045284)	-0.378473*** (0.038576)	-0.266717*** (0.037625)
POL	-0.021336 (0.023033)	-0.029323 (0.021784)	-0.020973 (0.020364)	-0.008348 (0.018580)
CPI	-0.000736** (0.000304)	-0.000233 (0.000212)	-0.000834*** (0.000303)	-0.000609** (0.000275)
R^2	*0.5299*	*0.6880*	*0.5317*	*0.6229*
F- stat	*23.9439*	*43.3035*	*24.1129*	*32.4457*
DW-stat	*0.9824*	*2.0731*	*1.0199*	*1.8317*

The coefficients of TDEBT (-0.021656) and DEBTS (-0.016778) in the lagged model suggest that both total debt and debt service reduce private capital formation by about 2 percent despite debt service being insignificant. The other variables, PUCF, RIR, FB, CAB, POL and CPI all have negative signs, which agree with the theoretical expectations.

Following the above presentation of the results from the fixed effects model for the two panels (panels of 12 and 13 SADC nations), these results alone cannot be considered sufficient to warrant the use of the fixed effects regressions. The next section therefore, presents the random effects model regression results in line with section 4.5.1.3 as outlined in chapter four of this study. The regression of the random effects model follows the same format as in the fixed effects model, where two separate models are estimated with total debt and debt service. The separation of the two variables (debt service and total debt) was done to avoid any possible correlation(multicollinearity) between these variables.

Table 5.15:Panel random effects results (total debt and debt service) of 12 nations

Dependent variable = PCF

Variables	tdebt	tdebt with PCF(-1)	debts	debts with PCF(-1)
Constant	10.03699***	4.021889***	9.986426***	4.188404***
	(1.123189)	(0.937901)	(1.038904)	(0.909195)
PCF(-1)		0.478443***		0.466590***
		(0.035818)		(0.036679)
PUCF	-0.362702***	-0.341180***	-0.359731***	-0.338456***
	(0.036748)	(0.032688)	(0.036549)	(0.032751)
RGDP	0.185112**	0.136786**	0.165826**	0.131450*
	(0.075792)	(0.068920)	(0.075626)	(0.068997)
RIR	-0.026974	-0.021836	-0.025684	-0.020970
	(0.017985)	(0.015494)	(0.017766)	(0.015495)
GNS	0.359435***	0.257272***	0.370290***	0.261230***
	(0.036493)	(0.031157)	(0.035199)	(0.031085)
FB	0.0000	0.008911	0.005839	0.008211
	(0.055986)	(0.049956)	(0.055056)	(0.049537)
TDEBT	-0.010763*	-0.003114		
	(0.006375)	(0.005574)		
DEBTS			-0.037527***	-0.014378
			(0.010494)	(0.009285)
CAB	-0.384854***	-0.247480***	-0.386426***	-0.253456***
	(0.037847)	(0.035405)	(0.037430)	(0.035643)
POL	-0.039585*	-0.009806	-0.042221**	-0.010578
	(0.021152)	(0.017988)	(0.020457)	(0.017551)
FAID	-0.013627	0.052731	-0.014983	0.054153*
	(0.042192)	(0.035185)	(0.038911)	(0.032842)
CPI	-0.000706**	-0.000457	-0.000803**	-0.000504*
	(0.000316)	(0.000286)	(0.000314)	(0.000275)
R^2	*0.3833*	*0.5914*	*0.4004*	*0.5934*
F-Stat	*26.1719****	*53.6902****	*28.1237****	*54.1335****
DW-Stat	*0.87495*	*1.88842*	*0.92893*	*1.89319*

Asterisks ***, ** and * indicate significant at 1%, 5%, and 10% level of significance respectively. Standard errors are in parentheses.

The random effects estimation results for the 12-country panel reveal the following; first, the results from both the total debt and debt service models suggest that the effect of public capital formation is significant at 1 percent level of significance. Second, the effect of real growth rate of gross domestic product (RGDP) on private capital formation is positive and the estimated coefficients are significant at 5 percent level. Third, the real rate of interest (RIR) has a negative effect, though insignificant at all levels. Fourth, the effect of gross national savings (GNS) on private capital formation is positive and significant at 1 percent level of significance. Fifth, the effect of fiscal balance is found to be insignificant and the coefficient in the total debt model is almost zero while in the debt service model the coefficients suggest that fiscal balance contributes about 0.9 percent in private capital formation. Sixth, total debt is found to have a negative effect and statistically significant at 10 percent. Seventh, the effect of current account balance on private capital formation is negative and significant at 1 percent level of significance. Eighth, the polity variable that measures the extent of political instability has a negative effect and it is statistically significant at 10 percent. Ninth, foreign aid is found to be insignificant while inflation is significant at 5 percent.

Lastly, the estimation of private capital formation model with debt service yields results that are no different from those of total debt in terms of the significance except that debt service coefficient is highly significant at 1 percent level. The

other interesting results from the random effects for the 13 country panel are presented in appendix C19 through C22.

5.3.3 Model selection based on the F test and Breusch-Pagan LM test

Model selection when dealing panel data is very important in determining which of the three models as outlined by Dougherty (2011)[7]. One needs to determine if the data can be pooled (use of pooled effects), contains random or fixed effects. In order to achieve this goal (selecting appropriate model), the following table (5.16(a)) is used as a guideline.

Table 5.16(a): Different scenarios for model selection

	Randon effects B-P LM test	Fixed effects Wald (F) test	Appropriate model
Scenario 1	H_0 is not rejected (no RE)	H_0 is not rejected(no FE)	Pooled OLS
Scenario 2	H_0 is rejected (no RE)	H_0 is not rejected(no FE)	Random effects model
Scenario 3	H_0 is not rejected (no RE)	H_0 is rejected(no FE)	Fixed effects model
Scenario 4	H_0 is rejected (no RE)	H_0 is rejected(no FE)	Random and fixed effects models(choose either RE or FE based on Hausman test)

The F-test (Wald) as well the Breusch-Pagan Lagrange multiplier (LM) test are performed to select the model and the results are presented in table 5.16(b). in both the Wald and B-P LM tests, the null hypothesis is rejected and we conclude

[7] See figure 4.1 in chapter 4

that scenario 4 is applicable. The null hypothesis in the LM test is that there is no cross-section dependence in the residual (correlation) and this null is tested against the alternative hypothesis of presence of cross-section dependence.

Table 5.17(b):The results of the Breusch-Pagan LM and Wald (12 and 13-country panels)

	Randon effects B-P LM test	Fixed effects Wald (F) test	Decision & Model
12-Country panel	120.2809***	132.6376***	Reject null, RE and FE
13-Country panel	111.7204***	238.8113***	Reject null, RE and FE

Asterisks ***, ** and * indicate significant at 1%, 5%, and 10% level of significance respectively

Here we reject the null hypothesis in both the 12–country and 13– country panels and conclude that there is no cross-section (correlation) dependence in residuals. This is justified by the probability values (p-value) that are lower than 1 percent level of significance.

5.3.4. Hausman test

The inherent problem associated with the pooled effects regression has compelled the use of both the fixed and random effects regressions. The use of the Hausman (1978) test at this point seeks to establish if either the FE or the RE regression is preferred, especially when the results from the FE and the RE have provided different results. It is therefore worth noting that the study considers the test that can guide as to which regression model to apply in this study. At this juncture, the Hausman test is performed, with the null hypothesis being that the

RE model is appropriate, whereas the alternative hypothesis states that the FE model is appropriate. This test compares the coefficients from the two regressions (FE and RE) and has a Chi-square with degrees of freedom that corresponds to the number of exogenous variables in the model. If the null hypothesis is rejected, it would imply that the FE model is to be used to present the final results. Table 5.17 gives the summary of the Hausman test, the Chi-square statistic and the corresponding probability value.

Table 5.18:Hausman Test results for 12 and 13 – country panels

Test Summary	*Panel*	*Chi-Square Statistic*
Cross-section random (debts)	12	48.97985***
Cross-section random (total debt)	12	48.60826***
Cross-section random (debts)	13	58.55770***
Cross-section random (total debt)	13	69.75462***

Asterisks ***, ** and * indicate significant at 1%, 5%, and 10% level of significance respectively

The chi-square statistics of 48.97985 and 48.60826 for the 12 – country panel are highly statistically significant with probabilities of zero. These results indicate that the null hypothesis is rejected and the conclusion is that the individual effects are uncorrelated with the explanatory variables in the two regression models of the 12 – country panel. The 13 – country panel also displays the results where the null hypothesis is rejected at both the debt service (debts) and total debt (tdebt). Based on these findings, the study therefore concludes that the fixed model is appropriate.

5.3.5 Robustness and Heteroskedasticity

The estimation results displayed the presence of serial correlation and this was corrected by estimating the model with lagged private capital formation as an explanatory variable. The problem of heteroskedasticity was controlled by running a robust estimation of the fixed and random effects models, the results of which are presented in table 5.18.

Table 5.19: Regression results from the robust panel fixed effects model with lagged PCF

Dependent variable = PCF	Coefficient	Robust S.E	t-Statistic
PCF(-1)	0.378521***	0.123698	3.06
PUCF	-0.34552	0.249181	-1.39
FB	-0.03314	0.078529	-0.42
RGDP	0.143108*	0.073838	1.94
CAB	-0.26703**	0.095087	-2.81
DEBTS	-0.01681	0.012319	-1.36
POL	-0.01329	0.022333	-0.6
GNS	0.221158***	0.066778	3.31
CPI	-0.00055***	0.000117	-4.72
FAID	0.040338	0.037192	1.08
RIR	-0.00118	0.016575	-0.07
C	7.235884	4.949864	1.46
R^2 = *0.5818*	*rho = 0.1188*		*F-stat = 64351.17****

Asterisks ***, ** and * indicate significant at 1%, 5%, and 10% level of significance respectively.

5.4 The non-reversibility analysis of capital formation

The non-reversibility conditions are derived from the parameterised equation (4.27). The idea behind the reversibility is to establish if increases in selected explanatory variables outweigh the decreases of such variables and their impact on private capital formation within the SADC countries. The results of the non-reversibility analysis are presented in table 5.19 below.

Table 5.20:Results from the reversibility analysis of the private capital formation

Variable	Coefficient	Std. Error	t-Statistic
t	-4.077907	2.532070	-1.610504
PCF_R	-0.015734	0.021969	-0.716214
PCF_D	0.034485	0.015024	2.295325**
PUCF_R	0.017820	0.011045	1.613453
PUCF_D	0.088863	0.027062	3.283629***
DEBTS_D	-0.007627	0.016279	-0.468498
DEBTS_R	-0.001548	0.001910	-0.810474
RGDP_R	-0.056189	0.031915	-1.760592*
RGDP_D	-0.153524	0.048614	-3.158047***
GNS_R	0.009020	0.005501	1.639647
GNS_D	0.000471	0.001880	0.250816
CPI_R	0.000313	0.000147	2.127011**
CPI_D	0.002449	0.003531	0.693564
CAB_R	-0.033510	0.030160	-1.111103
CAB_D	0.011223	0.014876	0.754428
FB_R	0.034984	0.016179	2.162324**
FB_D	0.002184	0.028040	0.077906
R^2 =	*DW – stat =*		
0.4611	*2.17*	F-stat = 18.9128	*Wald test =333.89****

Asterisks ***, ** and * indicate significant at 1%, 5%, and 10% level of significance respectively. *t* is a trend coefficient as given by φ_0 in equation (4.27).

The coefficients of PCF_R (-0.015734) and PCF_D (0.034485) are not identical and fulfil the non-reversibility conditions of $\varphi_1 \neq \varphi_2$. The coefficient -0.015734 implies that the average incremental changes in the private capital formation in the SADC countries has a negative impact on the aggregate private capital formation, while the average decrements would drive private capital formation up. However, PCF_R is found to be insignificant, while average decrements are highly significant at 5 percent level. The same conclusion is drawn from the rest

of the variables. It is worth noting to mention that average decreases in private capital formation, public capital formation, real GDP are the only variables are found to be significant while the average increases in real GDP, inflation and fiscal balance are significant at 1 and 5 percent levels.

5.5 Panel cointegration

The panel cointegration technique suggests that the macroeconomic variables that are integrated of the same order could have a long-run association. If this is the case, then the variables are said to be cointegrated and the estimated coefficients are interpreted as long-run coefficients. The panel data analysis applied in this study required either the use or application of the stationary panel regression methods (pooled, fixed and random effects) or the nonstationary panel methods (cointegration). The use of each method depends on the properties of data. Considering that the study established evidence of stationarity[8] using five tests (LLC, IPS, Breitung, ADF and PP), three of which showed that some variables were only stationary at levels (polity, gross national savings and total debt), while the other two revealed presence of unit root. The discretion of the based on the majority tests, which concludes that the majority of variables are integrated of order zero (I(0)). Having drawn conclusions on stationarity based on majority tests, which revealed that the variables could sometimes be incorrect and lead to incorrect inferences, the study finds it compelling to ascertain if private capital formation and its theoretical factors move together in the long-run. To

[8] See tables 5.5 through 5.10 for stationarity analysis of the data.

ensure that the variables do move together in the long-run, it is imperative to confirm panel cointegration so as to ensure that the results are robust.

There are different cointegration methods or approaches/ techniques that are applicable within the panel analysis and these include the Pedroni (1995,1999, 2000, 2001), the Kao(1999) Kao and Chiang (2000) and the Likelihood-based cointegration tests. When there is cointegration within the data, the ordinary least squares (OLS) yields biased and inconsistent estimates and the panel methods of Pedroni (2001), Kao (1999) and Kao and Chiang (2000) and Larsson *et al* (2001) are preferred. Each of these tests has its assumptions and advantages, for example Pedroni method is able to generate consistent estimates even in very small samples and it does not suffer from large distortions (Nasreen and Anwar, 2014). The long run or cointegration test results are presented in tables 5.20(a), 5.20(b), 5.21(a) and 5.21(b). Table 5.21(a) gives the results from the Pedroni test of cointegration for two groups of countries (12 and 13).

Table 5.21(a): Pedroni cointegration test results for the 12 and 13 country groups

	12 - Country panel		13 - Country panel	
Test	**Test statistic**	**Probability**	**Test statistic**	**Probability**
Panel *v*	-2.035130	0.979	-2.03868	0.9793
Panel *rho*	2.2232	0.986	2.36416	0.9910
Panel *PP*	0.6770	0.750	0.64997	0.7421
Panel *ADF*	0.05805	0.5231	0.19077	0.5756
Group *rho*	2.8730	0.9980	3.00680	0.9987
Group *PP*	-0.4293	0.3338	-1.05599	0.1455
Group *ADF*	-1.1661	0.1218	-1.12498	0.1303

Table 5.21(a) provides a summary of the Pedroni cointegration test. Under this test, the null hypothesis is that there is no cointegration within the panel of both the 12 and 13 country blocs in the SADC region. In the 12 country analysis, foreign aid was included as one of the factors influencing private capital formation and the null hypothesis could not be rejected. This is shown by the high probability values associated with the test statistics. For example, the probability value associated with the test statistic for the panel *v* is given as 0.979 (about 98 percent). The test statistic is therefore highly insignificant and leads to conclusion that there is no long run relationship between private capital formation and its factors. Similar conclusion is also drawn from the rest of the tests (panel rho,PP, ADF) group (rho, PP and ADF). The 13-country bloc that includes South Africa also provides similar conclusion. Kao (1999) test on the other hand gives mixed results for the two panels. In a 12-country panel, private capital formation is found to be cointegrated with its explanatory variables, while in a 13 –country panel, the hypothesis that there is no cointegration is accepted.

Table 5.22(b): Kao residual cointegration test results

Panel	t-Statistic	Prob.
ADF (12 country)	-2.451168***	0.0071
ADF (13 country)	0.7495	0.2268

Asterisks ***, ** and * indicate significant at 1%, 5%, and 10% level of significance respectively.

The Likelihood-based (Fisher-type) cointegration results are given in tables 5.22(a) and 5.22(b). Both the trace and maximum-eigen tests reveal the presence of the long run relationship between private capital formation and its determinants.

The trace test rejects the null of at most four cointegration equations, while on the other hand the maximum – eigenvalue test rejects the null hypothesis of at most two cointegration equations.

Table 5.23(a): Johansen Fisher panel cointegration test results for the 12 countries

Trace test				Max-eigenvalue test			
H_0	H_1	Test stat	Prob.	H_0	H_1	Test stat	Prob.
r = 0	r > 1	570.2***	0.0000	r = 0	r = 1	226.8***	0.0000
r ≤ 1	r > 2	237.3***	0.0000	r = 1	r = 2	158.6***	0.0000
r ≤ 2	r > 3	113.9***	0.0000	r = 2	r = 3	72.42***	0.0000
r ≤ 3	r > 4	54.91***	0.0003	r = 3	r = 4	25.14	0.3983
r ≤ 4	r > 5	37.49**	0.0390	r = 4	r = 5	27.89	0.2645
r ≤ 5	r > 6	21.81	0.5908	r = 5	r = 6	16.21	0.8804
r ≤ 6	r > 7	18.32	0.7874	r = 6	r = 7	14.73	0.9285
r ≤ 7	r > 8	33.64	0.0912	r = 7	r = 8	33.64	0.0912

Asterisks ***, ** and * indicate significant at 1%, 5%, and 10% level of significance respectively.

From tables 5.22(a) and 5.22(b), the following conclusions can be deduced: The null hypotheses of no cointegration (r = 0), at most 1, 2, and 3 (r ≤ 1, r ≤ 2, r ≤ 3) against the alternatives of the presence of one or more (up to four) cointegrating equations are rejected at 1 percent and 5 percent levels of significance in the trace test technique. These suggest that there is cointegration that exists between private capital formation and its determinants. The maximum eigenvalue test of cointegration on the other hand suggests the presence of at most three cointegrating equations. This is shown by the probability values associated with

the null hypotheses of r = 0, r = 1, r = 2 and r = 3, which are rejected at 3 percent level of significance. The results from the two tests (trace and maximum eigenvalue tests) both reveal the presence of cointegration within the data set in the SADC countries.

Table 5.24(b): Johansen Fisher panel cointegration test results for the 13 countries

Trace test				Max-eigenvalue test			
H_0	H_1	Test stat	Prob.	H_0	H_1	Test stat	Prob.
r = 0	r > 1	302.4***	0.0000	r = 0	r = 1	209.3***	0.0000
r ≤ 1	r > 2	173.5***	0.0000	r = 1	r = 2	90.56***	0.0000
r ≤ 2	r > 3	98.51***	0.0000	r = 2	r = 3	36.90*	0.0764
r ≤ 3	r > 4	71.69***	0.0000	r = 3	r = 4	34.98	0.1121
r ≤ 4	r > 5	50.40***	0.0028	r = 4	r = 5	34.91	0.1137
r ≤ 5	r > 6	34.60	0.1207	r = 5	r = 6	23.32	0.6150
r ≤ 6	r > 7	50.48	0.0028	r = 6	r = 7	50.48	0.0028

Asterisks ***, ** and * indicate significant at 1%, 5%, and 10% level of significance respectively.

5.6 Summary

This section summarises the results of the study as well as the chapter. The results' summary highlights the main results pertaining to private capital formation and its non-reversibility in the SADC countries.

5.6.1 Summary of the results

The non-reversibility of the neoclassical private capital formation in the SADC region was done using the panel data analysis, applying different methods such as the pooled, random and fixed effects. The study found that the appropriate

model applicable to the SADC countries' data was of fixed effects nature. The results revealed that private capital formation was non-reversible and that public capital formation and debt had negative influence on private capital formation in these countries. The other variables that are found to have a negative influence on private capital formation include fiscal balance, current account balance, political instability, inflation and interest rate, while real growth of GDP, gross national savings and foreign aid affect private capital formation positively.

The non-reversibility analysis showed that whether the countries experience either average increases or decreases in debt, there will always be a decline in private capital formation. This could be due to the high levels of debt experienced by these countries. Average decreases in private capital formation, public capital formation, economic growth are statistically significant. Overall, the study results highlight the non-reversibility of private capital formation.

5.6.2 Summary of the chapter

This chapter presented the regression results from the panel data analysis. The descriptive nature of the data and variables is presented with a view to highlight the data type and how the data behaves. The correlation matrices are also shown and this was done as a precautionary measure to explore if there could be any linear relationship between the different variables. This helps guide on determining the extent of correlation between two variables and table 5.2 assisted in detecting the depth of correlation. Due to the differences in the countries within the SADC bloc and the main determinants of private capital formation, two

separate correlation matrices were presented, first with a group of twelve countries that excluded the South Africa, Namibia and Zimbabwe. The exclusion of these countries is attributed to the fact that Namibia and Zimbabwe have data missing for most of the period under consideration, while South Africa is seen as not reliant on foreign aid for its capital formation (private) as opposed to the rest of the SADC countries. The second group includes South Africa but excludes Namibia and Zimbabwe, in other words, Namibia and Zimbabwe are not considered due to data unavailability.

The stationarity test was performed using different panel unit root tests ahead of the regression in order to establish the descriptive pattern of the data, which guides on the method to apply. The pooled, fixed and random effects models were estimated and the Hausman test was also used to determine which of the two methods (random or fixed effects) was appropriate for this particular study. The cointegration test was done to ascertain if there was any long-run relationship between private capital formation and its theoretical determinants. Lastly, the test of reversibility/nonresversibility completes the chapter and answers the question of non-reversibility of private capital formation in the SADC region.

Chapter 6

SUMMARY AND CONCLUSION OF THE STUDY

6.0 Introduction

This chapter provides a summary of the study, provides the main conclusions pertaining to the study's findings, and finally highlight some policy implications as well as recommendations. The overall objective of this study was to estimate the private capital formation model for the SADC region with a view to establish the impact of debt and public capital formation and to test the reversibility of private capital formation in the region. The analysis was conducted within the panel regression using two distinctive models. Private capital formation plays a very crucial role in the SADC countries and modelling this variable requires careful attention since the developing nations lag behind in promoting investment and private capital formation. This study is based on neoclassical investment theory and sought to unpack the link between private capital formation and its determinants, with emphasis placed on debt service ratio and total debt in the SADC region. This study attempts to answer questions: what is the effect of debt and public capital formation on private capital formation in the SADC region. The answers to these questions are indicated in the next section.

6.1 Discussion of the results

Private capital formation and its macroeconomic determinants

There are two models applied in this study, the first model consists of 12 SADC countries (South Africa excluded) and the second model consists of 13 SADC countries (inclusive of South Africa). The regression results from different techniques: the pooled, fixed and random effects indicate that public capital formation exerts a negative and significant impact on private capital formation. This is shown by the probability value that is less than the 5 percent level. This results imply that public capital formation crowds-out private capital formation in all the SADC countries, both the 12 and 13 country panels. The second variable is the growth of gross domestic product, and this shows a positive and significant effect on private capital formation. This supports both the neoclassical investment theory and the accelerator theory of investment. Empirically, this result is found to be consistent with Cann-Tamakloe (2008) and Green and Villanueva (1991).

The impact of real interest rate (RIR) was found to exert a negative impact on private capital formation but statistically insignificant. This result supports the neoclassical investment theory and empirically, it is consistent with Cann-Tamakloe (2008) and suggest that in developing nations such as the SADC countries, higher interest rates tend to boost savings and ultimately lead to higher bank credits for the private sector. Gross national savings is also found to impact positively on private capital formation in the SADC countries and this variable is statistically significant at 5 percent.

The effect of fiscal balance on private capital formation is found to be negative but statistically insignificant in the SADC countries. Perhaps one reason could be that these countries often record fiscal budget deficits and as deficits increase, investors become reluctant to commit their investment. In addition, the regression results show that inflation is statistically significant and affects private capital formation negatively. This implies that higher price levels reduce private capital formation and this result is no different from the empirical studies of Greene and Villanueva (1991).

The debt variables (total debt and debt service ratio) were found to have a negative impact on private capital formation and were statistically significant. The debt service ratio's coefficient indicates that in the long-run, the countries may experience debt-overhang and may struggle to service their debt. The polity (measure of political instability) variable was found to have a negative impact, although insignificant. The political instability, such as the change and frequency of heads of states and political tensions may lead to delay in policy implementation and as a result would discourage private investment. Most of the SADC countries often experience pre-post-election violence, which sometimes last long and can cause some instability and affect private investment. Another variable of concern is the foreign aid, which bears a positive contrition on private capital formation, despite being insignificant. The third and last research question of this study was based on the reversibility of private capital formation. The results from this test showed that private capital formation was irreversible in the SADC region.

6.2 Summary of the study

The main objective of this study is to use the panel data analysis to estimate the neoclassical private capital model (PCF) with a view to highlight the impact of debt and public capital formation and establish the non-reversibility of private capital formation in the SADC region. The study utilised the panel annual data spanning the period 1980 to 2015 for the 13 SADC countries to establish the link between private capital formation and its determinants with emphasis placed on debt and public capital formation. The study sought to answer the questions on the effect of debt (total debt and debt service) and public capital formation on private capital as well as to establish if the private capital formation was reversible for the SADC nations. The impact of public capital formation and debt was affirmed with the use of the fixed effects model and the cointegration techniques applied (Kao and Fisher-type) confirmed the existence of the long-run relationship in private capital formation.

6.3 Policy implications and Recommendations

The research findings of this study have implications at both country and regional level especially with regard to policy making. First, on the policy front, the study has shown that economic growth is an engine of private capital formation in the SADC countries and the respective governments will need to prioritise their economic policies that will lead to sustained economic growth if they are to achieve sustainable private capital formation. secondly, the fiscal policy that reduces the debt and fiscal deficits and the monetary policy that drives interests

up may increase (decrease) private capital formation due the negative correlation between fiscal variables (fiscal policy) and monetary variables (monetary policy) and its factors or determinants. The study has also shown that higher interest rates will reduce private capital formation in the SADC region. Thirdly, debt reduction policies and strategies should be undertaken at a sustainable manner that will not deter potential private investors. This is because high debt levels can be seen as impending capital tax.

Fourth, the political instability should not be taken slightly as it affects private capital formation negatively. Some of the sources of political instability can be due to the frequency of change of heads of states, civil unrest (pre-post elections). On the frequency of change of heads of states, private investors view this on a serious light as they perceive it as delaying policy implementation, which might affect their investment interests in the SADC region.

6.4 Contribution to literature

This study has estimated the private capital formation model based on the neoclassical investment model, where emphasis was placed on debt and public capital formation with a view to establish non-reversibility. Most studies on private capital formation/investment were mainly country-specific or were based on developed nations and these could not be used to draw general conclusions pertaining to capital formation. The inclusion of the political instability variable (polity) has shed some light on the impact of political instability on private capital formation for the SADC countries, while the original private capital formation

model only addressed the effect or impact of the determinants of private capital formation. The non-reversibility test of private capital formation on developing nations such as the SADC countries has provided some insights into the modelling of investment in developing countries.

6.5 Limitations and Directions for Future Research

The use of panel data (combination of time series and cross sectional) is prone to data unavailability like in any time series data and this study is no different when it comes to data. The main limitation is that of the missing data, which led to the exclusion of two countries (Namibia and Zimbabwe) in the analysis. This exclusion left only 13 nations to be used in the analysis. Another limitation is that the interpretation of the polity variable contribution is done such that it cannot be generalised due to different forms of political instability measures that can be used in applied econometric research. The analysis and interpretation were done carefully considering these limitations.

On the direction for future research, the study noted the use of aggregate private capital formation that assumes that different forms of investment behave the same way. Future research can use disaggregated private capital formation and test the applicability in the context of the SADC nations and the research can be extended to the sub-Saharan countries as well as the developing countries. Another way that a research of this nature can be extended is by exploring some comparative studies for the SADC and other regional trade blocs from other developing or developed nations using the panel smooth transition regression models (PSTR),

which describes heterogeneous panels with regression coefficients that vary across individual countries and over time.

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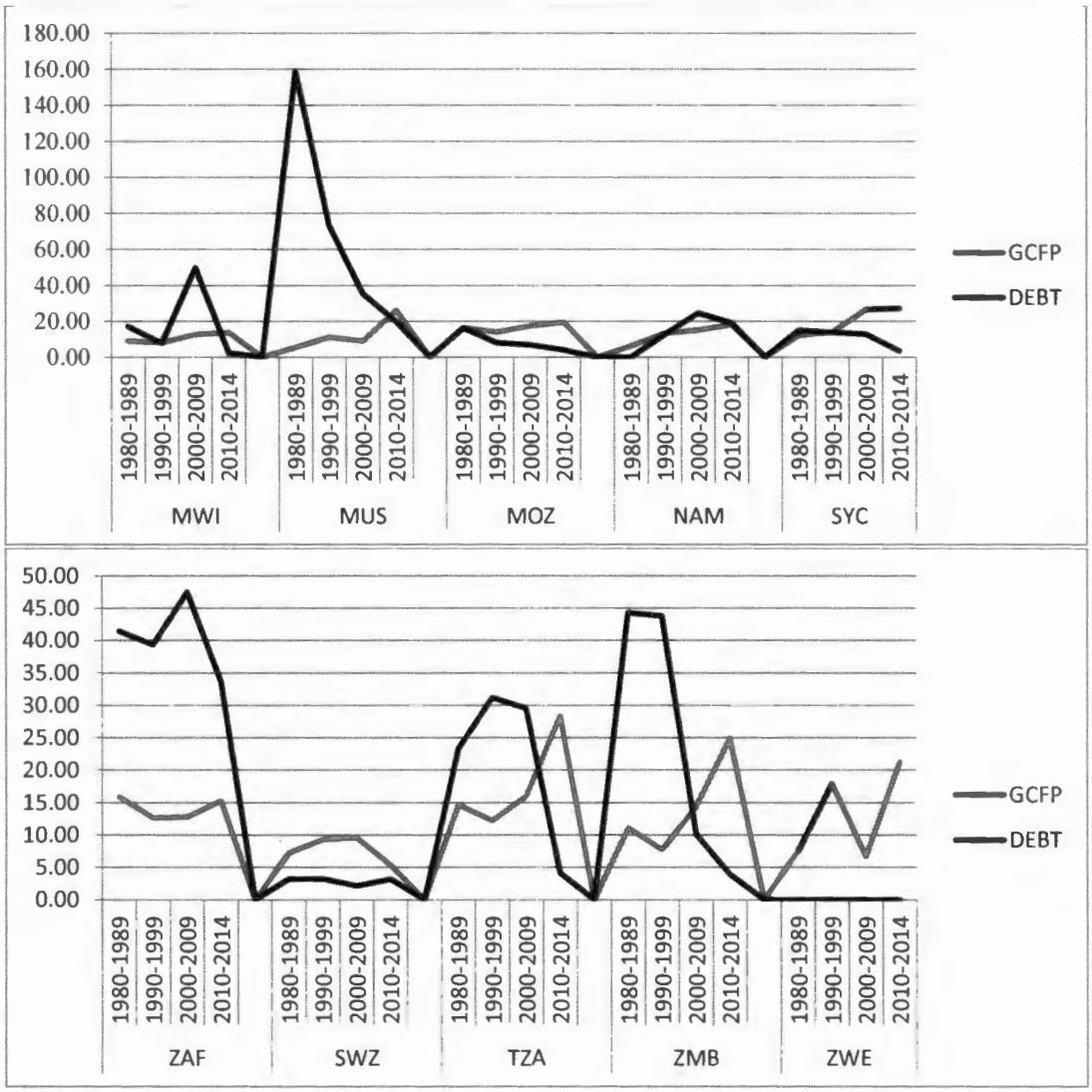
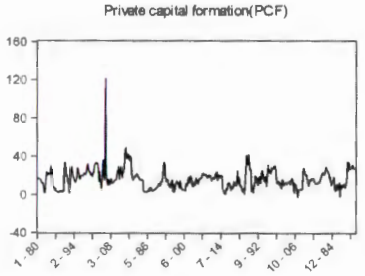
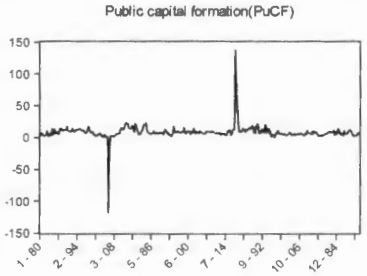
APPENDICES

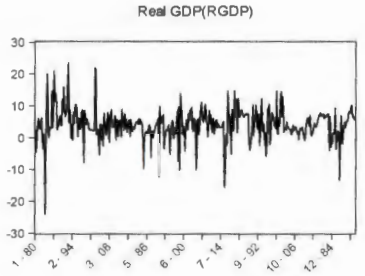
Appendix A: Gross private capital formation and Debt for 10 SADC countries

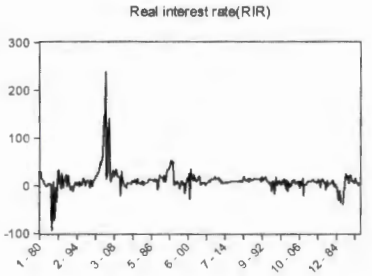


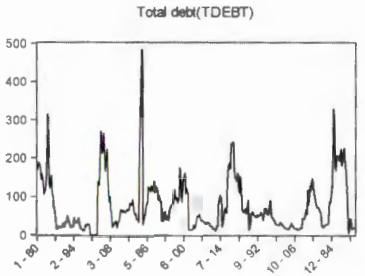
Appendix A1: Graphical presentation of aggregate macro-variables

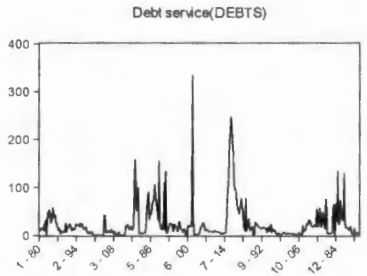


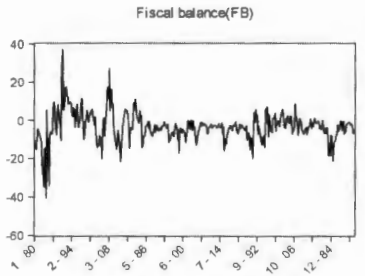


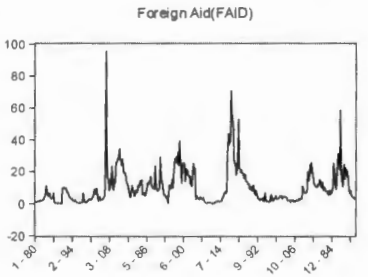


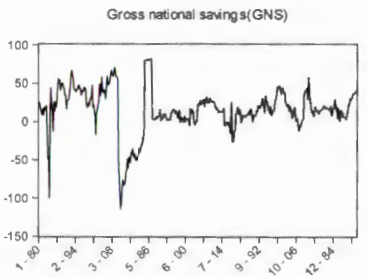


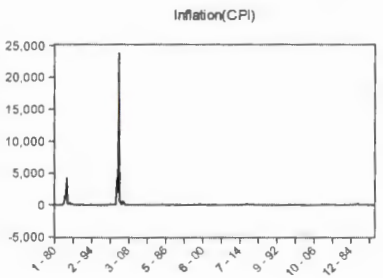


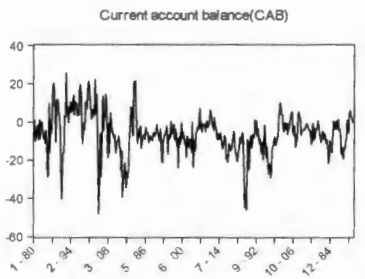












Appendix B: Autocorrelation functions of respective macro-variables

Appendix B1: private capital formation

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|***** |	.|***** |	1	0.633	0.633	188.93	0.000
.|**** |	.|* |	2	0.501	0.167	307.40	0.000
.|*** |	.|* |	3	0.442	0.124	399.87	0.000
.|*** |	.|. |	4	0.364	0.019	462.81	0.000
.|** |	*|. |	5	0.243	-0.095	490.82	0.000
.|* |	.|. |	6	0.194	0.005	508.82	0.000
.|** |	.|* |	7	0.218	0.113	531.53	0.000
.|** |	.|. |	8	0.215	0.066	553.66	0.000
.|* |	.|. |	9	0.159	-0.042	565.81	0.000
.|* |	.|. |	10	0.172	0.043	580.09	0.000
.|* |	.|. |	11	0.167	-0.000	593.49	0.000
.|* |	.|. |	12	0.155	0.024	605.04	0.000
.|* |	.|. |	13	0.138	0.018	614.24	0.000
.|* |	.|. |	14	0.121	-0.016	621.30	0.000
.|* |	.|. |	15	0.109	-0.008	627.03	0.000
.|* |	.|. |	16	0.077	-0.027	629.92	0.000

Appendix B2: Public capital formation

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|**** |	.|**** |	1	0.563	0.563	149.33	0.000
.|*** |	.|* |	2	0.382	0.095	218.18	0.000
.|** |	.|. |	3	0.266	0.027	251.75	0.000
.|* |	.|. |	4	0.185	0.005	267.89	0.000
.|* |	.|. |	5	0.116	-0.016	274.33	0.000
.|* |	.|. |	6	0.107	0.044	279.76	0.000
.|* |	.|. |	7	0.115	0.050	286.08	0.000
.|* |	.|. |	8	0.112	0.025	292.08	0.000
.|* |	.|. |	9	0.115	0.031	298.44	0.000
.|* |	.|. |	10	0.118	0.028	305.08	0.000
.|* |	.|. |	11	0.105	0.008	310.39	0.000
.|* |	.|. |	12	0.091	0.008	314.42	0.000
.|* |	.|. |	13	0.087	0.019	318.11	0.000
.|* |	.|. |	14	0.089	0.025	321.98	0.000
.|* |	.|. |	15	0.092	0.024	326.11	0.000
.|* |	.|. |	16	0.081	-0.001	329.27	0.000

Appendix B3: Total debt

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|****** |	.|****** |	1	0.887	0.887	370.58	0.000
.|***** |	*|. |	2	0.745	-0.194	632.81	0.000
.|***** |	.|. |	3	0.631	0.068	821.21	0.000
.|**** |	.|. |	4	0.538	-0.001	958.62	0.000
.|*** |	*|. |	5	0.444	-0.079	1052.1	0.000
.|*** |	.|* |	6	0.379	0.107	1120.6	0.000
.|** |	*|. |	7	0.319	-0.077	1169.1	0.000
.|** |	.|. |	8	0.266	0.022	1203.1	0.000
.|** |	.|. |	9	0.217	-0.021	1225.7	0.000
.|* |	.|. |	10	0.166	-0.065	1238.9	0.000
.|* |	.|. |	11	0.129	0.064	1246.9	0.000
.|* |	.|. |	12	0.095	-0.058	1251.3	0.000
.|. |	.|. |	13	0.067	0.020	1253.5	0.000
.|. |	*|. |	14	0.031	-0.073	1253.9	0.000
.|. |	.|. |	15	0.006	0.025	1254.0	0.000
.|. |	.|. |	16	-0.011	0.012	1254.0	0.000

Appendix B4: Debt service ratio

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|***** |	.|***** |	1	0.657	0.657	203.45	0.000
.|**** |	.|** |	2	0.575	0.252	359.54	0.000
.|**** |	.|. |	3	0.484	0.068	470.54	0.000
.|*** |	.|. |	4	0.438	0.071	561.39	0.000
.|*** |	.|. |	5	0.375	0.009	628.22	0.000
.|** |	.|. |	6	0.302	-0.043	671.61	0.000
.|** |	.|. |	7	0.246	-0.024	700.47	0.000
.|* |	.|. |	8	0.193	-0.026	718.31	0.000
.|* |	.|* |	9	0.211	0.098	739.69	0.000
.|* |	.|. |	10	0.159	-0.032	751.90	0.000
.|* |	.|. |	11	0.151	0.018	762.82	0.000
.|* |	.|. |	12	0.132	0.012	771.21	0.000
.|* |	.|. |	13	0.114	-0.012	777.54	0.000
.|* |	.|. |	14	0.120	0.032	784.52	0.000
.|* |	.|. |	15	0.107	0.003	790.11	0.000
.|* |	.|. |	16	0.077	-0.042	793.03	0.000

Appendix B5: Real GDP

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|*** |	.|*** |	1	0.368	0.368	63.758	0.000
.|* |	.|. |	2	0.160	0.028	75.820	0.000
.|* |	.|. |	3	0.093	0.030	79.949	0.000
.|. |	.|. |	4	0.071	0.027	82.326	0.000
.|. |	.|. |	5	0.065	0.029	84.361	0.000
.|. |	.|. |	6	0.051	0.013	85.602	0.000
.|* |	.|. |	7	0.080	0.057	88.679	0.000
.|* |	.|* |	8	0.128	0.086	96.489	0.000
.|* |	.|. |	9	0.089	0.005	100.26	0.000
.|. |	.|. |	10	0.070	0.019	102.62	0.000
.|. |	.|. |	11	0.063	0.020	104.51	0.000
.|. |	*|. |	12	-0.019	-0.073	104.68	0.000
.|. |	.|. |	13	-0.043	-0.037	105.59	0.000
*|. |	.|. |	14	-0.077	-0.063	108.44	0.000
*|. |	.|. |	15	-0.067	-0.031	110.60	0.000
.|. |	.|. |	16	-0.041	-0.012	111.40	0.000

Appendix B6: Gross domestic savings

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|*******	.|*******	1	0.908	0.908	387.29	0.000
.|******|	.|* |	2	0.838	0.077	717.77	0.000
.|******|	.|. |	3	0.766	-0.032	994.81	0.000
.|***** |	.|. |	4	0.705	0.021	1230.2	0.000
.|***** |	.|. |	5	0.659	0.058	1435.8	0.000
.|**** |	.|. |	6	0.610	-0.019	1612.7	0.000
.|**** |	.|. |	7	0.564	-0.015	1764.0	0.000
.|**** |	.|. |	8	0.514	-0.039	1889.9	0.000
.|*** |	.|. |	9	0.467	-0.011	1994.2	0.000
.|*** |	.|. |	10	0.426	0.008	2081.2	0.000
.|*** |	.|. |	11	0.387	-0.010	2153.2	0.000
.|*** |	.|. |	12	0.354	0.009	2213.6	0.000
.|** |	.|. |	13	0.327	0.020	2265.2	0.000
.|** |	.|. |	14	0.300	-0.007	2308.7	0.000
.|** |	.|* |	15	0.290	0.083	2349.3	0.000
.|** |	.|. |	16	0.272	-0.026	2385.1	0.000

Appendix B7: CPI

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|* |	.|* |	1	0.145	0.145	9.8886	0.002
.|* |	.|* |	2	0.199	0.182	28.646	0.000
.|* |	.|. |	3	0.102	0.055	33.583	0.000
.|. |	.|. |	4	0.009	-0.047	33.626	0.000
.|. |	.|. |	5	0.014	-0.012	33.721	0.000
.|. |	.|. |	6	0.020	0.022	33.904	0.000
.|. |	.|. |	7	0.013	0.014	33.990	0.000
.|. |	.|. |	8	0.000	-0.010	33.990	0.000
.|. |	.|. |	9	-0.003	-0.011	33.995	0.000
.|. |	.|. |	10	-0.006	-0.004	34.014	0.000
.|. |	.|. |	11	-0.006	-0.001	34.033	0.000
.|. |	.|. |	12	-0.008	-0.005	34.066	0.001
.|. |	.|. |	13	-0.008	-0.005	34.095	0.001
.|. |	.|. |	14	-0.007	-0.003	34.120	0.002
.|. |	.|. |	15	-0.003	0.001	34.125	0.003
.|. |	.|. |	16	-0.003	-0.000	34.131	0.005

Appendix B8: Current account balance

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|***** |	.|***** |	1	0.726	0.726	248.13	0.000
.|**** |	.|. |	2	0.546	0.040	388.77	0.000
.|*** |	.|. |	3	0.405	-0.009	466.45	0.000
.|** |	.|. |	4	0.285	-0.034	505.01	0.000
.|* |	.|. |	5	0.201	-0.002	524.15	0.000
.|* |	.|. |	6	0.171	0.066	538.15	0.000
.|* |	.|. |	7	0.141	0.001	547.67	0.000
.|* |	.|. |	8	0.107	-0.020	553.18	0.000
.|* |	.|. |	9	0.082	-0.004	556.43	0.000
.|* |	.|. |	10	0.088	0.056	560.14	0.000
.|* |	.|. |	11	0.079	-0.003	563.16	0.000
.|. |	.|. |	12	0.069	-0.004	565.49	0.000
.|. |	.|. |	13	0.057	-0.010	567.07	0.000
.|. |	.|. |	14	0.037	-0.019	567.73	0.000
.|. |	.|. |	15	0.011	-0.020	567.79	0.000
.|. |	.|. |	16	0.020	0.047	567.99	0.000

Appendix B9: Fiscal balance

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|***** |	.|***** |	1	0.672	0.672	212.48	0.000
.|**** |	.|* |	2	0.559	0.196	359.72	0.000
.|*** |	.|. |	3	0.429	-0.008	446.69	0.000
.|*** |	.|* |	4	0.396	0.108	520.88	0.000
.|*** |	.|. |	5	0.355	0.054	580.61	0.000
.|** |	*|. |	6	0.248	-0.118	609.97	0.000
.|** |	.|. |	7	0.218	0.038	632.57	0.000
.|* |	.|. |	8	0.146	-0.048	642.71	0.000
.|* |	.|. |	9	0.111	-0.032	648.57	0.000
.|* |	.|. |	10	0.080	0.012	651.63	0.000
.|* |	.|. |	11	0.086	0.059	655.20	0.000
.|. |	.|. |	12	0.057	-0.040	656.78	0.000
.|. |	.|. |	13	0.032	-0.013	657.28	0.000
.|. |	.|. |	14	0.017	0.003	657.41	0.000
.|. |	.|. |	15	0.015	0.005	657.52	0.000
.|. |	.|. |	16	0.037	0.041	658.17	0.000

Appendix B10: Foreign aid

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|****** |	.|****** |	1	0.778	0.778	263.01	0.000
.|***** |	.|* |	2	0.670	0.165	458.54	0.000
.|**** |	.|* |	3	0.598	0.091	614.79	0.000
.|**** |	.|. |	4	0.545	0.063	744.91	0.000
.|**** |	.|. |	5	0.493	0.020	851.43	0.000
.|*** |	.|. |	6	0.437	-0.011	935.44	0.000
.|*** |	.|. |	7	0.414	0.063	1011.0	0.000
.|*** |	.|. |	8	0.382	0.006	1075.4	0.000
.|** |	.|. |	9	0.337	-0.030	1125.8	0.000
.|** |	.|. |	10	0.290	-0.036	1163.2	0.000
.|** |	.|. |	11	0.250	-0.022	1191.0	0.000
.|** |	.|. |	12	0.234	0.035	1215.5	0.000
.|** |	.|. |	13	0.225	0.038	1238.2	0.000
.|* |	.|. |	14	0.208	0.005	1257.7	0.000
.|* |	.|. |	15	0.172	-0.054	1270.9	0.000
.|* |	.|. |	16	0.150	-0.005	1281.1	0.000

Appendix C: Pooled, fixed and random effects regression results

Appendix C1: Pooled regression of total debt in 12 countries

Dependent Variable: PCF
Method: Pooled Least Squares
Sample: 1980 2015
Included observations: 432
Cross-sections included: 12
Total pool (balanced) observations: 5184

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PUCF	-0.375637	0.011314	-33.20066	0.0000
RGDP	0.176480	0.023547	7.494734	0.0000
RIR	0.049283	0.005319	9.264754	0.0000
GNS	0.409374	0.009887	41.40414	0.0000
TDEBT	-0.005546	0.001913	-2.899428	0.0038
CPI	-0.000652	9.93E-05	-6.563136	0.0000
CAB	-0.390572	0.011351	-34.40911	0.0000
FB	0.030830	0.016758	1.839755	0.0659
FAID	-0.010237	0.012019	-0.851762	0.3944
POL	-0.042153	0.006161	-6.841496	0.0000
C	8.688290	0.299578	29.00178	0.0000

R-squared	0.413354	Mean dependent var	15.70913
Adjusted R-squared	0.412220	S.D. dependent var	10.23391
S.E. of regression	7.846016	Akaike info criterion	6.960009
Sum squared resid	318449.7	Schwarz criterion	6.973914
Log likelihood	-18029.34	Hannan-Quinn criter.	6.964873
F-statistic	364.4924	Durbin-Watson stat	0.800854
Prob(F-statistic)	0.000000		

Appendix C2: Pooled regression of total debt with lagged PCF in 12 countries

Dependent Variable: PCF
Method: Pooled Least Squares
Sample (adjusted): 1981 2015
Included observations: 420 after adjustments
Cross-sections included: 12
Total pool (balanced) observations: 5040

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PCF(-1)	0.478443	0.010468	45.70402	0.0000
PUCF	-0.341180	0.009554	-35.71194	0.0000
RGDP	0.136786	0.020143	6.790746	0.0000
RIR	0.021836	0.004528	4.822223	0.0000
GNS	0.257272	0.009106	28.25315	0.0000
TDEBT	-0.003114	0.001629	-1.911872	0.0559
CPI	-0.000457	8.36E-05	-5.474380	0.0000
CAB	-0.247480	0.010348	-23.91680	0.0000
FB	0.008911	0.014601	0.610294	0.5417
FAID	0.052731	0.010283	5.127794	0.0000
POL	-0.009806	0.005257	-1.865233	0.0622
C	4.021889	0.274116	14.67223	0.0000

R-squared	0.591425	Mean dependent var	15.67325
Adjusted R-squared	0.590531	S.D. dependent var	10.29305
S.E. of regression	6.586499	Akaike info criterion	6.610299
Sum squared resid	218124.5	Schwarz criterion	6.625835
Log likelihood	-16645.95	Hannan-Quinn criter.	6.615742
F-statistic	661.6531	Durbin-Watson stat	1.892661
Prob(F-statistic)	0.000000		

Appendix C3: Pooled regression of debt service in 12 countries

Dependent Variable: PCF
Method: Pooled Least Squares
Sample: 1980 2015
Included observations: 432
Cross-sections included: 12
Total pool (balanced) observations: 5184

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PUCF	-0.364779	0.011165	-32.67057	0.0000
RGDP	0.156446	0.023216	6.738749	0.0000
RIR	0.045301	0.005237	8.650588	0.0000
GNS	0.407957	0.009681	42.13930	0.0000
DEBTS	-0.041150	0.003091	-13.31368	0.0000
CPI	-0.000753	9.73E-05	-7.735604	0.0000
CAB	-0.396868	0.011181	-35.49551	0.0000
FB	0.022195	0.016352	1.357324	0.1747
FAID	0.007108	0.011086	0.641147	0.5215
POL	-0.044792	0.005899	-7.593550	0.0000
C	9.047218	0.280577	32.24506	0.0000

R-squared	0.431868	Mean dependent var	15.70913
Adjusted R-squared	0.430770	S.D. dependent var	10.23391
S.E. of regression	7.721218	Akaike info criterion	6.927941
Sum squared resid	308399.8	Schwarz criterion	6.941847
Log likelihood	-17946.22	Hannan-Quinn criter.	6.932806
F-statistic	393.2275	Durbin-Watson stat	0.873307
Prob(F-statistic)	0.000000		

Appendix C4: Pooled regression of debt service with lagged PCF in 12 countries

Dependent Variable: PCF
Method: Pooled Least Squares
Sample (adjusted): 1981 2015
Included observations: 420 after adjustments
Cross-sections included: 12
Total pool (balanced) observations: 5040

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PCF(-1)	0.466590	0.010691	43.64227	0.0000
PUCF	-0.338456	0.009546	-35.45429	0.0000
RGDP	0.131450	0.020111	6.536064	0.0000
RIR	-0.020970	0.004517	-4.642929	0.0000
GNS	0.261530	0.009061	28.86435	0.0000
DEBTS	-0.014378	0.002707	-5.312528	0.0000
CPI	-0.000504	8.30E-05	-6.072775	0.0000
CAB	-0.253456	0.010389	-24.39556	0.0000
FB	0.008211	0.014439	0.568698	0.5696
FAID	0.054153	0.009573	5.656803	0.0000
POL	-0.010578	0.005116	-2.067655	0.0387
C	4.188404	0.265015	15.80440	0.0000

R-squared	0.593410	Mean dependent var	15.67325
Adjusted R-squared	0.592521	S.D. dependent var	10.29305
S.E. of regression	6.570478	Akaike info criterion	6.605428
Sum squared resid	217064.7	Schwarz criterion	6.620964
Log likelihood	-16633.68	Hannan-Quinn criter.	6.610871
F-statistic	667.1155	Durbin-Watson stat	1.897344
Prob(F-statistic)	0.000000		

Appendix C5: Pooled regression of total debt in 13 countries

Dependent Variable: PCF
Method: Pooled Least Squares
Sample: 1980 2015
Included observations: 468
Cross-sections included: 13
Total pool (balanced) observations: 6552

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.379570	0.255481	32.79918	0.0000
PUCF	-0.378716	0.009565	-39.59409	0.0000
RGDP	0.188724	0.020690	9.121652	0.0000
GNS	0.410576	0.008773	46.80000	0.0000
FB	0.030114	0.014850	2.027873	0.0426
TDEBT	-0.004817	0.001536	-3.136430	0.0017
CAB	-0.395534	0.009971	-39.66732	0.0000
POL	-0.035208	0.005190	-6.783918	0.0000
CPI	-0.000627	8.80E-05	-7.118470	0.0000
RIR	-0.051275	0.004723	-10.85712	0.0000

R-squared	0.412787	Mean dependent var	15.64678
Adjusted R-squared	0.411980	S.D. dependent var	9.877021
S.E. of regression	7.573945	Akaike info criterion	6.888830
Sum squared resid	375279.5	Schwarz criterion	6.899190
Log likelihood	-22557.81	Hannan-Quinn criter.	6.892412
F-statistic	510.9743	Durbin-Watson stat	0.798252
Prob(F-statistic)	0.000000		

Appendix C6: Pooled regression of total debt with lagged PCF in 13 countries

Dependent Variable: PCF
Method: Pooled Least Squares
Sample (adjusted): 1981 2015
Included observations: 455 after adjustments
Cross-sections included: 14
Total pool (balanced) observations: 6370

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.027571	0.232579	17.31699	0.0000
PCF(-1)	0.472092	0.009206	51.27968	0.0000
PUCF	-0.325820	0.008122	-40.11706	0.0000
RGDP	0.156578	0.017664	8.864042	0.0000
GNS	0.256220	0.008109	31.59702	0.0000
FB	0.018277	0.012921	1.414507	0.1573
TDEBT	0.001030	0.001309	0.787337	0.4311
CAB	-0.261379	0.009047	-28.89054	0.0000
POL	-0.009413	0.004416	-2.131476	0.0331
CPI	-0.000506	7.40E-05	-6.836412	0.0000
RIR	-0.021987	0.004030	-5.456344	0.0000

R-squared	0.590406	Mean dependent var	15.60109
Adjusted R-squared	0.589762	S.D. dependent var	9.931853
S.E. of regression	6.361332	Akaike info criterion	6.540078
Sum squared resid	257326.8	Schwarz criterion	6.551750
Log likelihood	-20819.15	Hannan-Quinn criter.	6.544119
F-statistic	916.6145	Durbin-Watson stat	1.910686
Prob(F-statistic)	0.000000		

Appendix C7: Pooled regression of debt service in 13 countries

Dependent Variable: PCF
Method: Pooled Least Squares
Sample: 1980 2015
Included observations: 468
Cross-sections included: 14
Total pool (balanced) observations: 6552

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.056527	0.238301	38.00452	0.0000
PUCF	-0.365421	0.009338	-39.13184	0.0000
RGDP	0.162995	0.020426	7.979734	0.0000
GNS	0.407758	0.008555	47.66244	0.0000
FB	0.020903	0.014529	1.438677	0.1503
DEBTS	-0.040008	0.002649	-15.10460	0.0000
CAB	-0.401849	0.009789	-41.05078	0.0000
POL	-0.037401	0.004926	-7.592103	0.0000
CPI	-0.000727	8.65E-05	-8.399394	0.0000
RIR	0.046561	0.004651	10.01137	0.0000

R-squared	0.431723	Mean dependent var	15.64678
Adjusted R-squared	0.430941	S.D. dependent var	9.877021
S.E. of regression	7.450829	Akaike info criterion	6.856053
Sum squared resid	363178.2	Schwarz criterion	6.866412
Log likelihood	-22450.43	Hannan-Quinn criter.	6.859634
F-statistic	552.2208	Durbin-Watson stat	0.870400
Prob(F-statistic)	*0.000000*		

Appendix C8: Pooled regression of debt service with lagged PFC in 13 countries

Dependent Variable: PCF
Method: Pooled Least Squares
Sample (adjusted): 1981 2015
Included observations: 455 after adjustments
Cross-sections included: 14
Total pool (balanced) observations: 6370

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.511862	0.223974	20.14458	0.0000
PCF(-1)	0.460081	0.009416	48.86330	0.0000
PUCF	-0.320439	0.008026	-39.92314	0.0000
RGDP	0.148672	0.017687	8.405788	0.0000
GNS	0.257510	0.008056	31.96439	0.0000
FB	0.013195	0.012830	1.028436	0.3038
DEBTS	-0.012244	0.002332	-5.251256	0.0000
CAB	-0.268524	0.009051	-29.66833	0.0000
POL	-0.012993	0.004251	-3.056457	0.0022
CPI	-0.000530	7.39E-05	-7.174149	0.0000
RIR	0.021427	0.004020	5.329749	0.0000

R-squared	0.592135	Mean dependent var	15.60109
Adjusted R-squared	0.591494	S.D. dependent var	9.931853
S.E. of regression	6.347893	Akaike info criterion	6.535848
Sum squared resid	256240.7	Schwarz criterion	6.547521
Log likelihood	-20805.68	Hannan-Quinn criter.	6.539890
F-statistic	923.1949	Durbin-Watson stat	1.910870
Prob(F-statistic)	0.000000		

Appendix C9: Fixed effects regression of total debt in 12 countries

Dependent Variable: PCF
Method: Panel Least Squares
Sample: 1980 2015
Periods included: 36
Cross-sections included: 12
Total panel (balanced) observations: 432

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PUCF	-0.354704	0.037545	-9.447317	0.0000
RGDP	0.197700	0.076736	2.576346	0.0103
RIR	-0.005098	0.019309	-0.264011	0.7919
GNS	0.299219	0.044059	6.791363	0.0000
FB	-0.050153	0.059197	-0.847236	0.3974
FAID	-0.014921	0.047237	-0.315882	0.7523
TDEBT	-0.015945	0.006652	-2.397025	0.0170
CPI	-0.000760	0.000317	-2.394505	0.0171
CAB	-0.380739	0.040314	-9.444281	0.0000
POL	-0.030902	0.023033	-1.341612	0.1805
C	11.51162	1.174643	9.800093	0.0000

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.530814	Mean dependent var	15.70913
Adjusted R-squared	0.506783	S.D. dependent var	10.24479
S.E. of regression	7.194858	Akaike info criterion	6.834194
Sum squared resid	21224.05	Schwarz criterion	7.041382
Log likelihood	-1454.186	Hannan-Quinn criter.	6.915991
F-statistic	22.08831	Durbin-Watson stat	0.989181
Prob(F-statistic)	0.000000		

Appendix C10: Fixed effects regression of total debt with lagged PCF in 12 countries

Dependent Variable: PCF
Method: Panel Least Squares
Sample (adjusted): 1981 2015
Periods included: 35
Cross-sections included: 13
Total panel (balanced) observations: 455
Convergence achieved after 11 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	16.08244	1.458684	11.02531	0.0000
PUCF	-0.517360	0.030903	-16.74155	0.0000
RGDP	0.091802	0.058973	1.556688	0.1203
RIR	-0.002488	0.017539	-0.141854	0.8873
GNS	0.212989	0.046223	4.607820	0.0000
FB	0.018529	0.055602	0.333239	0.7391
TDEBT	-0.021656	0.009472	-2.286372	0.0227
CAB	-0.226007	0.045284	-4.990841	0.0000
POL	-0.029323	0.021784	-1.346082	0.1790
CPI	-0.000233	0.000212	-1.096404	0.2735
PCF(-1)	0.639618	0.038091	16.79170	0.0000

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.688014	Mean dependent var	15.60109
Adjusted R-squared	0.672126	S.D. dependent var	9.942005
S.E. of regression	5.692818	Akaike info criterion	6.365515
Sum squared resid	14000.33	Schwarz criterion	6.573794
Log likelihood	-1425.155	Hannan-Quinn criter.	6.447568
F-statistic	43.30359	Durbin-Watson stat	2.073072
Prob(F-statistic)	0.000000		

Appendix C11: Fixed effects regression of debt service in 12 countries

Dependent Variable: PCF
Method: Panel Least Squares
Sample: 1980 2015
Periods included: 36
Cross-sections included: 13
Total panel (balanced) observations: 468

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	10.85715	1.028002	10.56140	0.0000
PUCF	-0.368467	0.034447	-10.69650	0.0000
RGDP	0.187889	0.073461	2.557664	0.0109
RIR	-0.002763	0.018344	-0.150625	0.8803
GNS	0.312470	0.041356	7.555634	0.0000
FB	-0.046280	0.056274	-0.822401	0.4113
DEBTS	-0.032018	0.010860	-2.948377	0.0034
CAB	-0.378473	0.038576	-9.811200	0.0000
POL	-0.020973	0.020364	-1.029870	0.3036
CPI	-0.000834	0.000303	-2.753467	0.0061

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.531696	Mean dependent var	15.64678
Adjusted R-squared	0.509646	S.D. dependent var	9.886835
S.E. of regression	6.923287	Akaike info criterion	6.753526
Sum squared resid	21377.63	Schwarz criterion	6.948540
Log likelihood	-1558.325	Hannan-Quinn criter.	6.830263
F-statistic	24.11297	Durbin-Watson stat	1.019915
Prob(F-statistic)	0.000000		

Appendix C12: Fixed effects regression of debt service with lagged PCF in 12 countries

Dependent Variable: PCF
Method: Panel Least Squares
Sample (adjusted): 1981 2015
Periods included: 35
Cross-sections included: 13
Total panel (balanced) observations: 455

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.654766	1.027248	6.478247	0.0000
PCF(-1)	0.381199	0.037915	10.05408	0.0000
PUCF	-0.342314	0.031385	-10.90677	0.0000
RGDP	0.149440	0.067656	2.208832	0.0277
RIR	-0.003334	0.016794	-0.198516	0.8427
GNS	0.231249	0.038681	5.978361	0.0000
FB	-0.022530	0.052356	-0.430316	0.6672
DEBTS	-0.016778	0.010008	-1.676390	0.0944
CAB	-0.266717	0.037625	-7.088760	0.0000
POL	-0.008348	0.018580	-0.449291	0.6534
CPI	-0.000609	0.000275	-2.215798	0.0272

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.622973	Mean dependent var	15.60109
Adjusted R-squared	0.603772	S.D. dependent var	9.942005
S.E. of regression	6.258155	Akaike info criterion	6.554875
Sum squared resid	16919.07	Schwarz criterion	6.763154
Log likelihood	-1468.234	Hannan-Quinn criter.	6.636928
F-statistic	32.44573	Durbin-Watson stat	1.831771
Prob(F-statistic)	0.000000		

Appendix C13: Fixed effects regression of total debt in 13 countries

Dependent Variable: PCF
Method: Panel Least Squares
Sample: 1980 2015
Periods included: 36
Cross-sections included: 13
Total panel (balanced) observations: 468

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	11.13881	1.087820	10.23958	0.0000
PUCF	-0.359170	0.034766	-10.33096	0.0000
RGDP	0.201297	0.073310	2.745844	0.0063
RIR	-0.006155	0.018347	-0.335461	0.7374
GNS	0.303779	0.041767	7.273201	0.0000
FB	-0.054966	0.056522	-0.972463	0.3313
TDEBT	-0.015903	0.006012	-2.645364	0.0084
CAB	-0.388068	0.038592	-10.05561	0.0000
POL	-0.021336	0.020512	-1.040151	0.2988
CPI	-0.000736	0.000304	-2.419045	0.0160

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.529944	Mean dependent var	15.64678
Adjusted R-squared	0.507811	S.D. dependent var	9.886835
S.E. of regression	6.936228	Akaike info criterion	6.757261
Sum squared resid	21457.62	Schwarz criterion	6.952274
Log likelihood	-1559.199	Hannan-Quinn criter.	6.833998
F-statistic	23.94391	Durbin-Watson stat	0.982361
Prob(F-statistic)	0.000000		

Appendix C14: Fixed effects regression of total debt with lagged PCF in 13 countries

Dependent Variable: PCF
Method: Panel Least Squares
Sample (adjusted): 1981 2015
Periods included: 35
Cross-sections included: 13
Total panel (balanced) observations: 455
Convergence achieved after 11 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	16.08244	1.458684	11.02531	0.0000
PUCF	-0.517360	0.030903	-16.74155	0.0000
RGDP	0.091802	0.058973	1.556688	0.1203
RIR	-0.002488	0.017539	-0.141854	0.8873
GNS	0.212989	0.046223	4.607820	0.0000
FB	0.018529	0.055602	0.333239	0.7391
TDEBT	-0.021656	0.009472	-2.286372	0.0227
CAB	-0.226007	0.045284	-4.990841	0.0000
POL	-0.029323	0.021784	-1.346082	0.1790
CPI	-0.000233	0.000212	-1.096404	0.2735
PCF(-1)	0.639618	0.038091	16.79170	0.0000

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.688014	Mean dependent var	15.60109
Adjusted R-squared	0.672126	S.D. dependent var	9.942005
S.E. of regression	5.692818	Akaike info criterion	6.365515
Sum squared resid	14000.33	Schwarz criterion	6.573794
Log likelihood	-1425.155	Hannan-Quinn criter.	6.447568
F-statistic	43.30359	Durbin-Watson stat	2.073072
Prob(F-statistic)	0.000000		

Appendix C15: Random effects regression of total debt in 12 countries

Dependent Variable: PCF
Method: Panel EGLS (Cross-section random effects)
Sample: 1980 2015
Periods included: 36
Cross-sections included: 12
Total panel (balanced) observations: 432
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	10.03699	1.123189	8.936153	0.0000
PUCF	-0.362702	0.036748	-9.869864	0.0000
RGDP	0.185112	0.075792	2.442365	0.0150
RIR	-0.026974	0.017985	-1.499834	0.1344
GNS	0.359435	0.036493	9.849459	0.0000
FB	-9.87E-05	0.055986	-0.001763	0.9986
TDEBT	-0.010763	0.006375	-1.688332	0.0921
CAB	-0.384854	0.037847	-10.16856	0.0000
POL	-0.039585	0.021152	-1.871438	0.0620
FAID	-0.013627	0.042192	-0.322989	0.7469
CPI	-0.000706	0.000316	-2.230810	0.0262

Effects Specification	S.D.	Rho
Cross-section random	1.393478	0.0362
Idiosyncratic random	7.194858	0.9638

Weighted Statistics

R-squared	0.383349	Mean dependent var	10.24666
Adjusted R-squared	0.368701	S.D. dependent var	9.461449
S.E. of regression	7.517528	Sum squared resid	23792.07
F-statistic	26.17197	Durbin-Watson stat	0.874954
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.405944	Mean dependent var	15.70913
Sum squared resid	26872.70	Durbin-Watson stat	0.774651

Appendix C16: Random effects regression of total debt with lagged PCF in 12 countries

Dependent Variable: PCF
Method: Panel EGLS (Cross-section random effects)
Sample (adjusted): 1981 2015
Periods included: 35
Cross-sections included: 12
Total panel (balanced) observations: 420
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.021889	0.937901	4.288181	0.0000
PCF(-1)	0.478443	0.035818	13.35769	0.0000
PUCF	-0.341180	0.032688	-10.43736	0.0000
RGDP	0.136786	0.068920	1.984698	0.0478
RIR	-0.021836	0.015494	-1.409368	0.1595
GNS	0.257272	0.031157	8.257412	0.0000
FB	0.008911	0.049956	0.178368	0.8585
TDEBT	-0.003114	0.005574	-0.558774	0.5766
CAB	-0.247480	0.035405	-6.990048	0.0000
POL	-0.009806	0.017988	-0.545143	0.5860
FAID	0.052731	0.035185	1.498676	0.1347
CPI	-0.000457	0.000286	-1.599971	0.1104

Effects Specification

	S.D.	Rho
Cross-section random	4.22E-07	0.0000
Idiosyncratic random	6.505594	1.0000

Weighted Statistics

R-squared	0.591425	Mean dependent var	15.67325
Adjusted R-squared	0.580409	S.D. dependent var	10.30430
S.E. of regression	6.674697	Sum squared resid	18177.04
F-statistic	53.69023	Durbin-Watson stat	1.888419
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.591425	Mean dependent var	15.67325
Sum squared resid	18177.04	Durbin-Watson stat	1.888419

Appendix C17: Random effects regression of debt service in 12 countries

Dependent Variable: PCF
Method: Panel EGLS (Cross-section random effects)
Sample: 1980 2015
Periods included: 36
Cross-sections included: 12
Total panel (balanced) observations: 432
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PUCF	-0.359731	0.036549	-9.842288	0.0000
RGDP	0.165826	0.075626	2.192715	0.0289
RIR	-0.025684	0.017766	-1.445707	0.1490
GNS	0.370290	0.035199	10.51997	0.0000
FB	0.005839	0.055056	0.106053	0.9156
FAID	-0.014983	0.038911	-0.385063	0.7004
DEBTS	-0.037527	0.010494	-3.576022	0.0004
CPI	-0.000803	0.000314	-2.558100	0.0109
CAB	-0.386426	0.037430	-10.32398	0.0000
POL	-0.042221	0.020457	-2.063866	0.0396
C	9.986426	1.038904	9.612462	0.0000

Effects Specification	S.D.	Rho
Cross-section random	1.186883	0.0266
Idiosyncratic random	7.174067	0.9734

Weighted Statistics			
R-squared	0.400488	Mean dependent var	11.14896
Adjusted R-squared	0.386248	S.D. dependent var	9.571880
S.E. of regression	7.498834	Sum squared resid	23673.89
F-statistic	28.12379	Durbin-Watson stat	0.928939
Prob(F-statistic)	0.000000		

Unweighted Statistics			
R-squared	0.427467	Mean dependent var	15.70913
Sum squared resid	25899.08	Durbin-Watson stat	0.849127

Appendix C18: Random effects regression of debt service with lagged PCF in 12 countries

Dependent Variable: PCF
Method: Panel EGLS (Cross-section random effects)
Sample (adjusted): 1981 2015
Periods included: 35
Cross-sections included: 12
Total panel (balanced) observations: 420
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PCF(-1)	0.466590	0.036679	12.72099	0.0000
PUCF	-0.338456	0.032751	-10.33433	0.0000
RGDP	0.131450	0.068997	1.905153	0.0575
RIR	-0.020970	0.015495	-1.353335	0.1767
GNS	0.261530	0.031085	8.413471	0.0000
FB	0.008211	0.049537	0.165766	0.8684
FAID	0.054153	0.032842	1.648863	0.0999
DEBTS	-0.014378	0.009285	-1.548513	0.1223
CPI	-0.000504	0.000285	-1.770111	0.0775
CAB	-0.253456	0.035643	-7.110893	0.0000
POL	-0.010578	0.017551	-0.602687	0.5471
C	4.188404	0.909195	4.606715	0.0000

Effects Specification	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	6.507181	1.0000

Weighted Statistics

R-squared	0.593410	Mean dependent var	15.67325
Adjusted R-squared	0.582448	S.D. dependent var	10.30430
S.E. of regression	6.658461	Sum squared resid	18088.72
F-statistic	54.13348	Durbin-Watson stat	1.893092
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.593410	Mean dependent var	15.67325
Sum squared resid	18088.72	Durbin-Watson stat	1.893092

Appendix C19: Random effects regression of total debt in 13 countries

Dependent Variable: PCF
Method: Panel EGLS (Cross-section random effects)
Sample: 1980 2015
Periods included: 36
Cross-sections included: 13
Total panel (balanced) observations: 468
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.233778	0.970246	9.516940	0.0000
PUCF	-0.370164	0.033443	-11.06842	0.0000
RGDP	0.191908	0.071725	2.675588	0.0077
RIR	-0.036465	0.016838	-2.165624	0.0309
GNS	0.378950	0.033095	11.45027	0.0000
FB	0.010349	0.052617	0.196680	0.8442
TDEBT	-0.008438	0.005513	-1.530662	0.1265
CAB	-0.392190	0.035415	-11.07415	0.0000
POL	-0.033179	0.018610	-1.782861	0.0753
CPI	-0.000662	0.000303	-2.189382	0.0291

Effects Specification

	S.D.	Rho
Cross-section random	0.944408	0.0182
Idiosyncratic random	6.936228	0.9818

Weighted Statistics

R-squared	0.391348	Mean dependent var	12.11734
Adjusted R-squared	0.379387	S.D. dependent var	9.370467
S.E. of regression	7.381958	Sum squared resid	24957.94
F-statistic	32.72024	Durbin-Watson stat	0.839025
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.409579	Mean dependent var	15.64678
Sum squared resid	26952.15	Durbin-Watson stat	0.776945

Appendix C20: Random effects regression of debt service with lagged PCF in 13 countries

Dependent Variable: PCF
Method: Panel EGLS (Cross-section random effects)
Sample (adjusted): 1981 2015
Periods included: 35
Cross-sections included: 13
Total panel (balanced) observations: 455
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PCF(-1)	0.472092	0.033906	13.92343	0.0000
C	4.027571	0.856583	4.701902	0.0000
PUCF	-0.325820	0.029912	-10.89256	0.0000
RGDP	0.156578	0.065057	2.406760	0.0165
RIR	-0.021987	0.014841	-1.481504	0.1392
GNS	0.256220	0.029865	8.579208	0.0000
FB	0.018277	0.047589	0.384066	0.7011
TDEBT	-0.001030	0.004820	-0.213777	0.8308
CAB	-0.261379	0.033321	-7.844345	0.0000
POL	-0.009413	0.016265	-0.578737	0.5631
CPI	-0.000506	0.000273	-1.856219	0.0641

Effects Specification	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	6.261567	1.0000

Weighted Statistics

R-squared	0.590406	Mean dependent var	15.60109
Adjusted R-squared	0.581181	S.D. dependent var	9.942005
S.E. of regression	6.434088	Sum squared resid	18380.48
F-statistic	64.00013	Durbin-Watson stat	1.906681
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.590406	Mean dependent var	15.60109
Sum squared resid	18380.48	Durbin-Watson stat	1.906681

Appendix C21: Random effects regression of debt service in 13 countries

Dependent Variable: PCF
Method: Panel EGLS (Cross-section random effects)
Sample: 1980 2015
Periods included: 36
Cross-sections included: 13
Total panel (balanced) observations: 468
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PUCF	-0.365787	0.033101	-11.05067	0.0000
RGDP	0.168958	0.071866	2.351028	0.0191
RIR	-0.031406	0.016841	-1.864866	0.0628
GNS	0.380157	0.032742	11.61084	0.0000
FB	0.007256	0.052316	0.138696	0.8898
DEBTS	-0.038002	0.009719	-3.909884	0.0001
CAB	-0.392574	0.035288	-11.12490	0.0000
CPI	-0.000761	0.000301	-2.523933	0.0119
POL	-0.033981	0.018090	-1.878411	0.0610
C	9.640150	0.918458	10.49602	0.0000

Effects Specification	S.D.	Rho
Cross-section random	0.946670	0.0184
Idiosyncratic random	6.923287	0.9816

Weighted Statistics

R-squared	0.406361	Mean dependent var	12.09665
Adjusted R-squared	0.394696	S.D. dependent var	9.367754
S.E. of regression	7.288234	Sum squared resid	24328.21
F-statistic	34.83476	Durbin-Watson stat	0.906729
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.429283	Mean dependent var	15.64678
Sum squared resid	26052.65	Durbin-Watson stat	0.846712

Appendix C22: Random effects regression of debt service with lagged PCF in 13 countries

Dependent Variable: PCF
Method: Panel EGLS (Cross-section random effects)
Sample (adjusted): 1980 2014
Periods included: 35
Cross-sections included: 13
Total panel (balanced) observations: 455
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.356518	0.801873	6.680004	0.0000
PCF(1)	0.463854	0.035403	13.10195	0.0000
PUCF	-0.330348	0.029489	-11.20241	0.0000
RGDP	0.107405	0.064373	1.668473	0.0959
RIR	-0.005785	0.015035	-0.384795	0.7006
GNS	0.242676	0.030044	8.077458	0.0000
FB	0.015513	0.045736	0.339184	0.7346
DEBTS	-0.014798	0.008526	-1.735640	0.0833
CAB	-0.226370	0.033321	-6.793619	0.0000
CPI	-0.000293	0.000273	-1.070465	0.2850
POL	-0.020884	0.015552	-1.342844	0.1800

Effects Specification	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	6.240737	1.0000

Weighted Statistics

R-squared	0.585261	Mean dependent var	15.57926
Adjusted R-squared	0.575920	S.D. dependent var	9.876005
S.E. of regression	6.431392	Sum squared resid	18365.09
F-statistic	62.65537	Durbin-Watson stat	1.785165
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.585261	Mean dependent var	15.57926
Sum squared resid	18365.09	Durbin-Watson stat	1.785165

Notes: $rho = \frac{(\delta\_u)^2}{(\delta\_u)^2 + (\delta\_e)^2}$, where δ_u = 0 is the standard deviation of residuals within groups u_i and δ_e = 6.2496424 is the standard deviation of residuals (overall error term) e_i.

Appendix D: Granger causality test for individual SADC countries

Causality	F-stat 1	F-stat 2	F-stat 3	F-stat 4	F-stat 5	F-stat 6	F-stat 7	F-stat 8	F-stat 9	F-stat 10	F-stat 11	F-stat 12	F-stat 13
POL to PCF	3.52897**	2.5173*	0.08929	2.00570	0.53451	0.38613	3.97198**	1.07600	8.55503***	0.54120	2.12915	1.65958	1.09185
PCF to POL	0.05040	0.26638	0.27585	0.94047	0.50945	0.22569	-2.90348	0.10604	4.59615**	0.15645	0.08600	0.07111	1.31079
PUCF to PCF	3.83263**	0.97517	0.45551	1.20720	2.33787	0.85786	3.97198**	0.03054	0.42655	0.04791	1.48222	0.14067	4.82366**
PCF to PUCF	0.13358	0.10939	0.16349	0.36620	0.81191	0.14856	-2.90348	0.04064	0.16474	0.86348	0.03146	2.21362	4.77643**
RGDP to PCF	1.37523	1.06334	0.09605	3.80178**	2.08458	0.95983	2.52649*	0.33636	0.03321	1.88528	3.68102**	0.52822	0.85140
PCF to RGDP	1.06836	0.85596	0.16200	0.51907	0.10475	4.4948**	0.17716	1.05980	0.17792	1.03123	0.74948	3.45216**	1.29598
GNS to PCF	0.43091	1.46538	10.0502***	0.06436	6.37472***	0.40910	0.35975	1.73371	0.72234	0.17764	1.30618	0.86350	5.90904***
PCF to GNS	1.93451	0.60721	0.21682	0.45323	1.06629	2.26617	0.25112	0.22309	0.92099	0.63809	0.31229	0.76844	2.51166*
FAID to PCF	0.68753	1.36126	0.73967	1.16521	1.02349	0.00348	0.50680	0.50854	5.26628**	4.51348**	0.35225	0.18817	
PCF to FAID	1.61769	0.35105	0.45463***	1.92451	1.12450	0.71428	3.17735*	1.68499	0.15981	0.11630	2.10877	4.93331**	
DEBTS to PCF	0.71842	5.402**	0.17943	0.31544	0.27488	1.20013	0.82557	0.16507	0.50474	0.53381	1.25039	4.00146**	1.08381

Notes: F-stat 1= F statistic for nation1, F-stat 2= F statistic for nation 2, F-stat 3= F statistic for nation 3, F-stat 4= F statistic for nation 4, F-stat 5= F statistic for nation5, F-stat 6= F statistic for nation 6, F-stat 7= F statistic for nation 7, F-stat 8= F statistic for nation 8, F-stat 9= F statistic for nation9, F-stat 10= F statistic for nation 10, F-stat 11= F statistic for nation 11, F-stat 12= F statistic for nation 12, F-stat 13= F statistic for nation 1.; 1= Angola, 2=Botswana, 3=DRC, 4=Lesotho, 5= Madagascar, 6=Malawi, 7= Mauritius, 8=Mozambique, 9=Seychelles, 10=Swaziland, 11=Tanzania, 12=Zambia, 13=South Africa.

Appendix D1: Granger causality test for individual SADC countries

Causality	F-stat 1	F-stat 2	F-stat 3	F-stat 4	F-stat 5	F-stat 6	F-stat 7	F-stat 8	F-stat 9	F-stat 10	F-stat 11	F-stat 12	F-stat 13
PCF to DEBTS	0.73833	1.31610	0.11732	0.91678	2.66086*	1.24865	2.05666	0.88655	5.58741***	8.96911***	1.68987	4.33656**	1.42304
TDEBT to PCF	2.28246*	1.02952	1.66428	0.12001	3.90781**	0.45439	0.13460	0.89579	2.34639	1.50094	2.59526*	2.69919*	0.48766
PCF to TDEBT	3.55392**	1.01356	3.51187**	0.74368	2.87620*	3.20096*	0.42097	0.17098	0.08438	0.64655	0.56282	10.0815***	3.32786**
CAB to PCF	0.38704	0.65359	2.10051	1.08999	3.54263**	0.65817	0.53504	4.30700**	0.19842	0.08518	0.58788	0.04638	2.49324
PCF to CAB	4.88464***	0.02627	0.63135	1.28142	4.99193**	0.16660	0.20070	1.73528	0.86250	0.63121	1.29957	2.11557	1.59096
CPI to PCF	4.43242***	1.07657	0.27479	4.9514***	1.06922	1.02648	3.95243**	0.28260	0.36333	0.44878	3.09898*	1.34271	6.55427***
PCF to CPI	1.45692	0.57579	0.04380	1.43317	1.25892	1.84235	1.10565	0.84539	1.04354	0.86332	0.48730	1.97058	0.02322
RIR to PCF	1.78935	1.94737	2.62416***	0.81767	1.73363	1.57502	0.16082	0.39770	2.05672	0.13713	0.96714	4.05963**	0.53119
PCF to RIR	5.5903***	2.5569*	0.75270	1.43317	3.36730**	0.29454	0.60024	0.42439	0.88134	2.16549	0.62844	0.07946	0.33567
FB to PCF	4.04605**	2.8946*	2.40253	4.13047**	0.19375	0.17943	4.36202**	0.10836	1.81468	0.96287	0.3749	1.60014	0.87040
PCF to FB	1.66199	1.37214	1.43291	0.71281	0.89086	2.50225*	1.75652	0.16655	1.04878	0.83776	3.699**	0.01596	1.60363

Notes: F-stat 1= F statistic for nation1, F-stat 2= F statistic for nation 2, F-stat 3= F statistic for nation 3, F-stat 4= F statistic for nation 4, F-stat 5= F statistic for nation5, F-stat 6= F statistic for nation 6, F-stat 7= F statistic for nation 7, F-stat 8= F statistic for nation 8, F-stat 9= F statistic for nation9, F-stat 10= F statistic for nation 10, F-stat 11= F statistic for nation 11, F-stat 12= F statistic for nation 12, F-stat 13= F statistic for nation 1.; 1= Angola, 2=Botswana, 3=DRC, 4=Lesotho, 5= Madagascar, 6=Malawi, 7= Mauritius, 8=Mozambique, 9=Seychelles, 10=Swaziland, 11=Tanzania, 12=Zambia, 13=South Africa.

Appendix E: Country-specific unit root tests

Appendix E1: Group unit root test summary for Angola

Series: PCF, POL, PUCF, RGDP, GNS, FAID, DEBTS, TDEBT, CAB, CPI, RIR, FB
Sample: 1980 2015
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 2

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-4.02802	0.0000	12	417
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-4.06820	0.0000	12	417
ADF - Fisher Chi-square	59.0754	0.0001	12	417
PP - Fisher Chi-square	66.1726	0.0000	12	420

Appendix E2: Unit root test summary for Botswana

Series: PCF, POL, RGDP, GNS, FAID, DEBTS, TDEBT, CAB, CPI, RIR, FB, PUCF
Date: 02/11/17 Time: 09:17
Sample: 1980 2015
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 2
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-4.26251	0.0000	12	416
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-5.46094	0.0000	12	416
ADF - Fisher Chi-square	82.2039	0.0000	12	416
PP - Fisher Chi-square	67.8153	0.0000	12	420

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality

Appendix E3: Group unit root test summary for DRC

Series: PCF, POL, PUCF, RGDP, GNS, FAID, DEBTS, TDEBT, CAB, CPI, RIR, FB
Sample: 1980 2015
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-6.69222	0.0000	12	419
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-7.51572	0.0000	12	419
ADF - Fisher Chi-square	109.673	0.0000	12	419
PP - Fisher Chi-square	104.273	0.0000	12	420

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Appendix E4: Group unit root test summary for Lesotho

Series: PCF, POL, PUCF, RGDP, GNS, FAID, DEBTS, TDEBT, CAB, CPI, RIR, FB
Sample: 1980 2015
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 8
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-2.76917	0.0028	12	412
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-5.58414	0.0000	12	412
ADF - Fisher Chi-square	88.1814	0.0000	12	412
PP - Fisher Chi-square	84.4507	0.0000	12	420

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Appendix E4: Group unit root test summary for Lesotho

Series: PCF, POL, PUCF, RGDP, GNS, FAID, DEBTS, TDEBT, CAB, CPI, RIR, FB
Sample: 1980 2015
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-4.69728	0.0000	12	418
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-5.64603	0.0000	12	418
ADF - Fisher Chi-square	85.4188	0.0000	12	418
PP - Fisher Chi-square	97.2417	0.0000	12	420

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Appendix E5: Group unit root test summary for Madagascar

Series: PCF, POL, PUCF, RGDP, GNS, FAID, DEBTS, TDEBT, CAB, CPI, RIR, FB
Sample: 1980 2015
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-4.69728	0.0000	12	418
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-5.64603	0.0000	12	418
ADF - Fisher Chi-square	85.4188	0.0000	12	418
PP - Fisher Chi-square	97.2417	0.0000	12	420

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Appendix E6: Group unit root test summary for Malawi

Series: PCF, POL, PUCF, RGDP, GNS, FAID, DEBTS, TDEBT, CAB, CPI, RIR, FB
Sample: 1980 2015
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0
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*	-7.49674	0.0000	12	420
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-9.91824	0.0000	12	420
ADF - Fisher Chi-square	148.275	0.0000	12	420
PP - Fisher Chi-square	157.968	0.0000	12	420

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Appendix E7: Group unit root test summary for Mauritius

Series: PCF, POL, PUCF, RGDP, GNS, FAID, DEBTS, TDEBT, CAB, CPI, RIR, FB
Sample: 1980 2015
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 5
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-3.18405	0.0007	11	379
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-4.68110	0.0000	11	379
ADF - Fisher Chi-square	73.4896	0.0000	11	379
PP - Fisher Chi-square	79.5292	0.0000	11	385

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality

Appendix E8: Group unit root test summary for Mozambique

Series: PCF, POL, PUCF, RGDP, GNS, FAID, DEBTS, TDEBT, CAB, CPI, RIR, FB
Sample: 1980 2015
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.56034	0.0593	12	418
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-2.90108	0.0019	12	418
ADF - Fisher Chi-square	49.9227	0.0014	12	418
PP - Fisher Chi-square	50.4747	0.0012	12	420

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Appendix E9: Group unit root test summary for Seychelles

Series: PCF, POL, PUCF, RGDP, GNS, FAID, DEBTS, TDEBT, CAB, CPI, RIR, FB
Sample: 1980 2015
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-5.51995	0.0000	11	381
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-6.37354	0.0000	11	381
ADF - Fisher Chi-square	84.0686	0.0000	11	381
PP - Fisher Chi-square	86.1123	0.0000	11	385

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Appendix E10: Group unit root test summary for Swaziland

Series: PCF, POL, PUCF, RGDP, GNS, FAID, DEBTS, TDEBT, CAB, CPI, RIR, FB
Sample: 1980 2015
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 3
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-4.55424	0.0000	12	416
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-5.72817	0.0000	12	416
ADF - Fisher Chi-square	85.2975	0.0000	12	416
PP - Fisher Chi-square	95.8127	0.0000	12	420

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Appendix E11: Group unit root test summary for Tanzania

Series: PCF, POL, PUCF, RGDP, GNS, FAID, DEBTS, TDEBT, CAB, CPI, RIR, FB
Sample: 1980 2015
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 3
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.91417	0.0278	12	410
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-2.97673	0.0015	12	410
ADF - Fisher Chi-square	48.9690	0.0019	12	410
PP - Fisher Chi-square	45.6447	0.0049	12	420

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Appendix E12: Group unit root test summary for Zambia

Series: PCF, POL, PUCF, RGDP, GNS, FAID, DEBTS, TDEBT, CAB, CPI, RIR, FB
Sample: 1980 2015
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 3
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-2.55799	0.0053	12	416
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.01147	0.0013	12	416
ADF - Fisher Chi-square	52.2131	0.0007	12	416
PP - Fisher Chi-square	52.7045	0.0006	12	420

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Appendix E13: Group unit root test summary for South Africa

Series: PCF, POL, PUCF, RGDP, GNS, DEBTS, TDEBT, CAB, CPI, FB, RIR
Sample: 1980 2015
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-4.80332	0.0000	11	382
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-5.50809	0.0000	11	382
ADF - Fisher Chi-square	79.0883	0.0000	11	382
PP - Fisher Chi-square	73.0864	0.0000	11	385

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.