UNIVERSITY OF ZULULAND

Budget Deficits, Economic Growth and External Balances in SADC countries: A Panel Data and Time Series Analysis

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(**201100856)**

Thesis presented for the Degree of

Doctor of Philosophy (PhD)

In

Economics

In the

Faculty of Commerce, Administration and Law

University of Zululand

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February 2017

Declaration

I, ELISHA MAVODYO, declare that this dissertation is my original work, save for citation and referencing signify otherwise in the text. The dissertation has not and will not be presented for the award of any degree at any other university.

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Certificate of Approval

We declare that this thesis is from the student's own work and citations have been made where other sources of information have been used. This thesis is therefore submitted with our approval.

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Acknowledgements

I am gratefully indebted to my two suspervisors, Professor Irrshad Kaseeram and Professor Eleftherios Contogiannis for their, patience, motivation and vast knowedge and experience in research that steered this thesis in the right direction. They always squeezed in a discussion with me in their busy schedules. Their guidance helped me in all of the time the research and writing of this research. This accomplishment would not have been possible without them.

I also wish to express my sincere gratitude to Brian Mazorodze, my friend and post-graduate fellow study partner for his thought-provoking, insightful and stimulating discussions. I could not have imagined a better study companion for my PhD.

I also wish to thank my colleagues at the University of Zululand, Department of Economics, Mrs Fortunate Mahuni Tarwireyi, Mr Mushoni Bulagi, Mr Thato Mokoma and Miss Nomfundo Khumalo for accepting nothing less than excellence from me. I also wish to thank participants at the MBALI Conference for their discerning comments, particularly Christian Tipoy.

Finally, I want to express my very profound gratitude to my son Kudakwashe Elisha (Junior), daughter Charmain Kunashe, and cousin sister Belinda Mupinga for their words of encouragement, spiritual support and always reminding me to live up to my set targets.

Dedication

To my late wife, Felistus Manyonga Mavodyo, our son Kudakwashe Elisha Mavodyo and our daughter Charmain Kunashe Mavodyo.

Abstract

The role fiscal policy plays as a macro-economic stabilisation tool remains a contentious issue in macro-economics. Yet an understanding of the role fiscal policy plays in influencing external balances as well as economic growth is instructive upon policy makers to craft stimulus packages in order to enhance sustainable economic growth, bearing in mind, as well, that lack of fiscal space underscores the limits of discretionary fiscal policy. In the same vain, an awareness of the role of budget deficits in driving external balances plays a principal role in adopting fiscal prudence as a way of harnessing the widening current account deficits which may have dire consequences on the economy. Notwithstanding the importance such an understanding is to the achievement of the Southern African Development Community (SADC)'s goals of fighting poverty and attaining economic integration through adoption of sound macroeconomic policies, the SADC region has received very little scholarly attention on this contemporary issue. This thesis fills this gap in the literature by providing empirical evidence that is SADC specific on the role of fiscal policy in driving the external balances as well as the impact of fiscal policy in accounting for economic growth in the region. This goal is achieved in three separate chapters; chapter4, chapter 5, and chapter 6 of this thesis.

In chapter 4 of this thesis the study analysed the co-movement between budget deficits and the external balances in 14 SADC member countries. Relying on evidence from the cutting edge Common Correlated Mean Group Estimator (CCEMG) and the system general methods of moments (GMM) estimation approaches, the study found evidence in support of the twin deficits hypothesis in the case of the 14 SADC member countries included in our analysis. The implications of these findings underscore the need to adopt fiscal austerity measures in order to harness the widening current account deficits which are way beyond the SADC set targets in most of the SADC member countries

Chapter 5 of this thesis presents the panel empirical evidence on the impact of public debt on subsequent economic growth in an unbalanced panel of 14 SADC member countries. Utilising various panel estimation approaches including the Dynamic Ordinary Least Squares (DOLS), the Fully Modified Ordinary Least Squares (FMOLS), the system GMM from use of initial values, and system GMM from the use of five and three-year averages. The study documents contradictory results on the relationship between public debt and economic growth. However, the study discriminated in favour of the DOLS which provide evidence in favour of the growth engendering role of public debt.

Furthermore, to the best of the researchers' knowledge no other study in the SADC context analysed the growth effects of public debt, particularly the non-linearities and the public debt-investment channels through which public debt is related to economic growth. To this end, the study found overwhelming evidence in support of the non-linearities in the relationship between public debt and economic growth. The policy implications of these findings are that though SADC member countries may rely on public debt as a counter cyclical measure but they ought to exercise restraint as excessive dependence on public debt beyond a certain threshold has detrimental effects on long run growth. Moreover, the analysis found that for public debt to be growth promoting it has to be channelled through investment in human capital.

The last set of empirical evidence in this thesis is presented in chapter 6. Chapter 6 reports the empirical evidence on the role of fiscal policy, specifically budget deficits, on economic growth in South Africa, Madagascar and Lesotho. Empirical evidence in this chapter, robust to some of the recent developments in time series literature- the DOLS, FMOLS, and the Canonical Cointegration Regression (CCR)-, overwhelmingly establish the growth promoting role of fiscal policy in South Africa, Madagascar and Lesotho. These findings may be taken to suggest that budget deficit in the three SADC countries could be dedicated to growth enhancing activities like investment in both physical and human capital, investment in technology and health that supports growth. In the case of South Africa, this study went further to analyse the growth effects of budget deficits in a pre and post democratic South Africa (1994) as well as the role of budget deficit in a pre and post inflation targeting era (2000).

The overall conclusion of this study is that debt spending, within limits, done in conjunction with broader developmental goals like investment in physical and social infrastructure, is essential for promoting growth in SADC countries.

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List of Abbreviations

ADF	-	Augmented Dickey Fuller
AR	-	Autoregressive
ARDL	-	Autoregressive Distributed Lag
ASEAN	-	Association of South Asian Nations
CCR	-	Common Correlated Effects
COSATU	-	Congress of South African Trade Union
CPI	-	Consumer Price Index
DOLS	-	Dynamic Ordinary Least Squares
FDI	-	Foreign Direct Investment
FGLS	-	Feasible Generalised Least Squares
FIP	-	Finance and Investment Protocol
FMOLS	-	Fully Modified Least Squares
G7	-	Group of Seven
GDP	-	Gross Domestic Product
GMM	-	Generalised Method of Moments
GNP	-	Gross National Product
HAC	-	Heteroscedasticity and Autorrelation Consistent
HIPC	-	Highly Indebted Poor Countries
IMF	-	International Monetary Fund
IPS	-	Im Pesaran and Shin
MG	-	Mean Group
OECD	-	

OLS	-	Ordinary Least Squares
PMG	-	Pooled Mean Group
PP	-	Phillips Perron
R&D	-	Research and Development
SACU	-	Southern African Customs Union
SADC	-	Southern Africa Development Community
SSA	-	Sub Saharan Africa
UNDP	-	United Nations Development Program
US	-	United States
VAR	-	Vector Autoregression
VECM	-	Vector Error Correction Model
WAEMU	-	West African Economic and Monetary Union
WEF	-	World Economic Forum

CHAPTER ONE

Introduction

1.1 Overview of the Thesis

Analyses of the role fiscal policy (budget deficits and public debt) plays in explaining movements in the external balances, and impacting economic growth, in the context of the Southern Africa Development Community (SADC) member countries, remains an under explored area in academic literature. Existing literature in this area focuses on developed countries with only a few sources focussing on Sub-Saharan Africa, which, at best, provide results that are not SADC specific. This thesis attempts to fill this gap in literature.

The analysis of the impact of fiscal policy (budget defits) on the external balances, as well as the growth impact of fiscal policy (public debt and budget deficits), is particularly appealing, within the SADC context, for a number of reasons. Proper utilisation of public debt/ budget deficits can foster economic growth, thereby leading to a reduction in unemployment, and social inequality, combat poverty, and lead to a general improvement in the social wellbeing of citizens. In this case, the major goal of SADC of reducing poverty among its member states can be realised. However, as important as fiscal policy is as a stabilisation tool, too much reliance on fiscal policy (public debt and budget deficits) can potentially expose SADC economies to macroeconomic risks, obstruct economic growth, deter employment creation and hinder economic development, thereby leading to an acceleration of poverty levels among its citizens.

Focusing on the role of fiscal deficits on the current account deficits (external balances), high current account deficits might be taken as a symptom of an anaemic economy. This causes a loss of confidence among investors leading to a possible risk of capital outflow that suppresses investment, leading to low economic growth, high levels of unemployment and a general worsening of the living standards of the citizens-thereby dampening SADC's goal of reducing poverty among its member states. More so, major credit rating agencies (Ranjan and Sharma, 2008) base their credit ratings for an economy, among other considerations, on the grounds of levels of economic growth, the size of the budget deficit as a percentage to GDP, the size of the current account deficit, levels of unemployment, and the level of public debt-to GDP ratios (Donnelly, 2016, Mittner, 2016).

An analysis of the impact of public debt/ budget deficit on economic growth and the twin deficits hypothesis within the SADC context is therefore particularly welcome as it has a direct impact on the realisation of SADC's objective of reducing poverty and achieving economic integration among the member states. Yet, as important as these issues are for the realisation of SADC 's goals, we are not aware of studies that have analysed the role of fiscal policy (public debt and budget deficits) on economic growth as well as the influence of fiscal policy (budget deficits) on the external balances in a panel of SADC member countries.

In an effort to provide a concise, yet comprehensive, picture of the public debt/budget deficit-economic growth and the twin deficits dynamics in SADC member states, we feel that, as a first step, a brief account of the political history that significantly define the public debt-economic growth dynamics and the twin deficits movement in SADC is an indispensable exercise. This helps in the understanding of the public debt/budget deficit-economic growth dynamics as well as the twin deficits hypothesis in the SADC region.

Most SADC countries, like other countries in Africa, attained independence from their colonial masters in the 1960s to the 1990s. Political independence put immense pressure on the new governments to redress the social imbalances and uplift the general livelihoods of the citizens (Bates et al., 2007), thereby putting tremendous pressure on the fiscus. The same period is also associated with regime changes, civil and military conflicts over natural resources, and poor macroeconomic performance- with the result of many SADC economies realising negative growth rates in the 1980s and 1990s (Besley et al., 2009, Berger et al., 2013). Recently, most of the countries in SADC have undergone economic structural reforms which have mainly entailed liberalising the domestic markets as well as opening the economy to the global world (Bates et al., 2007).

Yet the dire need to invest in both physical and human capital so as to lay the framework for future sustainable growth in SADC member countries can not be overemphasised. The usefulness of high levels of investment in infrastructure and human capital as engines of economic growth among SADC economies has well been documented in the literature (see for instance Seleteng & Motelle, 2015, WEF, 2015). In analysing the sources of economic growth in SADC, Seleteng and Motelle (2015) identify physical capital accumulation, human capital development and technological advancement as major sources of economic growth. In another study, in its 2014-2015 Global Competitiveness Report, the World Economic Forum, WEF (2015) shows that insufficient human capital and a lack of physical infrastructure are among the top constraining factors to conduct business and retard economic growth among SADC economies. More so, in its Regional Indicative Development Plan (RISD), SADC (1999) echoed the same sentiments by identifying infrastructure development, advancement in education and technological readiness as immediate priority areas for the future development of SADC and the eradication of poverty. Given the resource constraints of SADC member countries, just like other Sub-Saharan African countries, accumulation of physical and human capital may be achieved at the expense of rising levels of public debt and budget deficits. If it is to be accepted that public debt may have adverse consequences on economic growth, it may be confounding to think as to which of the policy option to adopt between accumulating physical and human capital today - which are pre-requisites for long term economic growth - but possibly at the expense of hurting future economic growth.

As is more fully detailed in chapter 3, high debt to GDP ratios, well above an average Sub-Saharan African country - for most of the SADC member countries have prevailed in many SADC member states over the last three decades. Given SADC's preponderant principle that regional economic integration and macroeconomic stability are prerequisites to sustainable economic growth, and for the creation of a monetary union, the natural question one could ask is whether high public debt/budget deficit is beneficial or injurious to subsequent economic growth among SADC member economies. An understanding of the impact of public debt on long-term economic growth in the SADC region is instructive on policymakers in developing a common set of macro-prudential principles that would ensure sustainable growth and the realisation of greater economic integration in the community.

Most SADC economies have experienced a widening of the current account balance well beyond the 9 % target set by SADC for both 2008 and 2012, and the threshold for a number of countries. The overall picture is that the majority of SADC economies have current account deficits which are worse off than that of an average Sub-Saharan African country, an average country from the Association of South East Asian Nations (ASEAN), and an average country from Asia for the entire period under review. From 2003 onwards ASEAN and countries from Asia enjoyed positive balances on their current account balances yet the majority of SADC countries had reasonably high current account deficits. The question that remains paramount is whether the ballooning current account deficits in most SADC countries are largely driven by fiscal deficits. Such an understanding is crucial as it provides guidelines for SADC policymakers to craft policies that result in containing fiscal deficits so as to keep the current account deficits under control.

Taking into account SADC's background, this thesis has three major objectives with regards to the role of fiscal policy in SADC member countries. First, this study analyses the role of fiscal policy (budget deficits) in explaining movements in the generally widening external balances in most of SADC countries. This is achieved in chapter 4 of this study. Second, the thesis assesses the impact of fiscal policy (public debt) in accounting for economic growth in a panel of 14 SADC member countries, in chapter 5 of this study. Further to this, in chapter 5 of this thesis, the study analyses the non-linearity effects in the manner in which public debt correlates with economic growth. Such an understanding is decisive for it unveils whether there is any need for SADC member countries to exercise deterrent measures in their reliance on public debt as a macro-economic stabilisation tool. Another important issue analysed in chapter 5 is an evaluation of the public debt-physical investment interaction as well as the public debt-education interaction with subsequent economic growth in the 14 SADC member countries analysed in this study. Given SADC countries' infrastructure deficiency as well as the dire need to invest in education as rudiments for economic growth, such an understanding is imperative as it validates whether public debt channelled towards infra-structure development and education has any growth engendering effect. The third objective of this thesis is to empirically examine the impact of fiscal policy (budget deficit) on the subdued economic growth performance in a single-country time series framework for three selected SADC countries, namely South Africa, Madagascar and Lesotho. This is achieved in chapter 6 of this thesis. In the case of South Africa, the study further analyses the budget deficit-economic growth performance in the pre- and post-democratic South Africa as well as the pre and post inflation targeting regime. In the case of Madagascar, in the spirit of chapter 5, the study seeks to unveil the threshold effects of public debt on economic growth as well as the budget deficit-infrastructure and education interaction with economic growth.

In chapter 4 of this thesis the study analyses the co-movement between budget and current account deficits in a panel of 14 SADC member countries. In line with this objective the study relies on results from the system GMM- a panel estimation technique designed for large N and small T - with results from the Common Correlated Mean Group Estimator (CCEMG) - a panel time series estimation technique.

The empirical results from both sets of estimation techniques in (chapter 4) provide evidence in support of a positive and statistically significant relationship between the budget deficits and the current account deficits. The implications are that worsening budget deficits lead to widening current account deficits in SADC economies. The two deficits, in other words move together and this confirms the existence of the Keynesian twin deficits hypothesis. The policy relevance of these findings is that policy makers in SADC countries are advised to exercise fiscal austerity as part of the solution to harness the widening current account deficits.

Chapter 4 of this thesis contributes to the literature in both empirical and methodological grounds. First, we are not aware of any study that has investigated the twin deficits hypothesis within a SADC framework and this study, in this chapter, fills this empirical gap in literature. Second, and equally important, the study abstracts from the usual practice in literature of relying solely on the system GMM estimator in arriving at their empirical findings. While the system GMM addresses the problem of heterogeneity and endogeneity - it does not account for cross-sectional dependence, which is a likely problem in panel estimations as evident in this study. By augmenting results from the system GMMby employing the Common Correlated Mean Group Estimator which accounts for cross-sectional dependence, this study contributes meaningfully to the literature as the study obtains results which are unbiased and efficient. Use of the CCEMG is not only appealing on account of addressing cross-sectional dependence but it also, like any panel time series estimator, combines the cross-sectional diversity and the time-series dynamic interactions thereby adding diversity to the analysis.

Having analysed the role of fiscal policy (budget deficit) in explaining the external balances among SADC member counties, this study finds it imperative to assess the role of fiscal policy (public debt and budget deficit) in explaining the future growth trajectory among SADC member countries. This reasoning prompted us to present the panel empirical analysis of the impact of public debt on subsequent economic growth in an unbalanced panel of 14 SADC member states observed from 1980 to 2015 in chapter 5 of this thesis. Towards this objective, the study utilised a number of panel growth estimation approaches - the Dynamic Panel Ordinary Least Squares (DOLS), the Panel Fully Modified Ordinary Least Squares (FMOLS), and the system GMM, when using initial values and averages of the variables. The results in this chapter provide contradictory findings on the nexus between public debt and economic growth among SADC member countries.

For reasons to be fully explained in chapter 5 of this thesis, the study discriminated in favour of the DOLS and FMOLS results which provided evidence in support of the Keynesian growth stimulating role of fiscal policy. The study complimented this finding with an evaluation of the presence or absence of non-linearities in the manner in which public debt interacts with economic growth. The results provide overwhelming evidence in support of the existence of non-linearities in the way in which public debt correlates with economic growth. The implication of these results is that while SADC member countries can rely on public debt as a growth promoting fiscal tool but they need to exercise great restraint as there is a certain threshold beyond which public debt impacts adversely on economic performance. It would have been more exciting if this study could have unveiled the exact public debt-to-GDP threshold beyond which public debt hurts economic growth. This study, however, was constrained to achieve this objective due to scanty data availability. The study also documented evidence in support of the view that the public debt-physical investment development interaction has growth inducing results in a panel of 14 SADC member countries. The policy relevance of these results is not only to draw attention to the growth intensifying role of investment in physical infrastructure but as well that SADC countries that commit public debt to physical infrastructure development attain faster economic growth rates.

The notable contributions of chapter 5 of this thesis lie, as well, in both empirical and methodological grounds. The first contribution of this chapter is that it provides empirical evidence with respect to the growth effects of public debt in the context of SADC countries, a context that has not been explored in literature. Second, to circumvent any methodological problems inherent in any growth model, the empirical evidence in this chapter is robust to different estimation techniques. A third notable contribution of chapter 5 of this thesis is that the study augments the system GMM results with empirical results from the DOLS, and FMOLS panel estimation techniques which are robust to endogeneity and heterogeneity and therefore hope to get consistent results. A fourth remarkable contribution of this chapter is that panel estimation techniques are more desirable as they add panel diversity as well as enjoy the dynamic interaction between public debt and economic growth from the long time frame used. Fifth, this study is not aware of an empirical study that has documented the presence or absence of non-linearities in the manner in which public debt correlates with economic growth in SADC. Such an understanding is instructive on SADC member countries to depend on public debt with great caution as there exists a threshold beyond which the growth engendering role of public debt are reversed. Given the infrastructure deficiency of SADC countries, like any country in Africa, a sixth contribution of this study is an analysis of the growth effects of the public debt-investment interactions. Such an understanding accentuates the need and urgency to embark on physical capital development as a way of attaining sustainable economic growth rates, thereby raising prospects of reducing poverty among SADC member countries.

Having analysed the growth impact of fiscal policy within a panel framework the study find it worthwhile to carry out a single country time-series analysis of the growth effects of fiscal policy in three selected SADC countries, namely South Africa, Madagascar and Lesotho. The rationale behind this approach lies with realising and appreciating that panel regression analysis only gives an average effect and hence a generalised picture of fiscal policy on economic growth in SADC. It is merit-worthy to augment the panel empirical findings on the impact of public debt on economic growth in chapter 5 with single-country time series analysis in chapter 6.

Consistent with this line of reasoning, chapter 6 of this thesis presents empirical evidence on the impact of fiscal policy, specifically making use of budget deficit, on three of SADC’s member countries namely, South Africa, Madagascar and Lesotho. The chief motive was to assess if the impact of budget deficits on economic growth is uniform across all SADC member countries given their apparent diversity. From this standpoint, the study intends to offer country specific policy inference on the impact of fiscal policy, particularly budget deficits, on economic growth in the three selected SADC countries. In arriving at the empirical evidence, the study utilised the recent developments in time series estimation by relying on evidence from the DOLS, the FMOLS, and the Canonical Cointegration Regression (CCR) estimation techniques.

The major empirical results in chapter 6 of this thesis reveal that budget deficit promotes growth in the three countries, South Africa, Madagscar and Lesotho. This is in support of the Keynesian counter-cyclical role of fiscal policy and as well, is in line with the study's panel results in chapter 5. Related to this empirical reality is finding that budget deficit accounts for the largest variation in economic growth in the growth regressions in South Africa and Madagascar while budget deficit is second in place in Lesotho. This reinforces the importance budget deficit plays on intensifying long-run economic growth, and in some way justifies the need and urgency of this study. Further to this, chapter 6 documents, similar to the study's results in chapter 5, the growth stimulating role of budget deficit that is commited to investment in infrastructure development in the case of Madagascar. In the case of South Africa, the study show that budget deficit is associated with faster economic growth in the post democratic South Africa compared to the apatheird era. This provides empirical justification for embarking on expansionary fiscal policy in the post independence South Africa as it redresses the socio-economic imbalances of colonial regime as this is associated with higher growth rates. The study also show, in the case of South Africa, that budget deficit during the inflation targeting era is associated with slower economic growth rates. This provides some empirical evidence as regards yet another contemporary issue on the role of inflation targeting in accounting for the slow growth rates in South Africa.

Chapter 6 of this thesis contributes to the literature in both empirical and methodological grounds. First, it adds to the scarce empirical evidence on the impact of budget deficit on economic growth in SADC member countries, particularly, South Africa, Madagascar and Lesotho. Second, given the apparent incidence of structural breaks in our series, the study departs from the traditional practice of making use of standard unit root and cointegration techniques by adopting test techniques that remain valid in the presence of structural breaks, and as well as incorporating structural breaks in our regression analysis. Third, by making use of the DOLS, FMOLS, and the CCR estimation techniques we make use of some of the recent developments in time series cointegration literature which are suitable for the study's purposes as they have small sample properties and are more robust to serial correction, endogeneity problems which are characteristic features of any growth regression. Fourth, by examining non-linearities in the manner in which budget deficit correlates with economic growth in Madagascar, the study provides useful policy relevant information to the Malagasy policy makers. Fifth, the study is not aware of an earlier attempt to analyse the growth impact of budget deficit in the pre and post democracy South Africa, yet this is essential for crafting growth friendly policies in the contemporary South Africa. Sixth, by analysing budget deficit-growth nexus during the pre- and post- inflation targeting era, the study contributes by providing empirical evidence to COSATU's claim that inflation targeting has a role to play in the escalating unemployment and slow growth in South Africa.

1.2 Structure of the Thesis

The previous section of this chapter present the background information as well as the research issues surrounding the relationship between fiscal policy (budget deficits and public debt) with the external balances as well as economic growth in SADC economies. Among other things, the previous section of this chapter has presented the main empirical findings and contribution from the subsequent chapters of this thesis. Futher to this introductory chapter, this thesis proceeds as follows:

Chapter 2: Theoretical perceptions on fiscal policy (public debt and budget deficit) on economic growth and the twin deficits hypothesis.

This chapter reviews the theoretical as well as past empirical evidence on the relationship that exists between fiscal policy (public debt and budget deficit) on economic growth, and the theoretical relationship as regards the twin deficits hypothesis. A review of these theoretical relationships is crucial as it forms the cornerstone of our empirical analysis of the twin deficits hypothesis in chapter 4, the impact of public debt on economic growth in a panel of 14 SADC countries in chapters 5, and the impact of budget deficit on economic growth in South Africa, Madagascar, and Lesotho in chapter 6. The guiding goal in this chapter is not to conduct an exhaustive growth and twin deficits literature exploration but to review those key theoretical linkages between fiscal policy and economic growth, and twin deficits hypothesis, without which the basis of the empirical analysis in the study's subsequent chapters would be impossible.

Chapter 3: The specifics of fiscal policy (public debt and budget deficits) and economic growth and the twin deficits in SADC

Chapter 3 of this thesis discusses an overview of SADC as an economic grouping, particularly focussing on its macro-economic objectives before presenting an evolution of public debt/ budget deficit and economic growth and the twin deficits in SADC. This helps to put the study's discussion of the impact of public debt and budget deficits on economic growth in SADC and the twin deficits in their proper context before engaging in the empirical analysis in the later chapters. It is important to note that much background information can be written about SADC but this study has limited itself to issues which relate only to the analysis of the public debt/ budget deficits-economic growth relationship as well as the twin deficits hypothesis.

Chapter 4: Empirical results on the twin deficits hypothesis in SADC: a panel data approach

This chapter presents the study's empirical results on the co-movement between the current account balance and the fiscal balances in SADC by utilising panel estimation techniques. The first part of this chapter provides an overview of the panel estimation techniques (both macro- and micro-panels) that we make use of in both chapter 4 and chapter 5. It is important to note that panel estimation literature (both macro and micro panels) has received and is still receiving much diversified contributions that it appears in so many variants and forms. It is not the intention of this study to pursue such developments in the panel econometrics literature, but to reveiw those panel estimation techniques that are dear to the research interests in this thesis. The last part of this chapter presents the study's panel empirical results on the co-movement between external balances and fiscal balances in SADC. The study makes use of both micro panels (system GMM Approach) and panel time-series estimation approach (the Common Correlated Mean Group Effects) to analyse the twin deficits hypothesis within SADC.

Chapter 5: Empirical results on the impact of public debt on economic growth in SADC: a panel data approach

This chapter present the panel empirical estimation results on the impact of public debt on economic growth in 14 SADC countries. The chapter also aims to evaluate the non-linear effects of public debt on economic growth in SADC countries. It is also the aim of this study, in this chapter, to assess the public debt-infrastructure interaction effects on economic growth. This chapter also aims to analyse the growth effects of public debt spending on education. The panel evidence on the growth impact of public debt in SADC countries is obtained from both macro and micro panel estimation approaches. The chief goal in this chapter and chapter 4 is to provide results that are robust to different panel estimation techniques. The preferred estimation technique in this chapter is the Dynamic Ordinary Least Squares (DOLS) and the Fully Modified Ordinary Least Squares (FMOLS) panel time-series estimation techniques. However, for robustness purposes the study relies, as well, on empirical evidence from system GMM approach utilising both average and initial values of the regressors as is standard in the literature.

Chapter 6: Empirical results on the impact of budget deficits on economic growth in selected SADC countries: a time series approach

This chapter presents the empirical results on individual country time series evidence on the relationship between budget deficits and economic growth in South Africa, Madagascar, and Lesotho. The study takes advantage of the recent developments in time series econometrics literature and employ the DOLS, FMOLS, and the CCR time series estimation techniques which have desirable small sample properties and are robust to endogeneity, heterogeneity and serial correlation. The first part of this chapter presents the methodological framework employed in this chapter, paying specific attention to the reasons leading to the selection of these estimators. The last part of this chapter presents the empirical evidence.

Chapter 7: Summary, conclusions and policy implications

This chapter completes the discussion of this thesis and presents the fundamental issues emanating from the study. From the study’s major findings, the research offers policy recommendations that may not only be relevant to SADC countries alone but to the entire Sub-Saharan Africa and other developing economies.

CHAPTER 2:

CONCEPTUAL FRAMEWORK ON PUBLIC DEBT, BUDGET DEFICITS, ECONOMIC GROWTH AND THE TWIN DEFICITS HYPOTHESIS

2.0 Introduction

The first part of this chapter presents both the theoretical relationship and previous, related work on the relationship between fiscal policy (public debt and budget deficits) and economic growth. This forms the basis of the theoretical framework for the panel empirical analysis of the impact of public debt on economic growth in 14 SADC member countries which is discussed in chapter 5 as well as the theoretical understanding of the single country analysis of the impact of budget deficits on economic growth as discussed in chapter 6. The last part of this chapter presents both the theoretical and previous work on the twin deficits hypothesis that forms the basis of the panel empirical analysis of the twin deficits hypothesis in the 14 SADC member countries that we present in chapters 4.

2.1 Theoretical Literature Review

2.1.1 Theories of Economic Growth

Since the objective in chapter 5 and 6 is to analyse the impact of public debt and budget deficits, respectively, on economic growth, it is imperative to present the alternative theories of growth in order to contextualise the role of fiscal policy on economic growth. For the purposes of this chapter, public debt and budget deficits are treated under the term “fiscal policy” as they are both aspects of fiscal policy. As the theoretical grounds governing their relationship with long run economic growth is the same, hence they are analysed under fiscal policy.

To this end, the major competing theories of growth, whose review and discussion is indispensable for a proper understanding of the key theoretical underpinnings behind fiscal policy and economic growth are, the Keynesian theories of growth, the neoclassical growth theory, and the endogenous growth theory.

2.1.1.1 Keynesian Theories of Growth

This section presents the theoretical justification of the Keynesian growth enhancing role of fiscal policy (budget deficits and public debt). There are many contributions and variations of the Keynesian perspective on growth. As such, the study's purposes the contributions of Harrod (1939) and Domar (1946) as well as the work of Galí et al, Lopez-Salido & Valles (2007), has been examined for their input have direct implications for the Keynesian reasoning of the stimulative role of public debt and budget deficits on economic growth.

In its various forms, Keynesian growth theories, trace their origin to the work of Keynes (1936) seminal growth theories which postulates that fiscal policy plays a stimulative role on the economy when aggregate demand is inadequate (Commendatore et al., 2001, Cammarosano, 2016, Barnett, 2013). The defining feature of Keynesian theories of growth is that economic slumps are not self-correcting as there may be a deficiency in aggregate demand that results in excess capacity thereby rendering monetary policy inefficient in dealing with cyclical growth slowdowns. This, therefore, justifies the active role fiscal policy should play so as to stimulate the economy.

The stimulative role played by fiscal policy can be explained through the workings of the simple Keynesian multiplier formulated as follows:

$$\bar{Y} = \frac{1}{1 - b + v}(C_0 + I + G + X - M) \qquad (2.1)$$

where $\bar{Y}$ is the equilibrium level of income. Assuming the economy is operating below full employment, the equilibrium income is expressed as the product of the autonomous expenditure multiplier, $\frac{1}{1-b+v}$ and the level of autonomous expenditure.

The Keynesian autonomous expenditure multiplier, $\frac{1}{1-b+v}$, gives the change in equilibrium income per unit change in autonomous expenditure. Simply stated, the multiplier effect implies that a small initial increase in spending produces a more than proportionately larger increase in national income. Keynesians, therefore claim that governments can manage employment and growth by manipulating the levels of aggregate demand in an economy (Hall, 2009, Perotti et al., 2007).

To help achieve economic growth during recessions, Keynesians advocate for governments to increase public expenditure by running budget deficits or reducing taxes. This will boost aggregate demand and production and employment will increase. The government acts counter-cyclically, raising government expenditure in excess of revenue, and or cutting taxes when private sector demand is too low, deflating the economy by cutting government expenditure spending, and or raising taxes when private sector demand is too high.

From this standpoint, the Keynesian multiplier, therefore, postulates a stimulative role played by public debt and budget deficits on subsequent economic growth. The argument is that a small change in public spending will induce a more than proportionate change in the level of aggregate income through the workings of the multiplier.

Though many scholars have contributed a lot and align themselves with Keynesian economics of growth, the contribution of Harrod (1939, 1948 and Domar (1946) deserves particular attention for it has a direct bearing on our current study. It is Harrod (1939) and Domar (1946) who first developed a formal analysis of the problem of growth. Their model illustrates how balanced growth may occur in an economy for which any departure from the equilibrium growth path will induce centrifugal forces to operate to restore equilibrium.

In order to study the warranted rate of growth (g_w) Harrod (1939) made use of the Ramsey's intertemporal investment approach, which can be stated as follows:

$$i = kg^* + f(g - g^*_{-1}) \qquad (2.2)$$

where i is the ratio between investment and the net output growth of the economy; g^* is the current period expected rate of growth of output; g^*_{-1} is the previous period expected rate of growth of the economy and g is the current period rate of growth. $g,$ is the actual growth rate which is determined by the saving ratio and the capital output ratio. The current period rate of growth (g) shows short run cyclical variations in the rate of growth. Lastly, $k,$ is the equilibrium capital output ratio or the productivity efficiency of capital.

Harrod (1939) assumed that, along the warranted equilibrium path, expectations are realised $(g^* - g)$ and the expected rates of growth are equal to the warranted growth rate $(g^* - g^*_{-1} = g_w)$.

When the rate of growth differs from the equilibrium warranted rate, some centrifugal forces operate. If, for example, the actual growth rate (g) exceeds the warranted growth rate (g_w) there will be insufficient equipment as actual income grows at a faster rate than that allowed by the growth in the productive capacity of the economy. Such a situation leads to secular inflation and will further lead to a deficiency of capital goods.

If, on the other hand, realised economic growth rate (g) is less than the warranted growth rate (g_w) there will be secular depression as actual income grows more slowly than what is required by the productive capacity of the economy leading to an excess of capital goods.

Harrod (1939) pointed out that the warranted rate of growth could be influenced by three different components of aggregate demand, namely, government expenditures, autonomous investment coming from the private sector, and the foreign sector.

Harrod's growth theory and dynamics can vaguely be conceived as an extension of Keynes's analysis to a long run. Harrod's growth theory outlines a framework that Keynesian literature has subsequently adopted; particularly Harrod's growth theory developed the view that the economic system does not necessarily tend to full employment and that the different components of aggregate demand may affect the rate of growth of the economy. For Harrod, fiscal policies have to be used both to stabilise the economy and to achieve higher growth.

The stimulative role played by fiscal policy through public debt and budget deficits can further be demonstrated through the rule-of-thumb model developed, recently, by Gali et al (2007).

1.1.1.1.2 New Keynesian Growth Theory

Following Campbell and Mankew (1989), Gali et al (2007) developed a new Keynesian growth model that features rule-of-thumb consumers to explain the effects of changes in government expenditure on aggregate economic activity. Gali et al's (2007) framework has in common many ingredients with recent dynamic optimising sticky price models (Rotemberg and Woodford, 1999, Clarida et al., 1999, Woodford, 2003).

The basic assumptions of the model are that the economy has a range of infinitely lived households called Ricardian households, as well as rule-of-thumb households; a variety of firms producing differentiated intermediate goods, perfectly competetitive firms producing final goods; a central bank in charge of monetary policy, and a fiscal authority. Ricardian (optimising) households are indexed by $i\epsilon[0,1]$ that constitute a fraction of the population, $1-\lambda$. Optimising (Ricardian households) have access to capital markets, and buy and sell physical capital. Rule-of-thumb consumers constitute the remaining fraction, λ of the population. Rule-of-thumb consumers are assumed to fully consume their current income; they neither serve nor borrow. Interpretations of the behaviour of rule-of-thumb consumers include myopia, lack of access to capital markets, fear of saving, and ignorance of intertemporal trading opportunities. In the model, rule-of-thumb consumers are assumed to co-exist with conventional infinite-horizon Ricardian consumers.

Following Gali *et al* (2007) a representative Ricardian household has a period utility defined as $U(C_t^0, L_t^0)$ and seek to maximise:

$$\mathrm{E}_0 \sum_{t=0}^{\infty} \beta^t \, U(C_t^0, N_t^0) \qquad (2.3)$$

where $C_t^0, L_t^0, and\ N_t^0$ denote consumption, leisure and hours of work, respectively. Preferences are defined by the discount factor $\beta\epsilon(0,1)$.The optimising household faces the following sequence of budget constraints represented as:

$$P_t(C_t^0 + I_t^0) + R_t^{-1}B_{t+1}^0 = W_tP_tN_t^0 + R_t^kP_tK_t^0 + B_t^0 + D_t^0 - P_tT_t^0 \qquad (2.4)$$

where $W_t, P_t, B_t^0, K_t^0, R_t, I_t^0, and\ D_t^0$ denote the real wage, the price level, the quantity of nominally riskless one-period bonds carried over from period $t-1$,rental income accruing to Ricardian households from renting his capital holdings,the rental cost , investment expenditures and dividends from ownership of firms, respectively. T_t^0 denote lump-sum taxes paid by consumers. At the beginning of the period the consumer receives labour income, $W_tP_tN_t^0$. The optimising household is also subject to the capital accumulation equation:

$$K_{t+1}^0 = (1-\delta)K_t^0 + \phi\left(\frac{I_t^0}{K_t^0}\right)K_t^0 \qquad (2.5)$$

Where δ is the depreciation of capital, and capital adjustment costs are introduced through the term$\phi\left(\frac{I_t^0}{K_t^0}\right)K_t^0$, which determines the change in the capital stock induced by investment spending, I_t^0. The model assumes $\phi > 0, and\ \phi'' \leq 0$, with, $\phi'(\delta) = 1$.

The first order conditions for the optimising consumer's problem can be written as:

$$1 = R_tE_t\left\{A_{t,t+1}\frac{P_t}{P_{t+1}}\right\} \qquad (2.6)$$

$$Q_t = \mathrm{E}_t\left\{A_{t,t+1}\left[R_{t+1}^k + Q_{t+1}(1-\delta) + \phi_{t+1} - \left(\frac{I_{t+1}^0}{K_{t+1}^0}\right)\phi'_{t+1}\right]\right\} \qquad (2.7)$$

$$Q_t = \frac{1}{\phi'\left(\frac{I_t^0}{K_t^0}\right)} \qquad (2.8)$$

where, $A_{t,t+k}$ is the stochastic discount factor for real $k - period$ ahead payoffs, and Q_t is the real shadow value of capital in place, namely, Tobin's Q.

Aggregate investment and the capital stock are, respectively, given by:

$I_t \equiv (1-\lambda)I_t^0$ and $K_t \equiv (1-\lambda)K_t^0$

On the other hand, the period utility of the rule-of-thumb consumers is given by:

$$U(C_t^r, L_t^r) \qquad (2.9$$

and subject to the budget constraint:

$$P_t C_t^r = W_t P_t N_t^r - P_t T_t^r \qquad (2.10)$$

and as well, the level of consumption will equate labour income net of taxes:

$$C_t^r = W_t N_t^r - T_t^r \qquad (2.11)$$

Aggregate consumption and hours are given by a weighted average of the corresponding variables for each consumer type, respectively as:

$$C_t \equiv \lambda C_t^r + (1-\lambda)C_t^0 \qquad (2.12)$$

and

$$N_t \equiv \lambda N_t^r + (1-\lambda)N_t^0 \qquad (2.13)$$

An intertemporal equilibrium condition, independent of the assumed labour structure, can be derived as follows:

$$c_t = \mathrm{E}_t\{c_{t+1}\} - \sigma(r_t - \mathrm{E}_t\{\pi_{t+1}\}) - \Theta_n \mathrm{E}_t\{\Delta n_{t+1}\} + \Theta_t \mathrm{E}_t\{\Delta t_{t+1}^r\}) \qquad (2.14)$$

The Euler equation, seen in 2.14 is the only log-linear equilibrium condition involving aggregate variables which display a dependence on the fraction of rule-of-thumb households, λ. The presence of rule-of-thumb households generates a direct effect of employment on the level of consumption and ultimately on the level of aggregate demand, beyond the effect of the long-term interest rate. Integrating the Euler equation above obtains:

$$c_t = \Theta_n n_t - \Theta_t t_t^r - \sigma \sum_{k=0}^{\infty} \mathrm{E}_t \{r_{t+k} - \pi_{t+k+1}\} \qquad (2.15)$$

The above equation implies that for any given path of real interest rates and taxes, an expansion in government expenditure purchases has the capacity to raise aggregate consumption through its induced expansion in employment and there will be a consequent rise in real wages, labour income and, as a result, consumption of rule-of-thumb households. Resultantly, the increase in consumption would raise aggregate demand, and the level of output, and employment even further, thus prompting a multiplier effect similar to the one found under traditional Keynesian models.

2.1.1.1.2 Conclusion on Keynesian growth theory

Although there is no unified theory of Keynesian growth the central theme that distinguishes Keynesian thought from any other growth philosophy is the assertion that economic systems do not necessarily turn to full employment but the autonomous components of aggregate demand affect the rate of growth of the economy (Commendatore et al, 2001). Rather than seeing budget deficits and public debt as wrong, Keynesians propose for the countercyclical fiscal policies that act against the direction of the business cycle. Keynesian economists recommend deficit spending on labour-intensive infrastructure projects to stimulate employment and stabilise wages during economic downturns.

2.1.1.2 Neoclassical Growth Theories

This section presents a review of the neoclassical growth theory, highlighting the main ternets of the neoclassical thinking. We, however, put specific emphasis and detail to the Solow (1956) growth model for a number of reasons. First, the Solow (1956) growth model gives a perfect theoretical basis for our data generating process that suits well our estimation technique that we use to analyse the impact of public debt on economic growth in chapter 5 and the impact of budget deficits on economic growth in chapter 6. As Hauk and Wacziarg (2009) argue, the Solow (1956) growth model is well suited for generating replicated data; it is amenable, and is probably the only strict theoretical basis for the specific functional forms often used in the majority of cross-country growth literature. Furthermore, Mankiw et al. (1992) and Islam (1995b) show that the Solow (1956) growth model can be formulated in a way to allow its estimation through a simple application of linear regression techniques. In this spirit, our growth model specification in chapter 5 and 6 take the form of an augmented Solow (1956) growth model, augmented to capture the impact of public debt and budget deficit, respectively, on economic growth.

The need to have sustained growth, anchored in the introduction of new technology, improving productivity and refining the organisation of production, and not so much in the basis of unused capacity, saw the birth of neoclassical growth theory in the 1950s to 1960s (Sharipov, 2015).

Aspects specific to the neoclassical thinking include: the competitive nature of markets, the simultaneous and immediate adjustment of prices to demand and supply shifts, the neutrality of money, and the unchanging structure of the whole economic system over time (Hudea, 2015, Van den Berg, 2013). The Great Depression of the 1930s, characterised by surging unemployment in many countries, threatened the belief in the neoclassical growth theory.

Notwithstanding the agreement with pure classics on the self-adjustment of markets in the long run, at full employment, neoclassical economists disagreed with pure classics for the short run status. In the long run, any economy tends to full employment, while maintaining the equilibrium on the market of goods and services, so that any subsequent increase in aggregate demand will result in an increment of prices. However, in the short run, any increase in aggregate demand, due to an expansionary monetary policy, or an increase in government expenditure, or to a decrease in taxes (or both), will stimulate producers to raise prices so as to obliterate the effect of the decreasing returns.

Sharipov (2015) singled out three major criticisms that neoclassical growth theorists levelled against neo-Keynesian growth adherents, specifically the Harrod-Domar model. The first criticism is that neo-Keynesian growth theorists ignored all other growth determinants, especially, those associated with technological progress such as the growth of education, skills improvement, and refining the organisation of production and primarily focused on one factor: capital accumulation. Secondly, neoclassical growth theorists take into account capital and labour, and assuming their interchangeability, this allows the possibility of change in the coefficient of capital. Thirdly, contrary to neo-Keynesian growth proponents, neoclassical growth theorists were firm believers in the fact that the only competitive market system is able to provide balanced economic growth.

The major underlying assumptions of the Solow (1956) model are: a closed economy with no government all factors of production are fully employed; production of a single good with constant returns to scale; the technology set and the amount of labour available is exogenously determined by the values of these variables at some moment in time.

In order to lay the theoretical basis for our data-generating process and our augmented Solow (1956) growth specification that we use in chapters 5 and 6, we discuss the general Solow growth model specification below. We follow the the Solow (1956) growth model specification adopted by Hauk and Wacziarg (2009) as specified as:

$$\log y(t_2) = \left(1 - e^{-\lambda\tau}\right)\frac{\alpha}{1-\alpha-\beta}\log s_k + \left(1 - e^{-\lambda\tau}\right)\frac{\beta}{1-\alpha-\beta}\log s_h - \left(1 - e^{-\lambda\tau}\right)\frac{\alpha+\beta}{1-\alpha-\beta}\log(n + g + \delta) + e^{-\lambda\tau}\log y(t_1) + \left(1 - e^{-\lambda\tau}\right)\log A(0) + g(t_2 - e^{-\lambda\tau}t_1) \qquad (2.16)$$

The country's per-capita income level at a particular point in time (t) is depicted by $y(t)$: where, $s_h \ and \ s_k$ is the country's human capital and savings rates in physical capital, respectively; $\beta \ and \ \alpha$ are the shares of the country's income attributed to human and physical capital, respectively; $n \ and \ g$ are the growth rates of the country's population and technology level; δ is the rate at which these variables depreciate; $\lambda = (n + g + \delta)(1 - \alpha - \beta)$ is the rate at which the economy converges to its steady-state equilibrium, and $\tau = t_2 - t_1$ is the time between two observations on per-capita income variable.

The dependent variable, the log of per-capita income variable ($\log y(t_2)$ implies that this specification is a growth rate and not a levels regression. To capture the inherent randomness in the dependent variable($\log y(t_2)$, we add an error term(v_{it}), with zero mean conditional on all the explanatory variables, equation (1) above is transformed as a fixed effects and panel data regression with the following form:

$$\log y_{it} = \beta_0 + \beta_1 logs_{k,it-\tau} + \beta_2 logs_{h,it-\tau} + \beta_3 \log(\mathrm{n} + \mathrm{g} + \delta)_{it-\tau} + \beta_4 logy_{it-\tau} + \mu_i + \eta_t + v_{it} \qquad (2.17)$$

Where t denotes the end of a time period of duration τ and $t - \tau$ denotes the beginning of that period. The general practice in panel growth estimation is to use either initial values or five-year average values of the growth determinants. However, Mankiw et al (1992) and Isal (1995) argue that introducing growth determinants as averages limit the extent of classical measurement error and remove cyclical variations in the data. On the other hand, Woo and Kumar (2015) use initial values of the growth determinants and argue that averaging loses valuable information. Panel econometric literature, considering the regressors to be constant, does not provide guidance as to whether to use initial values of the determinants or the average values (Hauk and Wacziarg, 2009). This prompted us to use both initial values and average values of the regressors in our panel growth estimation in chapter 5.

The reduced form parameters and error terms from equation (2.17) are defined as:

$$\beta_1 = (1 - e^{-\gamma\tau}) \frac{\alpha}{1 - \alpha - \beta}$$

$$\beta_2 = (1 - e^{-\gamma\tau}) \frac{\beta}{1 - \alpha - \beta}$$

$$\beta_3 = (1 - e^{-\gamma\tau}) \frac{\alpha + \beta}{1 - \alpha - \beta}$$

$$\beta_4 = (e^{-\gamma\tau})$$

$$\beta_0 + \mu_i = (1 - e^{-\gamma\tau}) \log A_i(0) \quad (an\ intercept\ plus\ a\ country\ effect)$$

$$\eta_t = g\left(t - e^{-\lambda\tau}(t - \tau)\right) \qquad (a\ time\ specific\ effect)$$

$$v_{it}\ is\ a\ zero - mean\ error\ term, with\ possibility\ of\ correlation\ with\ the\ regressors.$$

Equation (2.17) is the functional form that we use in our growth panel estimation in chapter 5. The log of $A(0)$ captures country-specific effects which primarily constitutes initial levels of technology, that includes variables such as different resource endowments, different climatic conditions, differences in the quality of institutions, and government type. This consideration is quite relevant in our study as the SADC community is heterogeneous in many respects. Heterogeneity across units can be addressed by defining $\beta_0 + \mu_i \equiv \left(1 - e^{-\lambda\tau}\right) \log A_i\,(0)$, where β_0 is a constant capturing the average level of initial technology across countries and μ_i is the zero-mean, country-specific effect.

The Solow catch-up growth is about capital investment. The Solow (1956) convergence theory states that if an economy is well below its potential growth, it will grow quickly as it accumulates more capital. The following equation can be used to calculate growth convergence:

$$Growth = \frac{Y_t + 1 - Y_t}{Y_t} = (1+g)\left[\lambda \frac{y^*}{y_t} + (1+\lambda)\right] - 1 \qquad 2.18)$$

where, Y represents GDP, λ is the convergence parameter which dictates how fast a country closes the gap between actual GDP (Y_t) and the potential GDP (y^*) and g is the steady state rate of aggregate output.

Thus, the Solow (1956) model states that the rate of change of the capital stock per unit of effective labour is the difference between actual investment per unit of effective labour and the breakeven investment. The most basic proposition of the Solow (1956) model is that only changes in the rate of technological progress have growth effects and this account for differential growth rates across time and countries.

The major failing of the Solow (1956) model, however, is that it is based on an unexplained technological progress (exogenous growth variable). Thus, the Solow (1956) model's focus on capital, at best, only partially explains economic growth, thus giving justifiable reasons for economists to seek more complementary models to explain economic growth dynamics. Another criticism of the Solow(1956) was that there was lack of empirical support for the model (Van den Berg, 2013). However, with the development of econometrics and the increase in computing power, more evidence has been presented in recent decades (Mnkiw et al., 1992, Easterly and Levine, 2001) that amply show that the Solow(1956) growth model seems to explain a set of stylised facts of growth after World War II. Such defence justifies our use of the augmented Solow (1956) growth model in chapters 5 and 6 of this thesis.

2.1.1.3 Endogenous Growth Models

One of the major shortcomings of the neoclassical growth models was the failure to incorporate the aspect that the rate of growth of economies should depend upon the thriftiness of the economy, and that technical change should be the outcome of intentional decisions of economic agents (Kurz and Salvadori, 1998, 1999). This motivated an alternative growth theory in the name of the endogenous growth.

Endogenous growth models maintain that economic growth is generated from within the system as a direct result of internal processes like investment in human capital, innovation, investment in research and development. Further to that, endogenous growth models assume that there are no diminishing returns to capital; investment by a firm or individual leads to an increase in productivity that exceeds the private gain.

The standard production function employed by many endogenous growth proponents (Lucas, 1988, Romer, 2012, Mankiw et al., 1992, Romer, 1986) is the so called AK model of the form:

$$Y = AK \qquad (2.19)$$

where Y is output; A is an expression representing factors that affect technology, and K is capital (which includes both physical and human capital). The AK model assumes a linear relationship between total output, Y, and a single factor capital, K, both consisting of the same commodity.

The rate of return on capital, r, is given by:

$$r + \delta = \frac{Y}{K} = A \qquad (2.20)$$

where δ is the exogenously given rate of depreciation.

There are quite a number of versions of the AK model in literature. Rebelo (1991) made use of a two-sector model. He assumed that the capital good sector produces the capital good by its own means and nothing else.

The model further assumes that there is only one method of production to produce the capital good. The relationship between the rate of growth, g, and the rate of profit, r , is determined by the saving-investment mechanism jointly with the assumption of steady-state equilibrium:

$$g = \frac{A - \delta - \rho}{\sigma} = \frac{r - \rho}{\sigma} \qquad (2.21)$$

Or

$$g = (A - \delta)s = sr \qquad (2.22)$$

Where ρ is the discount rate, or the rate of time preference, and $\frac{1}{\sigma}$ is the elasticity of substitution between present and future consumption, $1 \neq \sigma > 0$, and where, $Y = c(t) + K$. Equation 2.22 is obtained when the average propensity to save, s is given. Thus, in the model above the rate of profit is determined by technology alone and the growth rate of the system is endogenously determined by the saving-investment mechanism. The greater the propensities to acquire human and physical capital, the higher the rate of growth.

An important tenet of endogenous growth theory is the contribution of human capital to economic growth. This is particularly important to the study as we make use of human capital in the model specifications in both chapters 5 and 6. Lucas (1988), elaborating on the work of Uzawa (1965), presented a formal analysis of the role of human capital formation to the growth process (Kurz and Salvadori, 2001). Lucas (1988) assumed that agents either choose to spend their non-leisure time between contributing to current production or to accumulate human capital. Human capital accumulation is associated with a positive externality to society; the more human capital as a whole society has accumulated, the more productive each member will be. This is reflected in the following macroeconomic production function:

$$Y = AK^{\beta}(uhN)^{1-\beta}h^{*\gamma} \qquad (2.23)$$

Where the labour input consists of the number of workers, N, times the fraction of time spent working, u, times h, which gives the labour input in efficiency units. For Lucas (1988), through positive externalities of human capital accumulation, society as a whole benefits from more output, rather than from more capital accumulation. Lucas (1988) conceptualised the process by which human capital is built up as in the following equation:

$$\dot{h} = vh(1-u) \qquad (2.24)$$

Where v, is a positive constant. Lucas (1988) pointed out that endogenous growth is positive independent of the fact that there is a positive externality, γ implying therefore that growth is endogenous even if returns to scale are constant. Thus, Lucas (1988)'s analysis contributes to other endogenous growth theorists in that growth is endogenously determined by the intentional behaviour of economic agents when they or do not accumulate more human capital.

The analysis of endogenously generated technological change that can be an engine of growth was predominantly made by Romer (1986), who focused on knowledge or information and assumed that the information or knowledge was contained in inventions and discoveries. Knowledge and information assumed the properties of a public good being characterised by non-rivalry and non-excludability in consumption. Further, knowledge was assumed to be cardinally measurable and not to depreciate. Firms withhold resources from producing current output so as to engage in research and developments that in turn generate new knowledge.

Romer stipulates a research technology that is concave and homogeneous of degree one, formulated as:

$$k_i = G(I_i, k_i) \qquad (2.25)$$

where I_i is an amount of forgone consumption in research by firm i and k_i is the firm's current stock of knowledge. The forgone consumption good is a capital good utilised in the production of knowledge. The production function of the consumption good relative to firm i is:

$$Y_i = F(k_i, K, x_i) \qquad (2.26)$$

where K is the accumulated stock of knowledge in the economy as a whole and x_i are all inputs different from knowledge. The model is taken to be homogeneous of degree one in k_i and K. Further, the model assumes that factors other than knowledge are in fixed supply. Extended information gleaned from private research and development activities increase the public stock of knowledge.

The fundamental conception of Romer's (1986) model is that there is a trade-off between consumption today and knowledge that can be used to produce more consumption in the future; the saving-investment relationship endogenously determines the rate of growth.

Thus, the analysis presented above highlights that endogenous growth models offer an alternative to exogenous growth models in that, central to endogenous growth models, long-run economic growth is created and sustained from within the system (country) by adopting policy measures that enhance economic growth. The endogenous growth theory represented a substantial paradigm shift with respect to the neoclassical growth theory in that all the variables that are crucial for economic growth - nvestment and technical knowledge - are the outcome of rational decisions of economic agents.

2.1.2 Concluding Remarks on Economic Growth Models

This section has surveyed different models for analysing sources of economic growth within an economy**.** The main aim is to be able to contextualise the role of public debt and budget deficits in explaining long run economic growth. Such a motive cannot be successfully attained without having an intuitive understanding of the different viewpoint from which economic growth is said to be fostered. Of the theories surveyed, Keynesian growth theories emphasised the anti-cyclical demand management role played by the government in stimulating economic growth, while neoclassical economists see economic growth as exogenously determined by factors considered outside the realm of economic explanation. Lastly, endogenous growth models explain long-run economic growth as created and sustained within the system as economic agents intentionally adopt policies that enhance economic growth.

2.2 A Theoretical Model of Public Debt, Budget Deficits and Economic Growth

For us to be able to analyse the potential impact of public debt and budget deficits on subsequent economic growth among SADC member countries in chapters 5 and 6, respectively, we present a formal model of the growth impacts of public debt and budget deficits in this section.

As is standard in literature, our model, from which we heavily borrow from Ostry et al. (2015), is based on the assumption that the government is benevolent and is subject to the economy's wide resource constraint, its own budget constraint, and a feasibility constraint. The government, given these constraints, choses its optimum fiscal policy so as to maximise the representative economic agent's lifetime utility. We therefore first present a model of a utility maximising economic agent and then present the government's policy choice so as to maximise the representative economic agent's maximising behaviour.

Assuming an economy with a single infinitely lived economic agent who maximises his consumption behaviour within a closed economy set up, we have:

$$\underset{c_t.l_t,b_t,k_t^p}{\text{Max}} \sum_{t=0}^{\infty} \beta^t u(c_t, l_t, g_t) \qquad (2.27)$$

where $g, c, (1-l)$ are consumption of public goods, private good, and of leisure, respectively. The representative agent maximises his consumption behaviour subject to:

$$c_t + k_t^p + b_t = (1-\tau_t^L)w_t l_t + R_t k_{t-1}^p + Y_t b_{t-1} \qquad (2.28)$$

In which $w, \tau^L, R\ and\ Y$ are the wage rate, the the rate at which labour is taxed, and the returns on private capital, k^p, and bonds, b, respectively. The representative economic agent makes consumption decisions on how much to consume and to work, and as well as investment in physical capital and government bonds. The first order conditions, characterising the behaviour of the representative agent, letting μ_t, which denote the Lagrange multiplier are given as:

$$\beta^t u_{c,t} = \mu_t \qquad (2.29)$$

$$-\frac{u_{l,t}}{u_{c,t}} = (1 - \tau_t)w_t \qquad (2.30)$$

$$R_t = Y_t = \frac{u_{c,t-1}}{\beta u_{c,t}} \qquad (2.31)$$

The first-order conditions imply that the representative agent supplies labour subject to the after-tax wage. The demand for government bonds is a function of the interest rate, and the representative agent makes investment decisions subject to the after-tax return on capital. A convenient summary of the private sector's behaviour takes the form:

$$\sum_{t=0}^{\infty} \beta^t \left(u_{c,t}c_t + u_{l,t}l_t\right) = u_{c,o}\left(Y_0 b_{-1} + R_0 k_{-1}^p\right) \qquad (2.32)$$

where $b_{-1}\ and\ k_{-1}^p$ are the initially inherited stocks of government bonds and private capital. Equation 2.32 constitutes the feasibility constraint that the government needs to take into consideration in choosing its optimal fiscal policy. The feasibility constraint captures the representative agent's reaction to taxation and its intertemporal budget constraint.

In its optimising behaviour, the government has to make decisions on how much to invest in public capital, how much of the public good to provide, what rate of tax to levy on both wages and on the return on private capital, and also how much to borrow. Since the government is assumed to be benevolent, there is no possibility of default on the part of government on payment of debt as public debt is in the form of one-period bonds.

Formally, the government maximises its behaviour as follows:

$$\underset{\tau_t, g_t, b_t, k_t^g}{\text{Max}} \sum_{t=0}^{\infty} \beta^t \, u(c_t, l_t, g_t) \qquad (2.33)$$

Subject to:

$$c_t + g_t + k_t^p - (1-\delta)k_{t-1}^p + k_t^g - (1-\delta)k_{t-1}^g = F\left(k_{t-1}^g, k_{t-1}^p, l_t\right) \qquad (2.34)$$

$$\sum_{t=0}^{\infty} \beta^t \left(u_{c,t}, c_t + u_{l,t}, l_t\right) = u_{c,0}(Y_0 b_{-1} + R_0 k_{-1}) \qquad (2.35)$$

And the optimal fiscal program is formulated as:

$$F_{k_t^p} = F_{k_t^g}, u_{g_t} = \mu_t \forall t \geq 0 \qquad (2.36)$$

$$-\left\{u_{l,t} + \lambda\left(u_{ll_t} l_t + u_{l,t}\right)\right\} = \left\{u_{c,t} + \lambda\left(u_{cc_t} c_t + u_{c,t}\right)\right\} F_{l,t} \forall t \geq 1 \qquad (2.37)$$

$$u_{c,t} + \lambda\left(u_{cc,_t} + c_t + u_{c,t}\right) = \beta\left(u_{c,t+1} + \lambda\left(u_{cc,t+1} c_{t+1} + u_{c,t+1}\right)\right)\left(F_{k_t^g} + (1-\delta)\right) \forall t \geq 1 \qquad (2.38)$$

Where, μ_t is the Lagrange multiplier on resource and λ is the Lagrange multiplier on feasibility constraints.

Assuming that only distortionary taxes are available, $\lambda > 0$, the impact of the government's ability to raise revenue need to be taken into consideration. A government's decision to accumulate debt has its own demerits. An economy that accumulates debt over a period of time is worse off by the present value of the distortions associated with raising the revenue to service debt. The government has to raise taxes so as to repay high initial debt. Higher taxes lower the incentive to offer formal taxed employment, thereby reducing the marginal product of capital, resulting to lower investment and ultimately lower economic growth. In this case, public debt and budget deficits have adverse effect as lower levels of output are associated with high levels of debt.

2.3. The Effect of Budget Deficit on Economic Growth

The research objectives in chapter 5 and 6 of this thesis is to analyse the impact of public debt and budget deficit, respectively, on economic growth. In line with these objectives, we found it useful to present the divergent theoretical views on the possible impact of public debt and budget deficits on subsequent economic growth, in this section.

Three definite and divergent schools of thought with respect to the impact of public debt and budget deficit on economic growth are readily discernible: The Ricardian view, the Keynesian view and the neoclassical view (Suiter, 1946). The neoclassical view considers public debt as being detrimental to investment and economic growth, and increases the trade deficit, while the Keynesian paradigm, public debt and budget deficit constitute a key fiscal policy's counter-cyclical demand management role, which stimulates long run growth. The Ricardian perspective claims that public debt and budget deficits are neutral to investment, interest rates, trade deficit and economic growth. This reveals the complex relationship that exists between public debt and budget deficits on economic growth. From a theoretical perspective it cannot be ascertained the possible impact of public debt and budget deficits on economic growth. This necessitates the need to empirically analyse the impact of public debt and budget deficits on economic growth in SADC member countries.

These competing theoretical views on the impact of fiscal policy (public debt and budget deficits) on economic growth are further discussed.

2.3.1 The Ricardian Equivalence View

The Ricardian equivalence is an old view on debt financing linked to the British classical economist, Ricardo (1951), of which Barro (1989) is probably the most important exponent (Black et al., 2008).

Under the Ricardian view, succeeding generations are connected through voluntary, philanthropically inspired resource transfers. This implies that consumption is determined as a function of hereditary resources (that is, the total resources of a taxpayer and that of his descendants). Since deficits simply shift the payment of taxes to future generations, they do not affect dynastic resources. Thus deficit policy is a matter of insignificance (Bernheim, 1989).

From the Ricardian standpoint, whether governments use taxes or debt financing is of no importance. The argument the Ricardian view advances is that when the government borrows instead of levying taxes to finance public expenditure, the current generation is "under-taxed''. As rational as the present generation is assumed to be, realising that the high public debt will have to be repaid by their heirs, they increase their savings by an equal amount of the increase in the future tax burden as they do not want their heirs to be in a poorer position on account of the under-funded benefit which they are enjoying.This constitutes a voluntary reduction in private spending, thus netting out the impact on domestic aggregate demand of the debt-financed government expenditure. The result is that the government's choice of debt financing is neutralised in terms of its effects on aggregate demand and the effect on the well-being of successive generations is nullified by the rational behaviour of tax payers (Black et al., 2008).

Following Romer (2012) the Ricardian equivalence can be demonstrated by the representative household budget constraint, formulated as:

$$\int_{t=0}^{\infty} e^{-R(t)}\, C(t)dt \leq K(0) + D(0) + \int_{t=0}^{\infty} e^{-R(t)}\, W(t)dt - \int_{t=0}^{\infty} e^{-R(t)}\, T(t)dt \qquad (2.39)$$

where, $\int_{t=0}^{\infty} e^{-R(t)}\, C(t)dt$ is the present value of consumption; $\int_{t=0}^{\infty} e^{-R(t)}\, W(t)dt$ is the present value of labour income; with $\int_{t=0}^{\infty} e^{-R(t)}\, T(t)dt$ being the present value of taxes; $C(t)$ is consumption at time (t); $K(0)$ is quantities of capital at time (t), and $D(0)$ is quantities of government bonds at time (t).

Thus, the representative household budget constraint states that the present value of a representative household consumption cannot exceed the sum of its initial wealth and the present value of its after tax income.

Assuming that the government satisfies its budget constraint with equality, it therefore implies that the present value of taxes, $\int_{t=0}^{\infty} e^{-R(t)}\, T(t)dt$ equals initial debt, $D(0)$ plus the present value of government budget purchases, $\int_{t=0}^{\infty} e^{-R(t)}\, G(t)dt$. Substituting this into the household budget constraint yields:

$$\int_{t=0}^{\infty} e^{-R(t)} C(t)dt \leq K(0) + \int_{t=0}^{\infty} e^{-R(t)}\, W(t)dt - \int_{t=0}^{\infty} e^{-R(t)}\, W(t)dt \qquad (2.40)$$

The fundamental importance of equation 2.40 is that the representative household's budget constraint is expressed in terms of government purchases without reference to the division of the financing of those purchases between taxes and bonds. Thus, there is a key result: only the quantity of government purchases, not the division of the financing of those purchases between taxes and bonds, matter for the economy.

This is the so called Ricardian equivalence result, which states that public debt (deficits) and taxes are equivalent in their effect on consumption (Fischer, 1993). According to the Ricardian equivalence theorem, public debt or budget deficits do not affect national savings, interest rates, or the balance of payments, therefore both investment and the trade balance remain unaffected. Overall, budget deficit (public debt) has no effect on economic growth and do not lead to any macroeconomic instability (Thornton, 2011).

Thus, under the Ricardian equivalence theorem proposed by Barro, a budget deficit or public debt will be fully offset, by an increase in private savings, as taxpayers recognise that the tax is merely deferred, not cancelled. Since desired national saving does not change, the real interest rate does not necessarily have to rise to maintain balance between desired national saving and investment demand. The offsetting increase in private saving means that the deficit will have no effect on national saving, interest rates, exchange rates, future domestic production, or future national income (Barro, 1989, Gale and Orszag, 2003). In an open economy there would also be no effect on the current account balance because desired private saving rises by enough to avoid having to borrow from abroad. Therefore current public debt would not cause current account deficits. Keho (2010) asserted that budget deficits are neutral to economic growth.

For the purposes in chapters 5 and 6, when we analyse the impact of public debt and budget deficit, respectively, on economic growth, for the Ricardian equivalence to hold, public debt and budget deficit, respectively must not be statistically significant. This has the implications that public debt or budget deficit does not contain meaningful information to explain any movements in economic growth. We also are of the view that, for the purposes, even though public debt or budget deficit is statistically significant but with an economic impact that is so small and almost insignificant may be regarded as suggesting the Ricardian equivalence.

2.3.2 The Keynesian View

The second alternative view on the potential impact of public debt and budget deficits on economic growth is the Keynesian perspective. The Keynesian line of thought is predicated under two critical assumptions: a significant fraction of the population is thought of as either myopic or liquidity constrained and that the economy is below full employment. The first assumption guarantees that aggregate consumption is very responsive to disposable income. The rule-of-thumb consumers have high inclinations to consume out of current disposable income. A public debt, or budget deficit therefore has an instantaneous and quantitatively substantial impact on aggregate demand. If the economy's resources are under-employed, national income rises, thereby generating second round effects and the well-known Keynesian multiplier effect applies. Since public debt or budget deficits stimulates both consumption and national income, saving and capital accumulation need not be adversely affected. Thus, appropriately timed deficits/public debt has beneficial consequences on economic growth (Suiter, 1946, Bernheim, 1989).

High public spending resulting in public debt and budget deficits is regarded as an effective way of reducing unemployment in a non-inflationary manner. Rising public debt or budget deficits in periods of recession and falling public debt in boom periods are associated, conceptually at least, with macro-economic stabilisation (Black et al., 2008).

From a Keynesian perspective, public debt or budget deficits are seen as both desirable and necessary to offset cyclical fluctuations in economic activity that were characteristic of capitalist, free-market economies (Thornton, 2011).

The implications of the Keynesian viewpoint is that public debt or budget deficits need not crowd out private investment. Eisner and Pieper (1984) suggested that public debt may rise aggregate demand thereby increasing the profitability of private investment at any given rate of interest. Thus, public debt or budget deficit can lead to an increase in domestic production, which makes private investors more optimistic about the future course of the economy resulting in them investing more – the "crowding-in-effect" (Buscemi and Yallwe, 2012).

For the purposes in chapters 5 and 6, where we analyse the impact of public debt and budget deficit, respectively, on economic growth, for the Keynesian view to hold true, public debt and budget deficit, respectively, must be statistically significant and positively correlated with economic growth.

2.3.3 The Neoclassical View

A third alternative view on the possible impact of public debt on economic growth is the neoclassical view. The neoclassical paradigm strongly argues that public debt is detrimental to economic growth (Keho, 2010).

An increase in government expenditure means that aggregate demand increases, which sets the multiplier in motion. The resultant increase in income leads to a rise in the demand for money. If the supply of money remains constant, in real terms, the excess demand for money causes interest rates to rise. Given the negative relationship between interest rates and investment, higher interest rates dampen private investment, which would aggregate in a phenomenon called ''crowding-out effect'' (Black et al. 2008). Crowding out is the decrease in private investment that is due to a result of increased government spending or financial needs of a budget deficit (Arnold and Roger, 2011, Aschauer, 1990, Aristei and Pieroni, 2008).

The insight behind the crowding out of private investment spending is based on the inherent assumption of scarcity of resources which government and private sectors compete for. Holding other things constant, increased public debt or budget deficits that may result in the government borrowing increases the demand for loanable funds and thus leads to greater competition for the available domestic savings thereby bidding up interest rates and reducing private investment (Gale and Orszag, 2004, Feldstein, 2016).

Future generations do pay for the current generation's deficit spending by inheriting a smaller productive capacity and enjoying a lower standard of living (Buscemi and Yallwe, 2012). The reason that fiscal discipline promotes long-term growth is that budget surpluses are perceived as a form of national saving. Higher national saving increases the assets owned by the nationals and leads to higher future national income (Bektasoglu and Sahan, 2012:, Gale and Orszag, 2004). Budget deficits and public debt, therefore, are an intergenerational liability in that they lead to a smaller stock of capital for future generations (Barro, 1989).

High and persistent budget deficits can negatively affect economic activity in various ways. High debt payments lead to lower public investment, which may, resultantly lead to declining private investment. High and persistent public debt can reduce the scope for countercyclical fiscal policies, thereby increasing volatility and constraining private sector activity. Large debt stocks lead to lower economic activity and reduce the probability that debt will be repaid in full. Furthermore, high debt may diminish the government's incentives to enact growth-enhancing stabilisation and policy reforms, because gains will go to service debt (IMF, 2013).

In conclusio the neoclassical view proposes that government budget deficits or public debt reduce national saving, and retards investment volumes that resultantly has adverse effects on the growth performance of an economy. For the neoclassical perspective to hold in the particular case of this study, the coefficient of public debt in chapter 5 and that for budget deficit in chapter 6, must be negative and statistically significant.

2.3.4 Conclusion on the Effect of Budget Deficit on Economic Growth

The sections above present three divergent views on the impact of public debt on economic growth. The source of the difference in opinion is, in part, due to the implied response of consumers to an increase in government expenditure. The Ricardian equivalence hypothesis features infinitely-lived Ricardian households, whose consumption decisions at any time are based on an intertemporal budget constraint. All other things held constant, an increase in government spending lowers the present value of after-tax income, thus generating a negative wealth effect that induces a cut in consumption.

By way of contrast, the Keynesian view features non-Ricardian households whose consumption is a function of current income. The rule-of-thumb households are assumed to fully consume their current disposable income- they do not smooth their consumption path in the face of fluctuations in disposable income nor do they intertemporally substitute in response to changes in interest rates. The source of the behaviour of non-Ricardian households under the Keynesian view is partially attributed to myopia, lack of access to financial markets, or binding borrowing constraints. High public debt leading to budget deficits, thus, is viewed as net wealth by non-Ricardian households under the Keynesian view to the extent that budget deficits increase aggregate demand thereby raising the profitability of private investment at any given rate of interest, resultantly leading to high levels of economic growth.

The neoclassical view, however, views the effects of government budget deficits as detrimental to economic growth as they (budget deficits or public debt) reduce national saving, dampens investment, reduce net exports, and create a corresponding flow of assets overseas.

Given this apparent theoretical divergence on the likely impact of fiscal policy (public debt or budget deficits) on economic growth, the real effects of public debt or budget deficits on SADC economies cannot, therefore, be ascertained based on theoretical grounds. This theoretical disparity suggests that the true impact of public debt and budget deficits on subsequent economic growth in SADC member countries can only be ascertained empirically. We discriminate against this competing theoretical dissimilarity in the impact of public debt and budget deficits on economic growth in chapters 5 and 6, respectively, as we present the empirical evidence.

Having examined the theoretical relationship binding public debt and budget deficits with economic growth, the next section presents past empirical evidence on the relationship between public debt and budget deficits with economic growth.

2.4 Review of Empirical Studies

In order to establish the state of research on budget deficits and economic growth, this section reviews past empirical evidence on the relationship between budget deficits and economic growth as well as public debt with economic growth. The first part of this section provides a review of the past empirical evidence with respect to the impact of budget deficits on economic growth while the last part of this section presents the past related empirical evidence on the impact of public debt on long run economic growth.

2.4.1 Empirical Review of Budget Deficit and Economic Growth

Chapter 6 of this thesis analyses the impact of budget deficit on economic growth in South Africa, Madagascar and Lesotho - three of SADC member states. Before such an exercise has been done, there is need to establish the state of knowledge or acknowledge previous work on the subject at hand in these particular countries. We note, however, that very little, if any previous studies have been done on the impact of budget deficit on economic growth in South Africa, Madagascar and Lesotho. Whilst it would have been ideal for us to pay more attention to the empirical literature review of South Africa, Madagascar, and Lesotho, given the scanty empirical evidence we, at best, will review the effect of budget deficit on economic growth in other similar countries so as to put the study into perspective.

There are several empirical studies from panel and time series data that analyse the effects of fiscal deficits on economic growth. Results, nevertheless, are mixed and at times ambiguous, revealing the convoluted nature of the relationship between budget deficit and long-term economic growth.

2.4.1.1 Evidence Pointing towards a Negative Relationship between Budget Deficit and Economic Growth

A number of studies have shown the detrimental effects of budget deficit on economic growth.

The closest to an analysis of the budget deficit-economic growth nexus in South Africa is an analysis of the impact of budget deficit on long-term interest rates in South Africa by Bonga-Bonga and Mabejane (2009). Employing the VAR methodology, the authors established a positive relationship between budget deficit and long-term interest rates under different assumptions of price expectations by economic agents. This provides evidence for the crowding out effect of budget deficit implying that fiscal deficits have growth inhibiting effects within the South African context. Similar findings were also obtained by Biza et al. (2015) who analysed the relationship between budget deficit and investment in South Africa. Based on a VAR/VECM framework the authors showed that budget deficit crowds out private investment in South Africa. This confirmeded the empirical findings of Bonga-Bonga and Mabejane (2009). If growth in South Africa is investment-driven, then these empirical foundings suggest the negative effects of budget deficit on long term economic growth through its negative effects on private investment.

Elsewhere, empirical studies on the relationship between budget deficit and economic growth also provide evidence in favour of the neoclassical view that budget deficit crowd out private investment and resultantly impedes long-run growth. For the Indian economy, Mohanty (2013) employed the VAR/VECM approach to analyse the impact of budget deficit on economic growth. The results show that a 1% worsening of the fiscal deficit retards long run economic growth by 2%. In the Nigerian context, Adedokun (2014), from a VAR analysis confirmed of a negative relationship between budget deficit and investment. This is evidence of the detrimental effects of budget deficit on long run economic growth through crowding out private investment.

Earlier on, within a panel context, Ghura (1995), using pooled time-series and cross-section data for 33 countries in Sub-Saharan Africa for the period 1970-1990 produced evidence that points towards the existence of a negative relationship between budget deficit and economic growth. In that study the sample countries were divided into three groups: high-growth countries with growth rates above 2%, medium-to-low-growth countries, with growth rates between 0% and 1.9%, and weak-growth countries, with growth rates below -0.9%.

In a more recent paper, Rubin et al. (2004) based on reasonable projections of the adverse effects of the large and sustained U.S budget deficit on the long run economic performance argued that such escalating budget deficits may provoke fiscal and financial panic, with probable costs far worse off than those presented in the literature.The authors buttressed the fact that budget deficit lead to declining asset prices, reduced national wealth, fear of inflation, reduced fiscal flexibility for dealing with macro-economic shocks and declining investor confidence.

In a panel of the West African Economic and Monetary Union (WAEMU), by utilising the granger causality test developed by Toda and Yamamoto (1995), over the period 1980 to 2005, Keho (2010a) found mixed results on the effect of budget deficit on economic growth. He reported no evidence of causality between budget deficit and economic growth for three countries, while deficits had adverse effects on growth in the other four countries. The author advised of the need to adopt fiscal prudence as the evidence from the majority of the countries support a negative impact of fiscal deficit on long run economic growth.

These are just but a few of the many previous studies that have established a negative relationship between budget deficit and subsequent economic growth. There is empirical evidence that shows the beneficial effects of fiscal deficits on economic growth.

2.4.1.2 Evidence pointing towards a Positive Relationship between Budget Deficit and Economic Growth

Contrary to the negative relationship between budget deficit and economic growth established in the previous section, a growing body of literature attempts to redress the balance by suggesting that the state can actually, through putting into operation deficit-funded growth enhancing activities like investment in education, research and development (R&D), health, and infrastructure development, foster long run economic growth.

In a recent paper, which is still under review with the Journal of Economics, Mavodyo and Kaseeram (2016) found that budget deficit is growth enhancing in the South African economy. The authors made use of a different estimation technique (VAR/VECM) using a different model specification from the one used in chapter 6 of this thesis and found evidence that budget deficit has growth pay-off in the South African context. The positive growth fostering role of budget deficit in South Africa had been earlier on established by Buscemi and Yallwe (2012). The study, by Buscemi and Yallwe (2012), employed a reduced form of GMM method within a dynamic panel framework over the period 1980 to 2005 in a panel of China, India and South Africa. The results show a positive relationship between budget deficit and economic growth.

In a study of the Greek economy, Alexiou (2009), after disaggregating government spending, reported evidence overwhelmingly in support of the Keynesian counter-cyclical demand management role of the government in nurturing economic growth through incurring budget deficits. Prior to this, Aschauer (1990) had also documented a positive and significant relationship between government spending and the level of output in the context of the Greek economy.

Further evidence in support of the growth stimulating role of budget deficit is provided by Rangarajan and Srivastava (2004). In a study of the Indian economy, the results provide evidence in support of a positive relationship between budget deficit and economic growth. Later on, the positive role budget deficit plays in stimulating economic growth for the Indian economy was established by Ranjan and Sharma (2008). The study found a positive relationship between budget deficit and economic growth.

This short review in this section show that, contrary to the neoclassical claim that budget deficit hurts economic growth, fiscal policy - through running budget deficit - can have a stimulative impact on long run economic growth. This empirical evidence clearly shows that it is not in every case that one can pre-conclude that whenever an economy is sustained by budget deficits, the long run economic growth is compromised.

With this exposition, the next section gives a small survey of the evidence in support of budget deficits having no discernible relationship with subsequent economic growth.

2.4.1.3 Evidence pointing towards No Relationship between Budget Deficit and Economic Growth

The Ricardian view predicts no effect of budget deficits on economic growth. Nevertheless, data do not provide an overwhelming support for the Ricardian Equivalence. What follows is a brief survey of the existing empirical literature in support of the fact that budget deficits are immaterial to economic growth.

A striking example, is the study by Nelson and Plosser (1982) who utilised quarterly U.S. data from 1954 to 1978. The study found that unexpected movements in the federal debt does not raise the nominal yield on government securities of various maturities. In fact, the study found a weak tendency for economic variables to be adversely affected by any movements in the federal debt, hence the conclusion that budget deficits are neutral to economic growth. Later on, Evans (1987) obtained similar results for nominal yields with quarterly data from 1974 to 1985 for Canada, France, Germany, Japan, the United Kingdom, and the United States.

In a study of the determinants of growth for a panel of 47 countries, Kormendi and Meguire (1985), among other foundings, reported no meaningful relationship between the ratio of government expenditure to GDP and long run growth. In a recent study, for the Vietnamese economy, Van and Sudhipongpracha (2015) were motivated by the high growth rate of Vietnam at a time when the country had the highest budget deficits in Southeast Asia, and they analysed the relationship between budget deficits and economic growth. Utilising what the authors called “panel data methods” specifically making reference to the “fixed effects methods” for only one country, Vietnam, the authors found that foreign direct investments (FDI) accounted for much of the growth in Vietnam whereas budget deficits were immaterial to economic growth.

The section above has presented empirical evidence on the relationship between budget deficits and economic growth. The empirical evidence on the relationship between budget deficits and economic growth provides mixed results. This therefore, underscores the need and urgency to conduct an investigation into the impact of budget deficit on economic growth. We provide the empirical evidence on the effects of budget deficits on economic growth in South Africa, Madagascar and Lesotho, three of SADC member countries, in chapter 6 of this thesis.

The empirical foundings in chapter 6 contributes to the literature in many ways. Firstly, not much empirical research has been done on the relationship between budget deficits and economic growth in these countries, and secondly, we employ recent developments in time series econometrics by making use of the DOLS, FMOLS, and the CCR estimation techniques which are robust to endogeneity and serial correlation. Thirdly this thesis analyses non-linearities in the way budget deficit correlates with economic growth in the case of Madagascar. Fourth, in the case of South Africa, this study analyses the impact of budget deficit on economic growth in the pre- and post- democratic South Africa as well as the pre and post inflation targeting regime, an issue that has not been explored in literature.

2.4.2 Empirical Evidence on Public Debt and Economic Growth

Chapter 5 of this thesis presents the empirical evidence on the impact of public debt on long run economic growth in a panel of 14 SADC member countries. The relationship between public debt and economic growth has been enlivened by a plethora of empirical research, albeit in advanced and emerging economies. The literature, however, is not decisive on the impact of public debt on economic growth, with a number providing evidence in favour of the neoclassical view of the adverse effects of public debt on economic growth and the other supporting the Keynesian growth reinforcing effect of public debt.

Increasingly, empirical literature has found a negative correlation between public debt and economic growth. Possibly, the natural starting point for the literature on the detrimental effects of public debt on economic growth is the seminal findings by Reinhart and Rogoff (2010) which triggered a renewed interest in the debt-growth nexus. Based on a large international debt database, the authors carried out an extensive analysis of the relationship between public debt and economic growth for the period 1990 to 2009. Their findings demonstrate that the relationship between public debt and economic growth, though weak but is negative. Another important outcome of their study, by comparing the debt-growth relationship for countries with low levels of debt (above 30%) and those with high levels of debt (above 90%), is that the authors established that a debt level above 90 % of GDP causes the growth rate of a country to stagnate. Such a magic threshold beyond which public debt leads the growth rate of the country to deteriorate generated a rekindled interest in understanding the impact of public debt on economic growth.

The empirical results of many scholars concur with those of Reinhart and Rogoff (2010). A notable example are the results of Kumar and Woo (2010). The authors (Kumar and Woo, 2010) focused on a panel consisting of advanced and emerging economies over the period 1970 to 2007. They found a negative and statistically significant relationship between public debt and economic growth. In fact, their results show that a 10% increase in the initial debt-to-GDP ratio retards subsequent annual growth rate by 0.2% per year. A similar quantitative negative impact of public debt on subsequent economic growth was confirmed by Afonso and Jalles (2013) for a panel of 155 countries over the period 1970 to 2008. In yet another study, based on data for the Euro area, Checherita and Rother (2011) found a non-linear relationship between public debt and economic growth indicating that at lower levels of debt-to-GDP ratios public debt is growth enhancing but turns out to be detrimental as soon as a threshold of 90-100% is exceeded.

Schclarek (2005), focussing on a panel of 59 developing and 24 advanced countries, analysed the relationship between public debt and economic growth.The author report that, for developing countries, there is always a negative and significant relationship between public debt and economic growth while for advanced economies the study does not found any meaningful relationship between public debt and economic growth. In the context of African countries, such as South Africa, Madagascar and Lesotho, Da Veiga et al. (2016) analysed the public debt-economic growth nexus for a panel of 52 African countries for the period 1950 to 2012. The authors reported an inverted U shaped behaviour where high levels of public debt are associated with lower rates of economic growth as well as rising inflation.

Other empirical literature focusses on the growth effect of external debt. Some studies have established a negative relationship between external debt and economic growt, that the negative correlation becomes particularly persuasive as debt reaches a certain threshold (Cordella et al., 2010, Pattilo et al., 2011, Siddique et al., 2016).

The above analysis has presented evidence in support of the negative effect of public debt on long run economic growth. Nevertheless, few studies have provided evidence in support of the growth stimulating role of public debt.

A notable contribution in this direction is offered by Kelly (1997). By exploring the effect of public debt on growth among 73 countries over the period 1970-1989, the author found that the crowding-out effect and rent-seeking concerns in the literature might have been overstated. According to the evidence obtained, the contribution of public expenditure to growth is rather positive and significant.This is a significant departure from the huge literature in support of the adverse effect of public debt on economic growth.

In a recent study of the relationship between public debt and economic growth for selected emerging market economies, Fincke and Greiner (2015a) found a statistically significant positive relationship between public debt and economic growth. An important contribution to the debate as to whether public debt significantly retards economic growth beyond a certain threshold was offered by Pescatori et al. (2014). Responding to the assertion by Reinhart and Rogoff (2010), the authors questioned whether there is any threshold beyond which debt significantly retards economic growth. Based on a regression analysis of the stock of debt and economic growth rate, the authors utilised a long historical series from a database developed by the IMF. The authors contended that there is no vivid evidence of a threshold level beyond which public debt meaningfully hampers long run economic growth. A similar conclusion was offered by, Eberhardt and Presbitero (2015), from a study of the public debt-economic growth nexus of a large panel of countries. Based on evidence from a dynamic time series, the authors maintained that the relationship between public debt and economic growth is dissimilar between countries and they found some support for a non-linear relationship in the long term. The authors argue that the controversial 90% debt threshold beyond which debt adversely affects economic growth was not consistent with the data and suggested that those who find such a threshold to be valid might be due to poor empirical specification or an erroneous interpretation of the results.

Thus, the empirical evidence on the relationship between public debt and economic growth is far from being conclusive. This leaves the exact impact of public debt on economic growth on a particular set of countries subject to empirical investigation. What is most striking about the existing literature on the public debt-growth nexus is that most of it is based on studies focusing on developed and developing economies with developing economies not getting much scholarly attention. Notably, SADC as an economic grouping, has been side-lined in literature as far as an analysis of the debt-growth relationship is concerned.

The empirical foundings on the impact of public debt on economic growth are presented in chapter 5 of this thesis. One of the contributions of this study is that gaps in the literature are filled by providing evidence on the relationship between public debt and economic growth focusing on a panel of 14 SADC member countries, a context that has been neglected in literature. The second contribution in this thesis is that the empirical foundings are robust to a number of panel estimation strategies, which would override any estimation biases inherent in relying on one estimation technique. Thirdly, by employing panel time series estimation techniques, the results make advantage of both panel diversity and the useful time series dynamic interaction between public debt and economic growth. Fourthly, this study analyses the non-linearities in the manner in which public debt interacts with economic growth. Fifth, this study analyses the investment and education channels through which public debt impacts economic growth.

2.5 Budget deficits and the Current Account Deficit

2.5.1 Defining the Current Account Deficit

Since this section is primarily centred on the relationship between the current account and budget deficits, we found it imperative to offer a definition of the current account. There are different ways of viewing the current account, but for the purposes of this study, the following working definitions suffices. One way of perceiving the current account deficit over a period of time is a decrease in the value of its net claims on the rest of the world. Put differently, a country's current account deficit is a decrease in its' net foreign assets. Following Obstfeld and Rogoff (1996), the current account balance can be defined as:

$$CA_t = B_{t+1} - B_t \qquad (2.41)$$

where, CA_t is the current account balance at time t, and B_{t+1} is the economy's net foreign assets at the end of a period t, and B_t is the value of the economy's net foreign assets, at the beginning of the period t.

For a country with no capital accumulation and no government spending, the current account balance can be represented as:

$$CA_t = B_{t+1} - B_t = Y_t + r_1 B_t - C_t \qquad (2.42)$$

where Y_t is gross income at a particular time, C_t is consumption at time t, and $r_1 B_t$ is interest earned on foreign assets acquired previously. Thus, an economy's current account balance is the difference between its total income and its consumption.

Alternatively, the current account balance can be viewed as the difference between national savings and investment. When an economy's level of investment exceeds its savings then a country is said to be running a current account deficit. With investment, total domestic private wealth at the end of the period is now given as:

$$W_t = B_{t+1} + K_{t+1} \qquad (2.43)$$

where B_{t+1} is the sum of net foreign assets at the end of the period and K_{t+1} is the stock of domestic capital at the end of the period. Capital investment at the end of the period (K_{t+1}) is the sum of preexisting capital (K_t) and capital accumulated during the period, I_t, assuming there is no depreciation, and this is reduced to:

$$K_{t+1} = K_t + I_t \qquad (2.44)$$

The change in total domestic wealth can then be represented as:

$$B_{t+1} + K_{t+1} - (B_t + K_t) = Y_t + rB_t - C_t - G_t \qquad (2.45)$$

which, after a series of manipulations, reduces to:

$$CA_t = B_{t+1} - B_t = Y_t + rB_t - C_t - G_t - I_t \qquad (2.46$$

Thus, the expression, $Y_t + rB_t - C_t - G_t - I_t$, simply means that income earned in a particular period,$(Y_t + rB_t)$, is spent on household consumption, government expenditure and investment expenditure and the rest is saved. This brings us to the national saving identity, S_t presented as:

$$S_t \equiv Y_t + rB_t - C_t - G_t \qquad (2.47)$$

The current account balance can then be formulated as:

$$CA_t = S_t - I_t \qquad (2.48)$$

Simply put, a current account balance at any time is the difference between a nation's savings and its investment. National investment in excess of national savings therefore constitutes a current account deficit. An increasing current account deficit indicates that a nation is living beyond its means. An economy's current account deficit therefore implies that local consumption and investment is funded from abroad. Such an increased reliance on foreign lenders in itself renders the domestic economy vulnerable to unexpected and sudden changes in economic fortunes (Alleyne et al., 2011).

2.5.2 Does the Current Account Deficit Matter?

A study like this, particularly chapter 4 of this thesis - motivated by a widening on the current account deficits of SADC member countries - is founded on the inherent assumption that a widening of the current account has some far-reaching consequences on the economy. But this view is not shared by every scholar and policy maker in international economics. This section briefly reviews some of the contemporary divergent viewpoints put forward in the literature as to whether the current account deficit is really harmful to economic performance or not. We seek, therefore, to present the different arguments presented on either side of the debate, before we present the theoretical relationship between budget deficit and the current account deficit.

There is no agreement among economists and policymakers alike as to whether persistent current account deficits are bad, good or are just immaterial to the economy. There are those who argue that persistent current account deficits are a matter of concern, while others are of the view that current account deficits do not matter.

Those who perceive the current account deficit as being harmful to the economy argue that a current account deficit implies that a country is accruing external liabilities as it finances its deficit with foreign credit in the form of external debt, aid, foreign direct investments (FDI), portfolio investment, and other forms of capital flow (Osakwe and Verick, 2009). They further elaborate that trade deficits matter as they are an indicator of a bad state of the economy (Sinai, 2000, Osakwe and Verick, 2009).

High and rising current account deficits, they argue, reflect various imbalances, or excesses, that eventually will have to be rebalanced. More so, the debt and debt service that go with current account deficits generate claims against future profits and cash flows of the country. Critics of persistent current account deficits also contend that foreign demand for domestic goods will, at some point in time, be quenched and the net capital inflow will stop or be withdrawn. A large, rapid capital outflow or reversal will lead to a sharp increase in the domestic interest rates and a severe depreciation of the domestic currency (Froyen, 2002). One line of argument in support of the fact that persistent current account deficits are harmful to the economy is the fact that countries with sizeable current account deficits suffered disproportionately when the financial crisis of 2007/2008 struck as international capital flows came to a halt

Hubbard. R.G. (2006) claimed that whether current account deficits are good, bad or immaterial depends on the size of the current account deficit in relation to GDP. A current account deficit of 5% of GDP and above matters, he maintained.

On the other hand, some economists have argued that a widening current account deficit is not necessarily bad. Puah et al. (2006) maintained that a current account deficit can be viewed as an excess of investment over domestic savings. The authors argued that a current account deficit may reflect a high level of investment relative to savings. If the country is investing the borrowed resources into more productive investment available in the rest of the world, paying back loans to foreigners will pose no problem because a profitable investment will generate a high return to cover the interest and principal on those loans.

Sinai (2000) contented that a high trade deficit is a sign of a growing economy. For capital-poor developing countries which have more investment opportunities than they can afford to undertake because of low levels of domestic savings, a current account deficit may be natural. A trade deficit may actually lead to employment creation as there is more investment leading to higher levels of output, thereby improving the standard of living in a country.

Trade deficits can also be viewed from an inter-temporal approach. Intertemporal theories of the current account are grounded in the consumption-smoothing role that current account deficits and surpluses can play. If, for instance, a country is struck by a natural disaster that temporarily dampens its ability to access productive capacity, the country can spread out the ill effects over time by running a current account deficit and thereby smoothing consumption over time (Obstfeld and Rogoff, 1996).

Finally, another line of thought views trade deficits as mere expressions of consumer preferences and as such are immaterial. These economists typically equate economic well-being with rising consumption and a wide variety of choice open to consumers. If consumers have an insatiable demand for imported food, clothing and cars, then why should they not buy them? Freedom of choice is part of a successful economy.

Thus economic theory cannot explicitly answer the question as to whether current account deficits are desirable or harmful or rather immaterial to the economy. Smit (2006) proposes that an ideal strategy would be to consider the actual experiences of countries with large-scale current account imbalances.

Elwell (2007) proposed that whether trade deficits are harmful or not to the economy depends on the current benefits from that added consumption by the current generation from increased imports relative to the future debt service burden to be incurred by the future generation.

Economic theory does not equivocally state whether current account deficits are bad, good or immaterial, as there are competing theoretical standpoints. In the context of SADC, however, SADC member states agreed, among other macroeconomic policy targets, to maintain a current account deficit of not more than 9% of GDP for the years 2008 and 2012 and 3% of GDP for the year 2018. This was on the reasoning that the member states unanimously believed that a current account deficit larger than the set targets would have harmful effects to the economy and hinder the achievement of regional integration. It is from these standpoints that the study also finds it worthwhile to investigate whether the ballooning current account deficits for most of SADC member states can be explained on the grounds of fiscal deficits.

We continue to discuss the scholarly frameworks that are available in the literature that are used to model the behaviour of the current account. Such an exposition enables us to set the basis of a framework for an empirical account of the relationship between budget deficits and the current account deficits in SADC member states in chapter 4.

2.5.3 Theoretical Models of Current Account Determination

This section gives a short survey of the recent intellectual evolution in scholarly thinking about the approaches used to analyse current account determination. Different approaches offer dissimilar predictions about the dynamics underlying an understanding of current account determination. For the purposes of this study, four basic frameworks commonly adopted in the literature in modelling the behaviour of the current account are presented. They are the: elasticity approach, the Keynesian absorption approach, the intertemporal approach and the stages of development approach.

2.5.3.1 The Elasticity Approach

The elasticity approach to the current account analysis is closely linked with the separate works of Marshall (1923) and Lerner (1944) popularly known as the Marshal-Lerner condition. The Marshal-Lerner condition states that when the sum of price elasticities of demand for exports and imports, in absolute terms, is greater than unity, then a devaluation (depreciation) of a currency will improve the country's balance of payments. Simply put:

$$\varepsilon_x + \varepsilon_m > 1 \qquad (2.49)$$

where ε_x is the demand elasticity of exports and ε_m is the elasticity demand for imports.

On the contrary, if the sum of price elasticities of demand for exports and imports, in absolute terms, is below unity($\varepsilon_x + \varepsilon_m < 1$), devaluation (depreciation) will worsen the current account deficit. If the sum of price elasticities of demand for exports and imports, in absolute terms, is equal to unity($\varepsilon_x + \varepsilon_m = 1$), then devaluation (depreciation) has no effect on the current account.

Assuming the Marshal-Lerner condition prevails, the elasticity approach postulates that devaluation (currency depreciation) reduces the domestic price of exports in terms of the foreign currency and as well increases the domestic price of imports which reduces the import of goods and increases exports, and all other things remaining constant. Following devaluation, (depreciation) export of goods increases and import of goods decreases thereby reducing a current account deficit or leading to a current account surplus. The extent to which exports increase and imports decrease depends on the demand elasticity for exports and imports, respectively.

The elasticity approach therefore postulates a direct relationship between exchange rate movements in improving the current account deficit, assuming the Marshal-Lerner condition holds. Devaluation (currency depreciation) improves the current account balance whereas a revaluation (currency appreciation) worsens the current account balance, assuming the Marshal-Lerner condition holds.

2.5.3.2 The Keynesian Absorption Theory

The Keynesian school of thought proposes that there is a positive relationship between budget deficits and the current account deficits (Bagheri et al., 2012). From a Keynesian perspective budget deficits fuel the current account deficits. The theory further propounds that an increase in the budget deficits would induce domestic absorption (an expansion of aggregate demand) and hence, an increase in imports, causing an increase or worsening of the current account deficits. Both the Mundell-Fleming model and the Keynesian absorption framework conclude that there exists a uni-directional relationship between budget deficits and the current account deficits running from budget deficits to current account deficits.

Chang and Hsu (2009) gave an alternative uni-directional relationship running from current account deficits to fiscal deficits. The theoretical explanation is that when the current account deteriorates, this leads to a slower pace of economic growth and hence to a worsening of the budget deficits. A country experiencing a solvency crisis resulting from chronic, excessive current account deficits may face a situation in which large injections of public funds are required to rehabilitate the troubled financial sectors, to improve the corporate governance system, and to attenuate a recession.

Alternatively, a bi-directional causality might exist between budget deficits and current account deficits. While budget deficits may cause current account deficits, the existence of significant feedback may cause causality between the two variables to run in both directions (Chang and Hsu, 2009).

2.5.3.3 The Intertemporal Approach to the Current Account

This analysis of the twin deficit hypothesis in chapter 4 of this thesis is rooted in the intertemporal approach to the current account. In this respect, we have dedicate more attention to a discussion of the intertemporal approach.

The intertemporal approach to the current account, proposed by Sachs (1981) and Buiter (1981) and further extended by Obstfeld and Rogoff (1996), forms the backbone to the contemporary economic theory underpinning the analysis of the current account (Algieri, 2013; Chinn and Prasad, 2003; Hassan et al., 2016). The basic insight of the intertemporal approach to the current account is that the current account can act as a shock absorber that enables a country to even out consumption and maximise welfare in the presence of transitory shocks in an economy's cash flow or net output (Semmler and Tahri, 2016).

An open economy with a temporary income underperformance can avoid a sharp narrowing of consumption and investment by borrowing from the rest of the world. Similarly, an economy with superflous savings can loan and participate in productive investment projects overseas (Obstfeld & Rogoff, 1996). In order to describe how a country can gain by rearranging the timing of its consumption through international borrowing and lending, this section makes use of the representative national consumer's lifetime utility maximisation behaviour.

The use of the representative national consumer to describe total dynamic behaviour may seem improbable but literature provides several justifications (Obstfeld and Rogoff, 1996). Firstly, several useful insights into the macro economy do not depend on a detailed consideration of household differences. Secondly, as amply discussed by Campa and Gavilan (2011), individual behaviour can be aggregated. To be more precise, one does not need to assume literally that all individuals are identical to conclude that aggregate consumption will behave as if chosen by a single maximising agent. Thirdly, many models in international macroeconomics can best focus on cross-country differences by downplaying within country differences (Obstfeld and Rogoff, 1996).

In this spirit, the analysis of the national representative consumer's utility maximisation behaviour is undertaken based on the following set of assumptions. Firstly, the model assumes a small open economy that consumes a single good and lasts for two periods, labelled $1 \& 2$. A small open economy is one which gets the world interest rate as given from the world capital market and whose actions have no influence on the world interest rate. A small economy can carry out any intertemporal exchange of consumption it desires at the given world interest rate subject to its budget constraints. Secondly, we assume that the representative consumer has impeccable far-sightedness of the future. This assumption implies that a model's predictions are driven by intrinsic logic rather than by ad hoc and arbitrary assumptions about how people form expectations.

An individual, i, maximises lifetime utility, U_1^i, subject to period consumption levels, denoted as c_1^i. Thus:

$$U_1^i = u\left(c_1^i\right) + \beta u\left(c_2^i\right) \qquad 0 < \beta < 1 \qquad (2.50)$$

where, β is a fixed preference parameter, called the subjective discount or time preference factor that measures the individual's impatience to consume. The assumption is made again that period utility function $u\left(c^i\right) < 0$. The implication of this assumption is that individuals always desire at least a little consumption in every period.

If we let y^i denote the individual's income (output), and r the real interest rate for borrowing or lending in the world capital market at date$_1$, then consumption must be chosen subject to the lifetime budget constraint. Simply stated, the present value of current consumption is a sum of present day consumption c_1^i , and the discounted future consumption $\frac{c_2^i}{(1+r)}$. Thus:

$$c_1^i + \frac{c_2^i}{(1+r)} = y_1^i + \frac{y_2^i}{(1+r)} \qquad (2.51)$$

In the same spirit, the present value of the individual's income (output) is a sum of current income(y_1^i) and future income $\left(y_2^i\right)$ discounted to the present at the real discount rate(r). The budget constraint for individual i restricts the present value of current consumption to equal the value of lifetime income. We further assume that output is perishable and cannot be stored.

The maximising lifetime utility function subject to the lifetime budget constraint reduces to:

$$\max_{c_1^i} u\left(c_1^i\right) + \beta u\left[(1+r)\left(y_1^i - c_1^i\right) + y_2^i\right] \qquad (2.52)$$

The first order conditions for the optimising problem, known as the intertemporal Euler equation reduces to:

$$\bar{u}\left(c_1^i\right) = (1+r)\beta\bar{u}\left(c_2^i\right) \qquad (2.53)$$

The intertemporal Euler equation simply implies that, at a utility maximum, there is no utility gain to the consumer from feasible shifts of consumption between periods. A one unit reduction in first-period consumption lowers U_1 by$u^{-}\left(c_1^i\right)$. The consumption unit thus saved can be converted by lending it into $(1+r)$ units of second-period consumption that raise U_1 by$(1+r)\ \beta u^{-}\left(c_2^i\right)$.

An alternative way of representing the Euler equation is:

$$\frac{\beta u^{-}\left(c_2^i\right)}{U^1\left(c_1^i\right)} = \frac{1}{(1+r)} \qquad (2.54)$$

Simply put, the consumer's marginal rate of substitution of present consumption for future consumption is equal to the price of future consumption in terms of present consumption (the discount price of future consumption).

Individual $i's$ optimal consumption plan is found by combining the first order condition with the intertemporal budget constraint. Under the assumption that the subjective discount factor equals the market discount factor,$\beta = 1/(1+r)$ the Euler equation implies that the consumer desires a flat lifetime consumption path, $c_1^i = c_2^i$ with the Euler equation being$u^{-}\left(c_1^i\right) = u^{-}(c_2^1)$.

Generalising the national representative consumer's optimum consumption plan to the whole economy, the intertemporal approach to the current account explains the current account developments through closer examination of intertemporal consumption, saving and investment decisions. A small open economy that is originally capital and income deprived, provided it is open to international capital markets, will run current account deficits for a prolonged period of time to build its capital stock. All things being equal, countries would wish to even out their consumption. Intertemporal trade makes possible a less uneven time profile of consumption. Ultimately, what determines the current account position of a country is the saving-investment gap, which depends, entirely on the willingness of foreigners to hold liabilities. Countries with a higher savings ratio will tend to be net capital exporters and run sustained current account surpluses, while countries with a lower savings ratio will tend to import capital and therefore run current account deficits.

The main conclusion from the intertemporal approach of the current account is that the current account deficit is the outcome of progressive dynamic saving and investment decisions driven by expectations of productivity growth, government spending, interest rates, and several other factors. Within this framework, the current account balance behaves as a buffer against transitory shocks in productivity or demand (Sachs, 1981; Obstfeld and Rogoff, 1995, 1999. The current account deficit is a result of an intertemporal optimisation with the objective of optimally distributing consumption overtime (consumption smoothing).

An important policy implication of the intertemporal approach to the current account is that is that policy actions that result in higher investment opportunities will necessarily generate deterioration of a country's current account balance. According to this view, however, this type of worsening of the current account should not be a cause of concern for policy action. Sachs (1981).

2.5.3.4 The Stage of Development Approach to the Current Account

The fourth alternative theory explaining the current account determination is the Stage of development approach. This is principally an economic theory on economic development entrenched in the original works of Rostow (1960), Harrod (1939b) and Domar (1946). The stage of development approach to the current account views the process of development as a series of succeeding stages of economic growth through which all countries must go through. Rostow (1960) identified five stages that all societies, in their economic dimensions, go through, namely, the traditional society, the pre-conditions for take-off into self-sustaining growth, the take-off, and the age of high mass consumption.

One of the fundamental strategies of development crucial for any take-off was the acquisition of domestic and foreign savings in order to generate adequate investment to fast-track economic growth. The economic mechanism by which more investment leads to more growth can be described in terms of the Harrod-Domar model, which can be specified as:

$$\frac{\Delta Y}{Y} = \frac{s}{k} \qquad (2.55)$$

where, $\left(\frac{\Delta Y}{Y}\right)$ shows the rate of change or rate of growth of GNP. This implies that the rate of growth of GNP is determined jointly by the national savings ratio, s, and the national capital-output ratio, k. The economic logic of the Harrod-Domar model is that for economies to grow, they must save and invest a certain proportion of their GNP. The more they can save and invest, the faster they grow for any level of saving and investment.

High investment accompanied by relatively low levels of savings for a backward country entails large current account deficits. Current account deficits for developing economies, like SADC countries, are therefore defined by the stage of economic development in which they happen to be. At an early stage of economic development, the external financing requirement initially rises with the increasing development of a country but then drops when a higher level of development has been reached. Current account deficits for poor and capital deficient developing countries are therefore a natural occurrence of the level of economic development they happen to fall in.

Work on the stage of development approach to the current account analysis has been conducted by, among others, Debelle and Faruquee (1996) and Chinn and Prasad (2003) for a comprehensive review.

In conclusion, the section above has presented the different theoretical grounds that help to explain movements in the current account. This is an important exercise to have a deeper understanding of the determinants and the theoretical grounds on which the current account is viewed. This is a pre-condition for the analysis of the interaction between the fiscal balance and the current account balance to be undertaken in chapter 4 of this thesis.

The theoretical framework on which the relationship between budget deficits and the current account deficits can best be understood. This is the theoretical framework within which the analysis of the twin deficits in chapter 4 of this thesis is based.

2.6 The Theoretical Framework between Budget Deficit and the Current Account Deficit

The national income accounting framework can be used to demonstrate the accounting basics of the relationship between fiscal deficits and the current account deficits. Several authors (Alleyne et al., 2011, Algieri, 2013, Bagheri et al., 2012) have amply documented the theoretical relationship between the twin deficits. In an open economy, the national income (Y) is viewed as the sum of household consumption(C), private investment expenditure(I), government expenditure (G) and net exports$(X-M)$. Thus, the national income accounting equation in an open economy can be stated as:

$$Y = C + I + G + (X - M) \qquad (2.56)$$

This can also alternatively be stated as:

$$Y = C + S + T \qquad (2.57)$$

where the other variables are defined as: S stands for savings, and T stands for taxes. Equation (2.57) implies that all income either goes to pay for consumption or to pay taxes, or becomes savings.

In equilibrium, injections are equal to withdrawals, thus:

$$S + T + M = I + G + X \qquad (2.58)$$

After re-arranging to see the equation from a national income identity, we get:

$$(X - M) = (T - G) + (S - I), \qquad S(r) > 0, \qquad I(r) < 0, \qquad (2.59)$$

where, $(X - M)$ is the trade deficit or the current account deficit, $(T - G)$ is the fiscal balance and $(S - I)$ is the savings-investment differential. It can also be inferred that real domestic savings, (S) is postulated to have a positive relationship with the rate of interest, (r) and real domestic investment,(I), is negatively related to the rate of interest. Simply put, a current account deficit (foreign deficit) is a sum of the budget (public deficit) and the private savings deficit.

Thus, an exogenous increase in the budget deficit can only be financed by an increase in domestic savings, a reduction in investment (both of which are functions of the real interest rate), and/or an increase in the nation’s current account deficit or inflow of net foreign savings. Net exports are inversely related to the real effective exchange rate. It can be concluded that a positive co-movement between budget deficits and the current account deficits (foreign deficit) exists. Thus, high budget deficits give rise to high current account deficits.

There can, however, be a reverse causation where high current account deficits give rise to high fiscal deficits. This reverse causation from current account deficits to budget deficits was coined by Summers (1988) as "current account targeting". The reasoning behind the reverse causation is that a worsening current account deficit causes a slower pattern of growth, thereby leading to high government spending, and at the same time shrinking the tax revenue which, resultantly, leads to high budget deficits (Alleyne, et al, 2011).

In either way, the presentation points to a positive causal relationship between budget deficits and the current account deficits.

Conclusively, this section has outlined the theoretical relationship that explains the positive relationship between the budget and the current account deficits. This theoretical framewok helps to put the twin deficits into perspective. We now further the theoretical explanations behind the co-movement between the external and the fiscal balances. This can be offered through the Keynesian twin deficits hypothesis, the Ricardian equivalence theory and the twin divergence hypothesis.

2.7 The Co-movement between Budget Deficits and the Current Account

The last section of Chapter 4 of this thesis aims at analysing the nature of the co-movement between the fiscal balances and the widening current account balances in most of the SADC member countries. The important empirical relationship we wish to analyse is whether the rising current account deficits in SADC countries can be explained on account of rising budget deficits. To set the theoretical basis of the analysis, we present the formal theoretical explanations, prevalent in the literature, that explain the possible comovement between the fiscal and current account deficits.

2.7.1 The Twin Deficits Phenomenon

First coined by Miller and Russek (1989), McKinnon (1980) and McKinnon (1990), the "twin deficits phenomenon", describe a positive relationship between fiscal balances and external balances. The issue of the co-movement between budget deficits and current account deficits started to draw attention in the 1980s, when the United States experienced significant fiscal and external deficits. Many researchers ascribed a significant part of the worsening in the external balance to escalating budget deficits (Algieri, 2012). The twin deficits hypothesis postulates that there is a strong causal relationship between budget deficits and the current account deficits. An economy is said to have a double deficit if it has a current account deficit and a fiscal account deficit.

Traditional macroeconomics predicts that persistent double deficits leads to currency depreciation that can be severe and sudden. The twin deficits hypothesis can be explained within two frameworks: the Mundell-Fleming model and the Keynesian absorption theory as has been discussed in its entirety in section 2.6.3.2.

2.7.1.1 Budget and Current Account Deficits within the Mundell-Fleming Model

Based on the original works of Fleming (1962) and Mundell (1963), the Mundell-Fleming Model which is an extension of the IS-LM model, is an open economy macroeconomic framework that portrays the short-run relationship between the nominal exchange rate and an economy's output (Salvatore, 2006). While the Mundell-Fleming model is used for various purposes, this study makes use of the model to explain the dynamic short-run effects of an exogenous increase in the budget deficit on interest rates, exchange rates and the current account deficit in an open economy under a free-floating exchange rate system.

In an open economy framework, the Investment-Savings (IS) equation, is derived from the goods market equilibrium condition and can be stated as:

$$S(Y) + T + Z(Y, \Pi) = I(r) + G + X(Y^f, \Pi) \qquad (2.60)$$

where, $S, Y, T, Z, \pi, G, Y^f, r$ stand for savings, national income, taxes, imports, exchange rates, government expenditure, foreign income, and interest rates, respectively. Imports are positively related to the level of domestic national income (Y) and negatively related to the real exchange rate (Π). Exports are positively related to foreign income (Y^f) and negatively related to the exchange rate. Within the Mundell-Fleming Model income is negatively related to the level of interest rates. Higher interest rates lead to low investment levels and are thus associated with lower levels of national income.

Incorporating the money market, for the money market to be in equilibrium real money supply must equal real money demand. This reduces to the LM equation that can best be represented as:

$$\frac{M}{P} = L(i, Y) \qquad (2.61)$$

To allow for the analysis of the relationship between budget deficit and the current account, the relationship of prime interest, we further incorporate the balance of payments analysis in to the IS-LM analysis. The balance of payments schedule can be stated as:

$$X(Y^f, \Pi) - Z(Y, \Pi) + F(r - r^f) = 0 \qquad (2.62)$$

where, $X(Y^f, \Pi) - Z(Y, \Pi)$ is the trade balance (net exports), and F is the capital inflow. The net capital inflow positively depends on the real interest rate differential between the domestic interest rate and the foreign interest rate$(r - r^f)$. A rise in the domestic interest rate relative to the foreign interest rate leads to an increased demand for domestic financial assets. The balance of payments is said to be in equilibrium when a trade deficit (surplus) is matched by an equal capital inflow (outflow). In an open economy framework, lower interest rates lead to lower capital inflows (or greater outflows) and must be matched by lower levels of national income and imports for the balance of payments to remain in equilibrium.

The standard implication of the Mundell-Fleming model, in an open economy framework and particularly for the purposes of this study, is that a fiscal expansion (exogenous budget deficit) leads to an appreciation of the exchange rate that leads to capital inflow which is synonymous with a rise in imports which resultantly lead to a widening (worsening) of the current account deficit. The model postulates a positive relationship between budget deficits and the current account deficit.

2.7.2 The Ricardian Equivalence View on Twin Deficits

An alternative explanation of the relationship between budget deficits and the current account deficits is the Ricardian equivalence theorem. The Ricardian equivalence theorem is of the view that there is no apparent relationship between budget deficits and the current account deficits (Bagheri et al., 2012, Chang and Hsu, 2009). This line of reasoning further reasons that for a given expenditure path, the substitution of debt for taxes has no effect on aggregate demand nor interest rates. As a result, it implies that a tax increase would reduce the budget deficit but would not alter the current account deficit, since altering the means that the government uses to finance its expenditures does not fundamentally affect private spending or national saving.

Following Enders and Lee (1990), we adopt the following model to explain the Ricardian equivalence within an open economy framework. The model is based on the assumption of a single commodity which can be used for private or government consumption. A representative resident at time t whose private consumption is c_t and real government purchases, g_t maximises expected utility function:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[c_t^{1-\gamma} g_t^{\gamma}\right]^{p/p} \qquad (2.63)$$

where $0 < \beta 1, \quad 0 < \gamma < 1, \quad p < 1$, and $E_t x_{t+j}$ is the mathematical expectation of x_{t+j} conditioned on the information set at t and contains all variables subscripted t and earlier. In the equation p measures the degree of relative risk aversion, β measures the discount rate, and γ is a share parameter measuring the degree to which real government spending contributes to the individual utility.

For us to incorporate the Ricardian equivalence theorem, we further assume that government debt is the only store of value. Each government may issue one-period discount bonds promising to pay one unit of output. The representative resident maximises expected utility subject to the budget constraint at time t as given:

$$\frac{B_t}{(1+i_t)} + \frac{F_t}{((1+i_i^*)e_t} + p_t c_t + p_t \sigma_t \leq p_t y_t + B_{t-1} + \frac{F_{t-1}}{e_t} \qquad (2.64)$$

where B_t is the monetary value of one period bonds purchased at time t, and held until $t+1$; i_t is the nominal interest rate; e_t is the foreign currency price of the local currency; F_t is the foreign currency value of foreign issued, one-period bonds, purchased at time t, and held until a future date, $t+1$; i_t^* is the nominal foreign interest rate; p_t is the monetary price of goods in local currency; y_t is real output, and σ_t is real lumpsum taxes. The representative resident is subject to the following budget constraint:

$$\left(\frac{b_t + f_t}{(1+r_t)}\right) + c_t + \sigma_t \leq y_t + b_{t-1} + f_{t-1} \qquad (2.65)$$

In order to maximise utility in each time period, the representative resident choose c_t and the sum $(b_t + f_t)$ subject to the budget constraint. In the maximisation process, the individual is aware that the sequence of future tax payments is related to government debt issue, best represented as:

$$g_t - \sigma_t = \left(\frac{b_t + b_t^*}{(1+r_t)}\right) - b_{t-1} - b_{t-1}^* \qquad (2.66)$$

where b_t^* denotes the real quantity of foreign residents holding of local bonds at time t and

held until $t+1$.

To incorporate the Ricardian equivalence hypothesis we substitute the government's budget constraint into the individual's budget constraint and solve the resulting difference equation. The result, as specified in equation (2.67) is the characteristic of the Ricardian Equivalence hypothesis for an open economy, specified as:

$$\sum_{t=0}^{\infty} [c_t + g_t - y_t] \prod_{j=0}^{t} d_{j-1} = f_{-1} - b_{-}^* \qquad (2.67)$$

where, $\prod_{j=0}^{t} d_{j-1} \equiv d_{-1} d_0 d_1 \ldots d_{t-1}$; $\quad d_{-1} \equiv 1$; $\quad d_j \equiv \frac{1}{(1+r_j)}$; $\quad and\, j \geq 0$.

From the specification in equation 2.67, the discounted value of the local residents' consumption stream must be financed from the income stream plus local residents' net claims on foreigners $(f_{-1} - b^*_{-1})$ less the discounted value of the government spending. Since taxes do not appear in the individual's lifetime budget constraint, the only way for the choice of debt issue versus current taxes to affect real consumption behaviour is through an effect on real interest rates. Foreign residents are assumed to select an optimal consumption program in the same manner as local residents.

Given real interest rates and the foreign government's expenditure stream, the substitution of foreign taxes for foreign debt does not change consumption potentials. The implication of this analysis is that the so called "twin deficits" does not exist. Letting nx_t denote the local economy's net exports in period t, the goods market equilibrium, requires that:

$$nx_t = y_t - c_t\,() - g_t \qquad (2.68)$$

Given y_t, g_t and the invariance of $c_t\left(\ \right)$ to debt issue, fiscal deficits can not be held responsible for the current account deficits. The Ricardian equivalence hypothesis implies that raising taxes without changing the level of government spending does not affect the current account deficit; simply altering the ways the government uses to finance its expenditure does not necessarily affect private sector spending.

2.7.3 Twin Divergence

This section offers an alternative way, to the twin deficits and the Ricardian Equivalence, of perceiving the relationship between the budget deficits and the current account. This line of thinking was born out of an empirical analysis of the U.S economy by Kim and Roubin (2008). This background understanding is crucial for the empirical evidence on the possible relationship between the budget and current account deficits in SADC member countries in the last section of chapter 4.

Although standard economic theory predicts a positive relationship between the fiscal balance and the current account balance (twin deficits phenomenon), at times, under some economic conditions, the fiscal balance may move in the opposite direction with the current account balance; the two twins may diverge away from each other. Twin divergence is a strand of literature that explains the possibility that there might be a negative co-movement between fiscal balances and the current account. This implies, therefore, that the expansionary fiscal shocks or government budget deficit shocks are associated with an improvement of the current account and a depreciation of the real exchange rate (Kim and Roubini, 2008). Corsetti et al. (2006) emphasised that any assessment of the co-movement of the budget and trade balance should take into account the fact that both variables adjust endogenously to the entire state of the economy.

Three outstanding explanations to the twin divergence phenomenon have been proposed in literature. For the purposes of this thesis and the analysis, we only present the major foundings and conclusions from the various standpoints on the likely explanation to the twin divergence. Any interest in the detailed account of these contributions is referred to in the original works.

The most widely accepted explanation of the twin divergence phenomenon rests on the work of Glick and Rogoff (1995) who captured the impact of country-specific productivity and global productivity shocks on the budget deficit-current account relationship. Glick and Rogoff (1995) extended the intertemporal approach to macroeconomics and drew inferences on international capital mobility. Using data from the G-7 countries, the authors' major conclusions were twofold: Firstly, country-specific productivity shocks affect the current account more than investment, because both consumption and investment respond to changes in productivity inducing a larger response by the current account. Secondly, global productivity shocks have no impact on the current account because global shocks affect all countries in the same way and thus there is no partner who wants to borrow or lend in the face of a global shock.

The notable contribution from the work of Glick and Rogoff (1995) to the understanding of the co-movement between the budget deficits and the current account is that country-specific aggregate productivity shocks may be the main source of fluctuations in the current account dynamics, rather than the budget deficit thereby leading to the conclusion that the current account and the budget deficit account may diverge away from each other (Iscan, 2000).

The work of Glick and Rogoff (1995) was extended by many researchers, in quite different ways, with the ultimate conclusion that budget and current account deficits may, in actual fact, diverge in the presence of productivity shocks. Some of these contributions are discussed brifly here. Gruber (2004) considered the role of habit-formation in the exposition of the budget and current account divergence. On the other hand Bussière et al. (2006) considered two types of consumers: liquidity constrained consumers (non-Ricardian) and non-liquidity constrained consumers (Ricardian consumers). The added innovation is that there is no room for habit-formation as non-Ricardian consumers spend all their current income. Ricardian consumers, on the other hand, maximise their consumption based on their life income. Another extension of the work of Glick and Rogoff (1995) was done by Iscan (2000) who considered two types of goods in the analysis: tradeables and non-tradeables. The only changes in productivity in tradeables have an effect on the current account position with changes in productivity in the non-tradeables having no effect on the current account position. Lastly, Nason and Rogers (1999) set many restrictions to the model and concluded that the results of the model are highly sensitive to the identification of the model.

These are just but some of the extensions of the original work of Glick and Rogoff (1995) but the common decisive supposition of these isolated pieces of work is that the budget and the current account balances, under some certain economic circumstances, do actually move in opposite directions to each other.

Another remarkable contribution to giving plausible grounds for the twin divergence is the work of Backus and Kehoe (1994) who considered the impact of technological shocks on the budget deficit-current account relationship. Considering technology-induced productivity shocks, the authors established that non-fiscal shocks are important for the co-movement of the external and the budget balance. Using a two-country stochastic growth model in which trade fluctuations reflect, in large part, the dynamics of capital formation, Backus et al (1994) demonstrated that budget and current account balances do not move together. The major inference from the work of Backus et al (1994) is that domestic technology shocks worsen the external balance and improves the budget balance, thereby alluding to the twin divergence. The trade balance, however, improves if the technology shock originates from the foreign country. Domestic technology shocks thus induce a negative correlation of budget and external balance, but less so the more open the economy is (Corsetti et al. (2006)).

The third explanation to the divergent co-movement of the fiscal and current account balance relates to the specific characteristics of the domestic tax systems. Obadić et al. (2014) argue that the dynamic relationship between budget and current account balances is dependent on the nature of the tax system of a country. The authors maintained that countries whose tax system are largely dominated by indirect tax are likely to have a divergence in the budget and current account balances. The reasoning is that in countries whose fiscal systems are dominated by indirect taxes, a deterioration of the current account balance would imply higher fiscal revenues due to larger imports and consumption. In such a scenario, a worsening of the fiscal balance is associated with an improvement of the external balance.

2.7.4 Conclusion on the Relationship between Budget and Current Account Deficits

The theoretical relationship that exists between fiscal and current account deficits has been reviewed. Three competing views standout: the Keynesian view, the Ricardian view and the twin divergence view. The Keynesian view is based on the Mundell-Fleming model and asserts that a worsening of the fiscal balance is associated with a deterioration of the current account balance. Contrary to the Keynesian view, the twin divergence standpoint, based on a number of theoretical justifications, establishes that the current account behaves differently depending on the macroeconomic circumstances in a particular country. The insight from the twin divergence perspective is that the budget and the current account balance, at times, move in divergence. The Ricardian equivalence theorem, on the other hand, asserts that there is no obvious causal relationship between the budget and the current account balances.

The lack of consensus on the apparent theoretical relationship between fiscal and current account balances motivates empirical investigation of economies of interest so as to discriminate among the competing schools of thought if any appropriate policy options are to be adopted. In this regard, given the widening current account balances among the majority of SADC member countries, we aim to empirically assess the nature of the relationship that exists between budget and current account deficits among SADC member countries.

Having established the theoretical background that helps explain the relationship between the budget and the current account deficits, we now present the empirical evidence presented by past researchers in the field with regards to the twin deficits hypothesis.

2.8 Empirical Literature on the Budget-Current Account Relationship

To get clarity of the twin deficits hypothesis and the state of research in the literature, we present, in this section, the research findings of other past scholars on the twin deficit hypothesis. The emphasis is to have a representative literature survey of those who support the twin deficits, the Ricardian, and lastly the twin divergence hypothesis.

Different researchers employing dissimilar estimation techniques within various contexts, have found different results on the relationship between budget and current account balances. The closest to our context are studies done within an African context, as we have cited before that we are not aware of any study done specifically considering SADC member countries. A number of researchers within the African context found a positive and statistically significant relationship between budget and the current account balances.

In a recent paper, Aloryito et al. (2016), employing a System GMM approach for 41 countries in Sub-Saharan countries for the period 2000 to 2012 found a positive and statistically significant relationship between budget deficit and the current account balance. The authors establish that a one unit worsening of the budget deficit leads to a deterioration in the current account deficit by 35%. In yet another study, Ahmad et al. (2015), in a study of nine African countries using the threshold cointegration approach based on quarterly data over the period 1980 to 2009 found a positive and statistically significant relationship between fiscal balance and external balances for six out of the nine countries included in the study. In yet another recent study, Ahmad and Aworinde (2015) analysed the co-movement between budget deficits and the external balances in 12 African countries by employing the ARDL approach using quarterly data. Their results reveal a positive and statistically significant relationship between budget deficit and the current account balance for eight out of the twelve countries with the other four countries exhibiting a negative relationship- evidence of the twin divergence phenomenon. For Sub Saharan African countries, Imoh and Ikechukwu (2015) analysed the twin deficits hypothesis employing the system GMM estimation technique and established that a one percentage worsening in the fiscal balance would lead to a widening of the current account balance by 27%. All the studies considered confirm the existence of the Keynesian twin hypothesis.

Elsewhere, the European countries have received a fair share of study on the twin deficits hypothesis. Recently, employing a bootstrap panel Granger Causality tests for 27 European Union countries, Bolat et al. (2014) found mixed results: for nine of the countries the authors found a positive relationship between budget deficits and the current account deficits, while in the other nine countries they did not find any discernible relationship between fiscal and external balances, thereby confirming the Ricardian equivalence.

In a different study, using yearly data while making use of the System GMM estimation technique for 33 European countries, Forte and Magazzino (2013) found evidence in support of the twin deficits. Their study reveals that a % increase in the government budget tends to deteriorate the current account balance by 37%.

Of late, empirical evidence has given support to the twin divergence in different research contexts. A notable contribution to this effect is the work by Corsetti and Müller (2008) who analyse the relationship between the budget and the current account balance for a sample of ten OECD countries. Their foundings reveal that the correlation between the fiscal and the external balances is negative and very small. The negative correlation between the budget and the current account balance provides evidence of the twin divergence. Nevertheless, the term "twin divergence" is attributed to Kim and Roubini (2008). The authors, (Kim and Roubini, 2008), employed a VAR analysis to analyse the effects of budget deficits on the current account for the US economy. Their results show that an expansionary fiscal policy shock improves the external balance and depreciate the real exchange rate. They coined this founding "twin divergence" and explained it on account of the pervasiveness of output shocks.

The empirical findings of Kim and Roubini (2008) were later confirmed by Rafiq (2010) in a study of the co-movement between the budget and the current account balances for the UK and the US economies. Based on a time-varying vector autoregression model that allows for the time variation in the stochastic and autoregressive parameters, the author found that a worsening of the fiscal balance improves the current account balance, thereby giving further evidence in support of the twin divergence. Elsewhere, in the context of ten developing economies of Asia for the period 1985 to 2012 by making use of the panel differenced System Generalised Method of Moments (DGMM) approach and the Pooled Mean Group (PMG) Estimation approach Nguyen Van (2014) found evidence of the twin divergence. The last empirical evidence in support of the twin deficits was for a time series assessment of the co-movement between the fiscal and the external balances in Ghana by Sakyi et al. (2016). Based on the Dynamic Ordinary Least Squares (DOLS) and the Fully Modified Ordinary Least Squares (FMOLS) the authors found that a deterioration of the fiscal balance improves the current account balance, thereby giving empirical evidence in support of the twin divergence hypothesis.

Evidence in support of the Ricardian equivalence is difficult to found in the literature.

In conclusion, the results presented are contradictory on the relationship between budget deficits and the current account deficits. Given this lack of consensus in the literature on the perceived impact of fiscal deficits on the current account deficits the study contributes to the literature in two ways. Firstly, no study has been done considering SADC as an economic grouping. The study therefore fill in this gap in the literature by providing evidence that is SADC-specific. Secondly, none of the studies have considered the possibility of cross-sectional dependence in the panel estimation technique. By employing the system GMMand the Common Correlated Mean Group Effects (CCMG) the results are not only robust to different estimation techniques but also take into account the possibility of cross-sectional dependence.

CHAPTER 3

THE SPECIFICS OF PUBLIC DEBT, BUDGET DEFICITS, ECONOMIC GROWTH AND THE TWIN DEFICITS IN SADC

3.1 Introduction

This chapter traces the historical performance of fiscal deficits, current account balances and public debt in SADC countries. This chapter is a precursor to an evaluation of twin deficits, in chapter 4 of this thesis; the analyses of the impact of public debt on economic growth in chapter 5, and the assessment of the relationship between budget deficit and economic growth in chapter 6. This synopsis is vital as it gives an insight into the topic begore one examines the formal relationship of the twin deficits and the growth effects of fiscal policy in subsequent chapters of this thesis.

The first exercise in this chapter is to present an overview of SADC's macro-economic objectives, set by SADC for its member states, as preconditions for the attainment of a stable macro-economic environment in section 3.2. The next section is section 3.3, which presents the evolution of public debt in SADC member states. The twin deficit evolution is presented in section 3.4, with section 3.5 concluding the chapter.

3.2 An Overview of SADC and its Macro-economic Objectives

The SADC economic regional grouping, the largest economic grouping in Southern Africa, comprises of fifteen member states, namely: Angola (Ang), Botswana (Bot), Democratic Republic of Congo (Drc), Lesotho (Les), Malawi (Mal), Mauritius (Mau), Tanzania (Tan), Namibia (Nam), Seychelles (Sey), Zambia (Zam), Zimbabwe (Zim), Mozambique (Moz), Swaziland (Swa), South Africa (Sa), and Madagascar (Mad). As outlined in the SADC Treaty of 1992, the primary goal of SADC is to promote equitable economic growth and socio-economic development through efficient and productive systems, deeper cooperation and integration, good governance and durable peace and security among its fifteen member states.

SADC is a varied economic grouping, whether measured by population, income levels, or composition of output. SADC economies differ distinctly, in terms of both economic structure and income levels. With the exception of South Africa and Mauritius, most SADC economies have a narrow production basis that is dependent on agriculture (Madagascar, Malawi, and Tanzania); specific natural resources (diamond in Botswana and Namibia, copper in Zambia, and oil in Angola); or specific manufacturing industries (for example, clothing in Mauritius, and soft drink concentrate in Swaziland).

SADC economies can be categorised into four sub-groupings, namely, oil exporters, middle-income countries, fragile countries, and non-fragile low-income countries (IMF, 2012b). Oil exporters are those countries where oil is sufficiently important as an export commodity that the evolution of world oil prices plays a key role in driving economic developments in that country. Angola is the only country belonging to the oil exporters' category. Middle-income countries are defined by reference to the World Bank's classification of economies by per capita GDP and institutional quality. South Africa is the dominant economy in this group, which also includes Botswana, Lesotho, Mauritius, Namibia, Seychelles, Zambia, and Swaziland. Fragile countries are defined as such on the grounds that economic developments in these economies can heavily be influenced by non-economic events, including the outbreak of civil war or subsequent recovery. Currently in this group are Zimbabwe and the Democratic Republic of Congo.
Non-fragile low-income countries are those whose economic developments are attributable to more conventional economic factors. This group currently comprise of Madagascar, Malawi, Mozambique, and Tanzania.

The Regional Indicative Strategic Development Plan, referred to as RISDP, outlines SADC's regional economic agenda for fifteen years (2005-2020). Being conscious of the fact that economic instability in one country has negative spill over effects on the rest of the region, SADC member states agreed to achieve and maintain macroeconomic stability, and devoted themselves to follow stability oriented economic policies, thereby contributing to faster economic growth and laying the basis for ultimate monetary union. The RISDP founded a roadmap for intensifying regional integration over a fifteen-year period, outlining a number of targets and milestones to be met along the way.

The commitments of SADC member states to macroeconomic convergence were first laid out in the SADC Memorandum of Understanding of 2002, and later reiterated in the RISDP of 2003, and finally outlined in the Finance and Investment Protocol (FIP). The level of inflation, the ratio of the budget deficit to GDP ratio, the ratio of public and publicly guaranteed debt to GDP, the balance and structure of the current account, and the rate of economic growth formed the basis on which macroeconomic convergence in the region is to be measured and monitored over a fifteen-year period. This was reinforced by the realisation that regional economic integration and macroeconomic stability are preconditions to sustainable economic growth and for the creation of a monetary union.

As detailed in Table1, the first targets were set for 2008, followed by targets for 2012 and 2018.

Table 1: SADC Macroeconomic Convergence Targets

	2008	**2012**	**2018**
Inflation (annual rate)	Single digits	5%	3%
Fiscal Deficit	5% of GDP	3% of GDP as anchor, with a range of 1%	3% of GDP as anchor, with a range of 1%
Public Debt	60% of GDP	60% of GDP	60% of GDP
Current Account Deficit	9% of GDP	9% of GDP	3% of GDP
Economic Growth	7% per year	7% per year	7% per year

Source: Regional Indicative Strategic Development Plan (RISDP) - SADC

With these SADC macroeconomic targets in mind, we present, in the following sub-sections of this chapter the evolution of public debt, economic growth, budget deficits, and the current account balance in the SADC region over the period under review.

3.3 Public Debt-Economic Growth Evolution in SADC

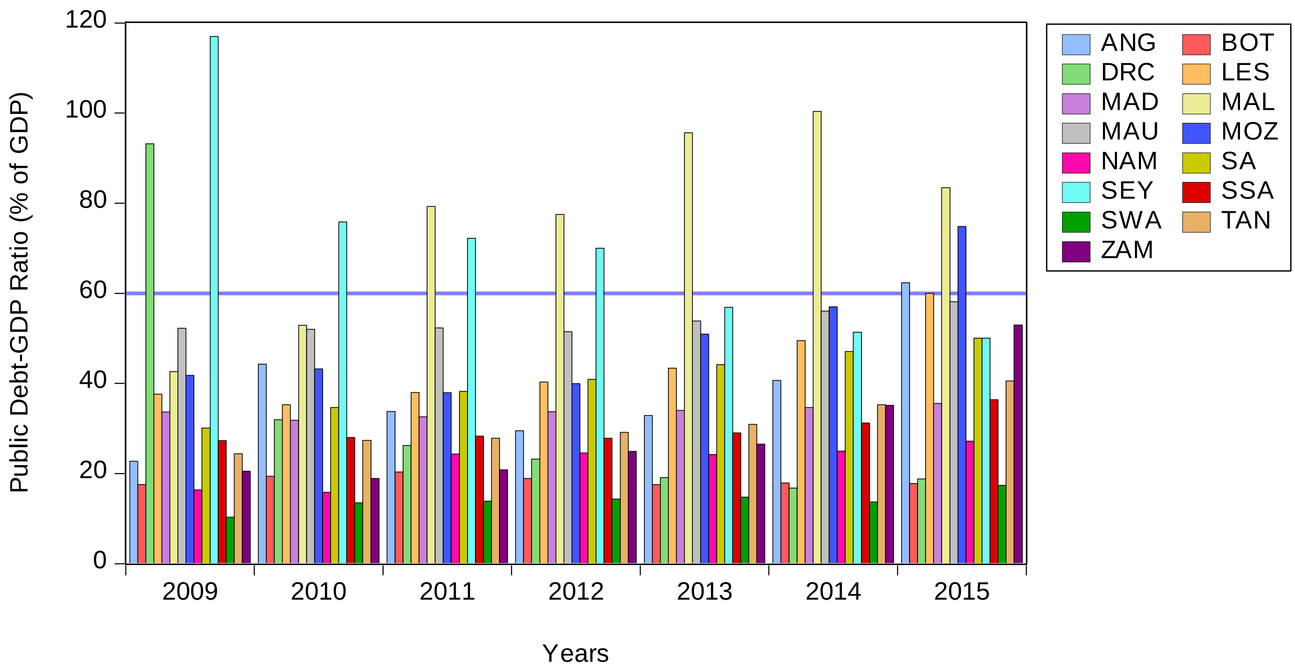
This section reviews the evolution of public debt and economic growth among SADC member countries over the period under review. We include Sub-Saharan African countries' public debt-to-GDP ratio performance together with that for the fourteen SADC countries included in our study in order to infer the performance of SADC economies in comparison with other economies almost sharing similar socio-economic circumstances. With this in mind, we present an evolution of public debt to GDP ratio in SADC countries in Figure 1.

Figure1 shows the public debt-to GDP ratio for the fourteen SADC member states included in our analysis together with that of Sub-Saharan Africa (SSA) as a region for the period 2009 to 2015. This period is dictated by data availability because there is a continuous debt-to-GDP ratio series for all the fourteen SADC member countries which starts from 2009. This period is also particularly desirable as it reflects the post global financial crisis behaviour of the debt-to-GDP ratio among the SADC members. Whilst the majority of SADC member countries' debt-to-GDP ratio is within the 60% threshold, but the general trend is that public debt for many SADC member countries is higher than that for an average Sub-Saharan African country's. Public debt, however, belies considerable heterogeneity among SADC member countries.

Countries like Seychelles, Mozambique, Lesotho, Mauritius, South Africa and Malawi have had public debt-to-GDP ratio well above that for an average Sub-Saharan African country's. Seychelles' debt to GDP ratio, for example, has been well above the 60% SADC threshold for the entire period, from 2009 to 2015. Rakotonjatovo (2007) found that the high public debt-to-GDP ratios for the majority of SADC countries is accounted for on the need to develop social and economic infrastructure. As a result, public expenditure has outpaced growth in revenue collection with the governments having to resort to borrowing so as to fund public expenditure.

Seychelles has posted high public debt-to-GDP ratios for the largest part of the period under review, which justifies giving it a special attention. On attaining independence in 1976, Seychelles adopted a state-led development model in which the government played a paramount role in every sector of the economy, implementing extensive controls and regulation in manufacturing, trade, distribution, and resultantly stifling private sector activity. The provision of education and health facilities was also principally the responsibility of the government (African Development, 2005; International Monetary Fund, 2014, Vincelette and Braga, 2011). The macroeconomic policies Seychelles adopted after independence explain the high level of public debt with which the country is battling.

Figure 1: Public Debt-GDP Ratio (% of GDP) in SADC & SSA: (2009-2015)



Notes to Figure 1: The data for the Public Debt-to-GDP ratio was obtained from the International Monetary Fund (IMF's) World Economic Outlook. The public Debt-to GDP ratio for the fourteen SADC member countries included in the analysis, Zimbabwe is excluded because of acute data challenges, is plotted on the vertical axis for the period 2009 to 2015. A continuous debt-to-GDP ratio series for all the fourteen SADC member states starts from 2009 to 2015, and this is why the time starts from 2009, yet the study is over the period 1980 to 2015. Together with the fourteen SADC member countries we also plot public debt-to-GDP ratios for Sub-Saharan Africa (SSA). The bold horizontal blue line represents the 60% public debt-to GDP-ratio macroeconomic convergence target in the SADC Finance and Investment Protocol (FIP) set for SADC member states in a bid to attain Regional integration and economic development. The abbreviations for the countries are as specified in the introduction to this chapter.

On the other hand, a small number of SADC member countries have not only managed to accumulate debt above the 60% SADC threshold but their debt has been below that for an average country in Sub-Saharan Africa. Notable examples are Namibia, Botswana, Tanzania, Zambia and DRC.

The overall position, however, is that the majority of SADC member countries' public debt to GDP ratio for the past years is above that for an average country in Sub-Saharan Africa, though within the SADC threshold. This observation gives some alarm as to whether this reasonably high public debt-to-GDP ratio for the majority of SADC member states may not adversely affect subsequent economic growth in the region.

Having examined the public debt to GDP evolution, we inspect to a review of the growth performance of SADC member countries in the period under review.

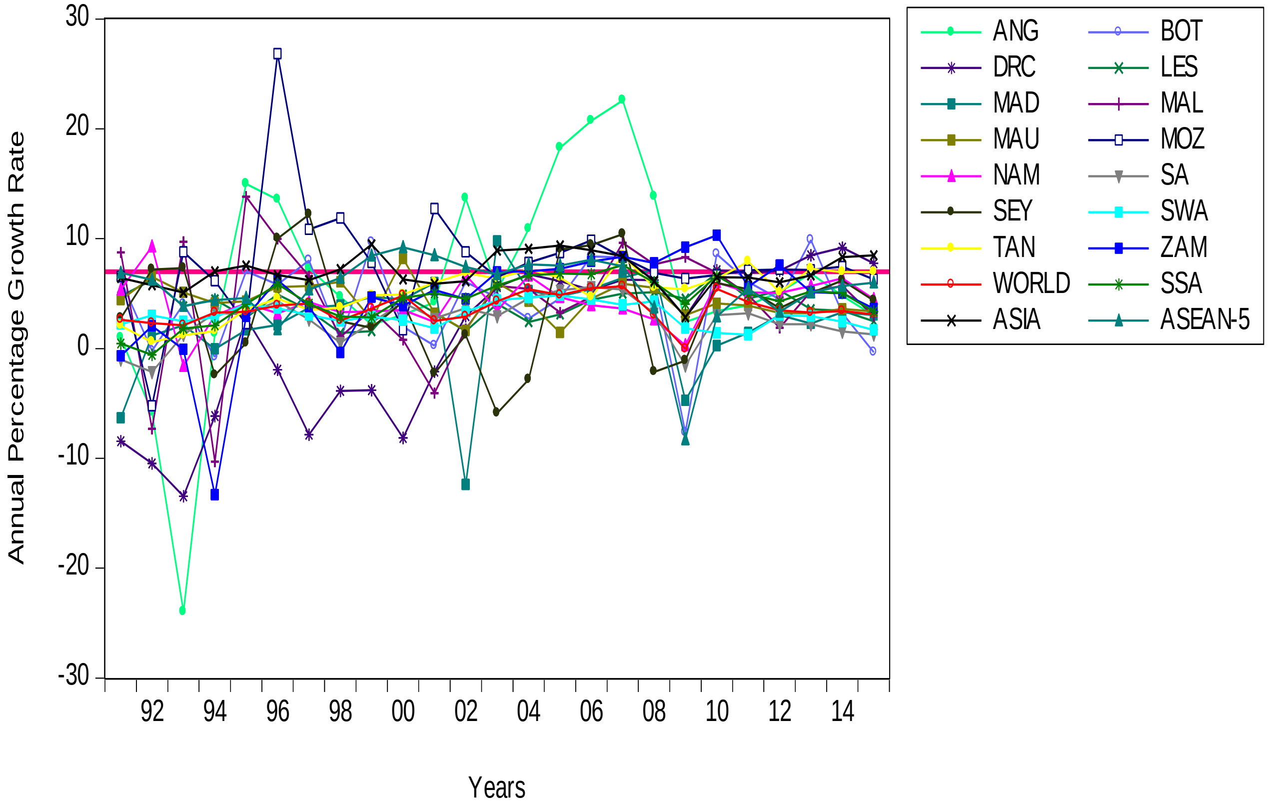
Though growth in SADC is mirrored by dissimilar patterns in different countries, the average annual growth rate in SADC was 4.7% for the period 2003 to 2013 (SADC, 2016). In some countries economic growth is due to a booming resource industry, for example, Angola and Mozambique, while in other SADC countries growth in the service sector, particularly the tourist sector, accounted for the growth rates. Nonetheless, while the 4.7% annual growth rate over the same period (2003 to 2013) may be perceived as impressive when compared to the European Union's average annual growth rate of about 2% and the world average growth rate, it lags behind other developing regions such as the Association of Southeast Asian Nations (ASEAN) region which attained an average growth rate of 7.4 % over the same period. This evidently show the potential for increased growth in SADC, and the role public debt played in subsequent economic growth in SADC should be thoroughly questened.

Figure 2 shows the annual growth rate of GDP for the fourteen SADC member states, world GDP growth rate, GDP growth rate for Sub-Saharan Africa as a region, GDP growth rate for ASEAN nations, and growth rate for Asia for the period 1990 to 2015. This period has been dictated by the availability of continuous time series growth data for the rest of the fourteen SADC member states. The growth performance in ASEAN and economies from Asia may arguably not be directly comparable to that of SADC economies but the common factor is that these are also emerging and developing regions that make them fairly analogous to SADC. The Association of Southeast Asian Nations (ASEAN) is a diverse, fast growing and competitive region which differs in culture, language and religion. ASEAN comprise of ten Southeast Asian countries namely Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam.

Heterogeneity in growth rates is evident among SADC member states. The general trend, though, is that the economic growth rates among SADC member states have been above the world and the Sub-Saharan economic growth rates. Countries like Botswana, Angola and Mauritius have economic growth rates above those of the world and Sub-Saharan Africa for the period 1990 to 2015.

Alternatively, countries like Madagascar, DRC and Seychelles have had low output growth, below that for an average country in both the world and in Sub-Saharan Africa. Yet, ASEAN and Asian countries have reported high growth rates well above those of the world growth rate and that for the majority of countries in SADC with the exception of the years 2007 to 2010 when ASEAN and countries from Asia were affected by the global financial crisis. If other developing economies, like SADC can attain such high levels of economic growth, this could raise questions as to whether the reasonably high public debt-to-GDP ratios for SADC economies could be negatively affecting economic growth.

Figure 2: Annual Percentage Growth Rates in SADC: 1990-2014



Notes to Figure 2: Annual GDP growth rates were taken from the IMF's World Economic Outlook for the period 1990 to 2015. Annual economic growth rates are in percentage changes and are represented on the vertical axis with the years from 1990 to 2015 presented on the horizontal axis. A red horizontal bold line is pegged at the 7 % macroeconomic convergence growth rate target set by SADC in the SADC Finance and Investment Protocol. A continuous series for economic growth rates for all the fourteen SADC member states starts from 1990 to 2015, hence explaining why the time starts from 1990, yet the study is over the period 1980 to 2015. The abbreviations for the countries are as specified in the Introduction to this chapter.

As has been noted figure 2, SADC mirrors a number of substantial differences in the public debt and economic growth performance but what seems to be common among policy makers is the dilemma as to which is the greater priority between lowering public debt or accumulating public infrastructure at the expense of high public debt and persistent budget deficits. The important policy question is whether the rise in public debt and budget deficits subdue investment and future growth prospects among SADC member states or should SADC member states embark on an ambitious public infrastructure program to help achieve high subsequent economic growth.

With this exposition of the public debt-economic growth trajectory, we now turn to the evolution of the budget deficits and the external balances in SADC over the period under review.

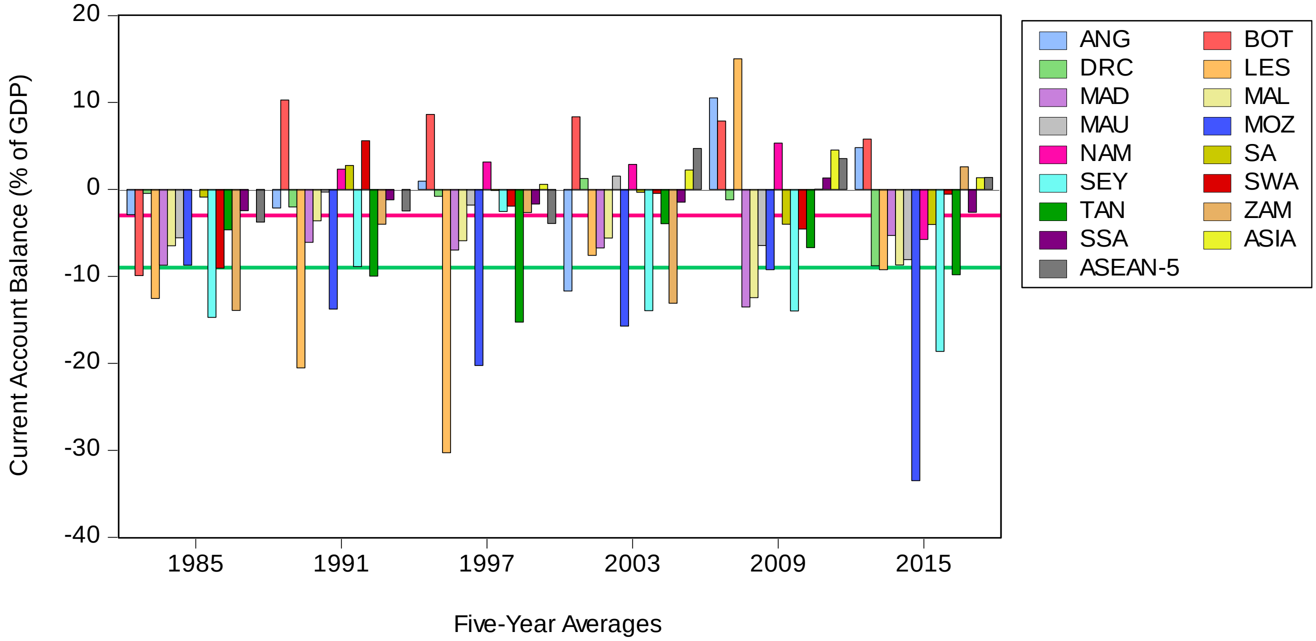
3.4 Twin Deficits Evolution in SADC

As a precursor to our empirical analysis of the twin deficits in chapter 4, this section reviews the historical progression of the budget deficits and the current account balances in SADC member countries.

In this section, we analyse the current account development in SADC member countries as per the threshold set in Annex 2 and 4 of the Protocol on Finance and Investment (FIP), SADC (2010) where SADC member states were bound to monitor their balance and structure of their national current accounts. These targets require SADC member states to observe a current account deficit as a percentage of GDP of 9 % for 2008 and 2012 targets. This target was lowered to 3 % of GDP for the 2018 targets. These targets reflect that SADC member states are worried about the level of the current account deficit as they perceive high and sustained current account deficits, beyond the set targets, to be a hindrance in the attainment of the achievement of regional integration and economic development of the region. In this regard, an analysis of the twin deficits hypothesis within the SADC context is particularly welcome as it provides useful information on the sustainability and existence of the twin deficits hypothesis.

Against this backround we proceed to present the current account historical progression for SADC member countries for the period 1980 to 2015 in Figure 3. For the purposes of convenience, to have a discernible picture of the current account dynamics, we computed five-year averages of the current account balances. For comparison purposes, we have included the current account movements for ASEAN countries, Asia and Sub-Saharan Africa.

Figure 3: Current Account Balancein SADC Countries, SSA, ASEAN & ASIA: (1980-2015)



Notes to Figure 3: the current account balance as a percentage of GDP is shown on the vertical axis while the five-year period averages from 1980 are shown on the horizontal axis. Annual time series data for the current account balance as a percentage of GDP were obtained from the IMF's World Development Indicators. For purposes of convenience in coming up with a discernible picture of the current account movements we calculated the five-year period averages from 1980 to 2015. The red horizontal bold line is meant to show the 3 % current account deficit target anchor for 2018 while the green horizontal bold line underneath it shows the 9 % current account deficit anchor for the 2008 and 2012 set in the macroeconomic convergence targets.

The overall representation is that SADC economies have experienced a bloating of the current account balance well beyond the 9 % target set by SADC for both 2008 and 2012 targets for a number of countries. It can be inferred, as well, from figure 3 that the majority of SADC economies have current account deficits which are lower than that for an average Sub-Saharan African country, for an average ASEAN nation, and an average country from Asia for the entire period under review. From 2003 onwards ASEAN and countries from Asia enjoyed positive balances on their current account balances yet the majority of SADC countries had reasonably high current account deficits. The crucial question is whether the worsening current account balances in most of SADC countries can be associated with rising budget deficits.

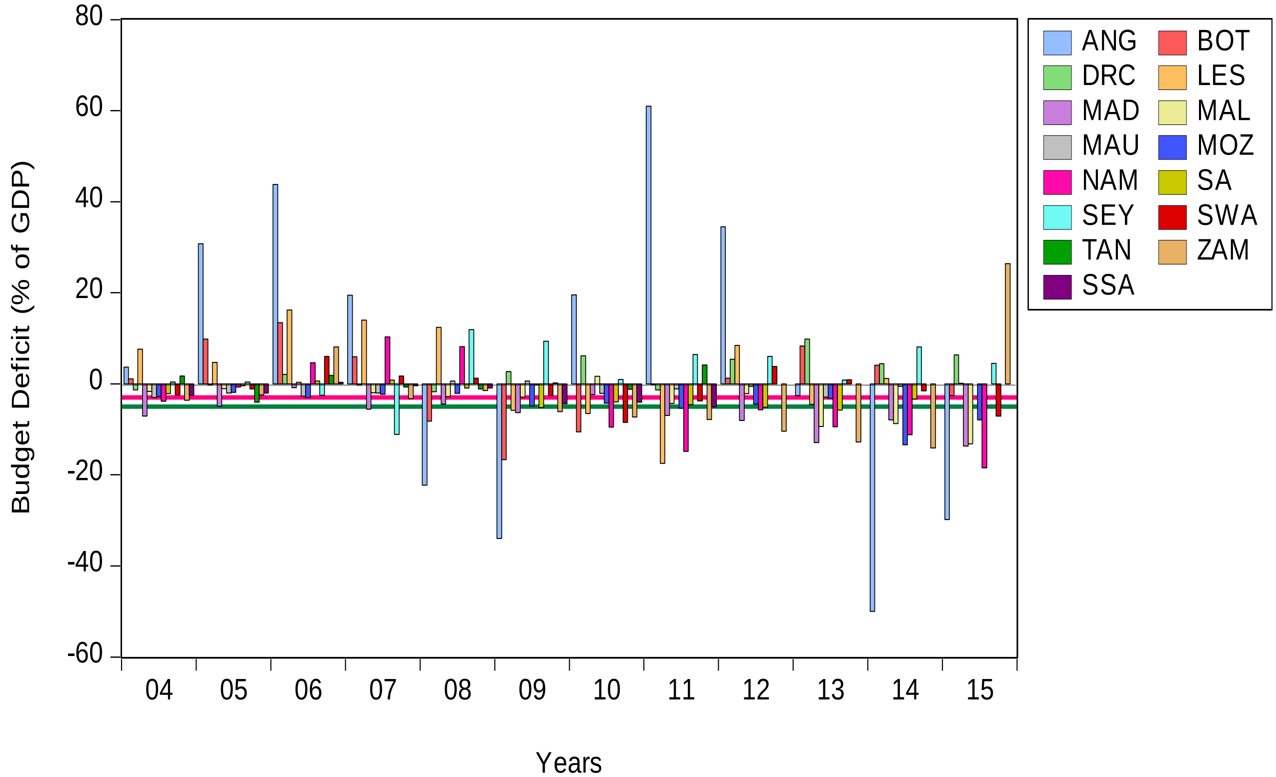
Current account dynamics are noticeably heterogeneous among SADC member states which can loosely be divided into two tiers: those with a rising current account surplus, such as Botswana, Namibia, and Mauritius, and those with high and deteriorating current account deficits, such as Mozambique, Seychelles, and Tanzania. The striking differences in current account movements among SADC economies, of late, can largely be explained by the differential impact on SADC economies and to a fall in international commodity prices, depending on the degree of dependence on export revenue. This explains why countries like Mozambique, Seychelles and Malawi have recorded high current account deficits of above 20 % (SADC, 2015).

The current account movement for countries like Mozambique and Seychelles is outstanding and deserves some attention. For Mozambique, the current account deficit as a percentage of GDP has been consistently high to the extent that Mozambique has not met the SADC macroeconomic convergence target of 9 % of GDP since the inception of SADC in 1992. Another notable economy which has experienced a widening of the current account deficit is Seychelles. Seychelles is a small developing island state in the Indian Ocean, with limited natural resources and essentially depending on imports for about 90 % of its consumer goods (SADC, 2015). This heavy dependence on imports for the majority of its essential goods renders the country vulnerable to world price shocks and that explains the perennial widening current account deficit of the country over the period under review.

The overall picture as regards the current account dynamics in SADC is that SADC economies have experienced high current account deficits which are not only beyond the 9 % macreconomic convergence target set by SADC but comparably higher to those from other Sub-Saharan African economies as well as ASEAN nations and countries from Asia. This trend warrants an analysis as to whether movements in the current account deficits for SADC economies is accounted for by movements in fiscal deficits, the so called “twin deficits hypothesis.”

We now give an overview of the budget deficit performance in SADC over the period under review. This is reflected in figure 4 which presents the fiscal balances for the fourteen SADC economies as well as that for Sub-Saharan Africa as a region for the period 2000 to 2015. This period was dictated by the availability of continuous time series data of the fourteen SADC countries.

Figure 4: Budget Deficits (% of GDP) in SADC



Notes to Figure 4. the budget deficit as a percentage of GDP data was computed from the total government revenue and total government expenditure data obtained from the IMF's World Development Indicators. Budget deficit as a percentage of GDP is presented on the vertical axis with time frame (in years) from 2000 to 2015 presented on the horizontal axis. The bold horizontal red line under the horizontal axis represents the 3 % budget deficit as a percentage of GDP threshold target set by SADC for the years 2018 onwards. The bold green horizontal line beneath the red bold line shows the 5 % budget deficit as a percentage of GDP for SADC economies set for the years 2008 and 2012.

Quite remarkably, the majority of SADC economies have reported declining budget deficits over the recent decade with a large number meeting the SADC budget deficit-to-GDP ratio target of 5% and 3 % for 2008 and 2012, respectively. Exceptions, however, are Seychelles and Namibia which have reported high budget deficits. The declining budget deficit to GDP ratio for the majority of SADC economies may largely be attributed to the success of the Highly Indebted Poor Countries (HIPC) initiative of the International Monetary Fund. It is, however, quite prominent that the budget deficits to GDP ratios for the majority of SADC member economies, though reasonably low and within the SADC set target are above those for an average Sub-Saharan African economy. This may raise some concern that such high budget deficits, compared to an average Sub-Saharan African economy may help drive movements in the widening current account deficits. It is therefore, imperative, to conduct an analysis of the twin deficits hypothesis in SADC so as to ascertain whether movements in the current account deficits can be accounted for by movements in budget deficits.

3.5 Conclusion

As an antecedent to our SADC empirical analysis of the twin deficits hypothesis in chapter 4, the public debt-economic growth relationship in chapter 5, and our single country analysis of the growth effects of budget deficits in chapter 6, this chapter has presented a historical progression of the current account balance, budget deficits, public debt and economic growth in SADC economies.

The general potrayal that has emerged in this chapter is that most SADC member countries have ballooning current account deficits which are not only worse than the SADC threshold but higher than an average country in Sub-Saharan Africa. Another notable attribute emerging from this chapter is that although the public debt to GDP ratios for most of SADC member economies has been declining in the recent few years they are fairly high compared to an average Sub-Saharan African country. The economic growth rates for most of SADC member countries, again, is not showing a favourable picture as they are subdued if one compares them with an average Sub-Saharan African country as well as ASEAN and countries from Asia. The budget deficit historical evolution could be said to be falling and within the SADC threshold for the past decades but they are still comparably high if one compares them with an average Sub-Saharan African economy.

The analysis in this chapter acts as background for an empirical assessment of the twin deficits hypothesis in chapter 4, the panel growth effects of public debt in chapter 5 and the single country time series analysis of the growth effects of budget deficits in South Africa, Madagascar and Lesotho in chapter 6.

CHAPTER 4

EMPIRICAL RESULTS ON THE TWIN DEFICITS HYPOTHESIS IN SADC: A PANEL DATA APPROACH

4.1 Introduction

Continuing from chapter 3, which gives an overview of the twin deficits hypothesis in SADC, this chapter conducts an empirical analysis of the twin deficits hypothesis among the fourteen SADC member states included in the panel. This is summarised that, the majority of SADC countries have widening current account deficits, which, for most countries, are well beyond the set SADC thresholds. An obvious question could be whether movements in the current account are driven by fiscal deficits. The policy implications relate to whether policies which address fiscal deficits can remedy the deteriorating current account deficits among the majority of SADC member countries. As important as this is for policy making, as we have noted earlier, we are not aware of a study which has analysed the twin deficits hypothesis within the SADC context so as to give appropriate policy recommendations which are SADC specific.

This chapter contributes to the literature in many ways. Firstly, while a number of studies on the twin deficits hypothesis, have been conducted within the context of Sub-Saharan Africa (Aloryito et al., 2016, Imoh and Ikechukwu, 2015), this study is the first attempt to analyse the co-movement between the budget deficit and the current account deficit within the SADC context. This study requires to draw policy recommendations which are SADC specific. To this extent we contribute to the gap in the empirical literature as we offer SADC-evidence based policy formulation which is critical for SADC countries to successfully harness the widening current account deficits thereby maintaining macro-economic stability in the region.

Secondly, this study contributes in terms of methodological approach by abstracting from the previous and current practice in the literature which relies sorely on the use of homogeneous panel regression techniques (see, for example, Imoh and Ikechukwu, 2015 and Aloryito, 2016), namely the system GMM approach which does not take into account any possibility for cross-sectional dependence.This study, however, augments the system GMM results with empirical findings from the baseline estimator-Pesaran (2006)'s Common Correlated Effects Mean Group Estimator (CCEMG) which has the superiority of addressing cross-sectional dependence in the data.

It is well established in the literature (Van Eyden, 2015, Van Eyden, 2011, Bara et al., 2016) that panel estimations, like ours, are riddled with estimation problems like heterogeneity, endogeneity and cross-sectional dependence. The system GMM and other homogeneous panel estimation techniques offer solutions to the problem of heterogeneity and parameter endogeneity but do not account for cross-sectional dependence. By augmenting the system GMM with the Common Correlated Mean Group Effects (CCEMG) thereby controlling for the cross-sectionally dependent errors we immensely contribute to the literature as we provide empirical evidence which is asymptotically unbiased and efficient.

Apart from relaxing the assumption of cross-sectional independence, the Common Correlated Effects Mean Group Estimator (CCEMG), like any other panel time series estimator, combines the cross-sectional dimension with the time-series dynamic interactions thereby utilising the best of both systems as it adds diversity to the analysis of the twin deficits hypothesis (Chiang and Kao, 2001). The analysis of the twin deficits hypothesis is still dominated by estimators developed for micro-datasets, with large N and small T(Eberhardt, 2012). Thus, this chapter adds to the literature by utilising a panel time series estimator (CCEMG), which is a novel development in the analysis of the twin deficits hypothesis.

The remainder of this chapter proceeds as follows: the chapter starts by presenting the theoretical framework within which the twin deficit hypothesis is analysed in section 4.2, which is then followed by section 4.3, where the model to be used in the chapter is specified. The sources of data and description of variables is conducted in section 4.4, while section 4.5 outlines the estimation strategy to be used in this chapter. The empirical findings with regards to the panel estimation of the twin deficit in the 14 SADC countries is presented in section 4.6. Finally, section 4.7 concludes the chapter.

4.2 Theoretical Framework

The analysis of the twin deficit hypothesis in the context of 14 SADC countries in this chapter is rooted in the intertemporal theory of the current account. As has been more fully detailed in chapter 2, the theoretical framework under which the analysis of the twin deficit hypothesis conducted in this chapter can be represented in equation (4.1):

$$(X - M) = (T - G) + (S - I), \qquad S(r) > 0, \qquad I(r) < 0, \qquad (4.1)$$

where, $(X - M)$ is the trade deficit or the current account deficit, $(T - G)$ is the fiscal balance and $(S - I)$ is the savings-investment differential. It can also be inferred that real domestic savings, (S) is postulated to have a positive relationship with the rate of interest, (r) and real domestic investment,(I), is negatively related to the rate of interest. Simply put, a current account deficit (foreign deficit) is a sum of the budget (public deficit) and the private savings deficit.

Thus an exogenous increase in the budget deficit can only be financed by an increase in domestic savings, a reduction in investment-(both of which are functions of the real interest rate)-and/ or an increase in the nation's current account deficit or inflow of net foreign savings. Net exports are inversely related to the real effective exchange rate. It can be concluded that a positive co-movement between budget deficits and the current account deficits (foreign deficit) exists. Thus high budget deficits give rise to high current account deficits. Given this exposition the next section spells out the empirical model to be used in the assessment of the twin deficit hypothesis in the subsequent sections of this chapter.

4.3 Model Specification

To analyse the twin deficit hypothesis among SADC economies, the study adopts the following model which is grounded in the intertemporal approach to the current account balance, first proposed by Sachs (1981) and Buiter (1981) and further extended by Obstfeld and Rogoff (1995). Loosely defined, a working definition of the intertemporal approach to the current account balance can be given as a recognition that saving and investment decisions of economic agents result from their forward-looking calculations on the basis of their expected values of various macroeconomic factors. Continuing with the essence of the intertemporal approach to the current account the empirical model the study adopts in the case of the Common Correlated Mean Group Estimator (CCEMG) is specified as:

$$ca_{it} = \alpha_i + \beta_{1i}bd_{it} + \beta_{2i}lgdp_{cap_{it}} + \beta_{3i}popg_{it} + \beta_{4i}exch_{it} + \mu_{it}, \qquad (4.2)$$

$$i = 1,2, \dots, N, t = 1,2, \dots, T$$

where the variables are as described earlier in this section, α_i is an individual effect. The parameter vector of the slope coefficients, $\beta_{i1} = (\beta_{i1}, \beta_{i2}, \beta_{i3}, \beta_{i4})$ is allowed to be heterogeneous across the fourteen SADC countries included in the panel. Following Pesaran and Yamagata (2010) the main focus of this study is on the estimation of the average value of ,namely $E(\beta_i) = \beta$ for us to be able to assess the overall effects of the covariates.

The parameter slope coefficient estimate of interest is, β_{1i} which is allowed to be heterogeneous across the fourteen SADC countries included in the panel. If β_{1i} is positive and statistically significant it gives testimony to the fact that the two deficits move together thereby supporting the twin deficits hypothesis. Alternatively, a negative and statistically significant β_{1i} suggests that the fiscal and external balances move in opposite directions thereby leading one to conclude that the twin divergence prevails in the data. The last possible empirical outcome is to have β_{1i} to be statistically not different from zero which lends support to the Ricardian hypothesis. The short-run adjustment to the long-run across countries is accommodated through the error term, μ_{it}. The error term, μ_{it}, is assumed to have the following multi-factor error structure:

$$\mu_{it} = \omega^{/} f_t + \varepsilon_{it} \qquad (4.3)$$

where f_t is a vector of unobserved common shocks, which can be stationary or non-stationary (Kapetanios et al., 2011). The individual specific errors, ε_{it}, are assumed to be distributed independently of both the regressors and the unobserved common factors and are allowed to be serially correlated over time and weakly dependent across countries (Cavalcanti et al., 2011).

4.4 Data Source and Description

The sample the study uses to examine the twin deficit hypothesis among the 14 SADC member countries covers annual data for the period 1980 to 2015 for an unbalanced panel with each country entering the panel at different dates, but still within the period 1980 to 2015. The fourteen SADC member countries are Angola, Botswana, the Democratic Republic of the Congo, Lesotho, Madagascar, Mozambique, Mauritius, Malawi, Namibia, South Africa, Swaziland, Seychelles, Tanzania and Zambia. Zimbabwe is excluded from the analysis due to data unavailability. Though almost all the SADC countries did not have a complete data set for the period 1980 to 2015 but Zimbabwe is an extreme case as it ended up having at best two entries on budget deficit and gross domestic product (GDP). Table 2 presents the data source, description and the expected sign for each variable as guided by economic theory.

Table 2: Data Source and Varaible Description

Variable	**Acronym**	**Description**	**Source**	**Expected Sign**
Current Account	Ca	Current account balance as a percentage of GDP	IMF's World Economic Outlook	The dependent variable
Budget deficit/Surplus	Bd	Cash surplus or deficit as a percentage of GDP	WDI and the IMF's World Economic Outlook. For other countries the budget deficit was computed as the difference between the government total revenue and government total expenditure obtained from the IMF's WEO expressed as a percentage of GDP	+/- Depending on whether the twin deficits hypothesis or twin divergence prevails
Exchange Rate	exch	Local currency per United States Dollar (USD$).	IMF's World Economic Outlook	+/-
Income Level	Lgdp-cap	Gross Domestic Product per capita expressed in logarithmic form	IMF's World Economic Outlook	+/-
Demographic factors	Pop_g	Annual Population growth expressed as a percentage	World Development Indicators	-/+

Notes to Table 2: the variables were taken over the period 1980 to 2015. The acronym IMF stands for the International Monetary Fund, WEO stands for the World Economic Outlook, and WDI stands for the World Development Indicators.

The key independent variable is the budget deficit as a percentage of GDP. As has been explained in detail in chapter 2, the relationship between budget deficit and the current account balance is not clear as it depends on whether consumers react in a Keynesian or Ricardian fashion or whether there is divergence between current and budget deficit. Following Kim and Roubini (2008) and Aloryito et al. (2016) the percentage change in GDP per capita expressed in logarithmic form is the key macro-economic variable that represents the broad economic performance. Real GDP growth is included to control for the cyclical components of the budget deficit. The effects of GDP growth rates on low frequency saving behaviour, and hence on the current account balance, are ambiguous and can best be empirically determined. The relationship depends, largely, on the implications of GDP growth rates, as perceived by households, for their permanent income. If current high growth rates of GDP were to be interpreted as signaling increases in permanent income, then saving rates as a proportion of current income could, according to the life cycle permanent income hypothesis, decline. Conversely, increases in GDP growth rates that are viewed as transitory would tend to raise saving rates thereby implying a positive relationship between the current account balance and the economic growth rates. Furthermore, these outcomes for aggregate household saving would also depend on the fraction of households that are liquidity constrained. High rates of GDP growth presumably also reflect high rates of productivity growth and, would, therefore, be expected to be associated with higher levels of investment and presumably, inflows of capital in search of higher rates of return. This therefore renders the net effect of these influences on current account balances to be obscure (Blanchard and Giavazzi, 2002).

The link between the foreign currency exchange rate ($exch$) and the current account balance is not obvious and can, as well, only be determined empirically. The Mundell-Fleming model predicts that an appreciation in the local currency relative to foreign currency can adversely affect a country's competitiveness position, leading to a worsening trade balance and, through this, a worsening current account balance. Further, to the extent that a real appreciation reflects productivity gains in manufacturing (the Balassa-Samuelson effect) as well as demand-side influences such as the use of capital inflows and comparatively high government spending to build up infrastructure, it has a negative effect on the propensity to save, and consequently on the current account balance. Furthermore, in the spirit of the consumption smoothing hypothesis, a temporary real appreciation of the local currency should result in an improvement of the current account (Herrmann & Jochem, 2005). According to this perspective, the current account acts as a buffer to smooth consumption in the face of shocks to national cash flow. For example, in response to a temporary positive term of trade shock or real effective exchange rate appreciation, an open economy would prefer to run a current account surplus and invest abroad rather than allow consumption on domestic goods (Chinn and Prasad, 2003, Nkuna and Kwalingana, 2010).

Lastly, our measure of demographic factors is the rate of population growth as an annual percentage. The demographic trends or structure of an economy has a direct impact on the current account movements. In a study of developing countries Chinn and Prasad (2003) found a statistically negative effect of the population growth on the current account balance. In another study Ivanova (2012) found a statistically positive relationship between population growth and the current account balance. The impact of the demographic structure of an economy on the current account balance depends on the saving behaviour of the population. This renders the impact of the demographic structure of an economy on the current account balance not obvious and to be ascertained empirically.

4.5 Estimation Technique

Since the interest of this study is analysis of the average response of the current account to movements in the budget deficit among SADC economies, within a panel time series framework, a number of estimation techniques seem appropriate to address this research interests. As we have highlighted earlier, there is significant cross-country dependence among the error term for the panel. Consideration has to be taken of the estimation technique that best addresses the statistical properties of the panel, like in our case.

When the underlying data contain cross-sectional dependence, traditional estimators such as ordinary least squares (OLS) are inefficient, and the estimated standard errors are biased (Donald, 2005) . The Mean Group (MG) and the pooled mean group (PMG) estimators designed by Pesaran and Smith (1995) and Pesaran et al. (1999), respectively, are potential candidates too. However, both of these estimation techniques are designed for non-stationary cointegrating panels. The data in this study, both the current account and budget deficit are stationary, and by definition, they can not be cointegrated. This, therefore renders the MG and the PMG inappropriate in this study given the stationarity properties of the data.

In view of the data generating properties of the series in this study, and considering its advanatges of addressing common asymmetric responses to aggregate shocks and robust to heterogeneous panels, the preferred estimation technique in this analysis is the Common Correlated Effects Mean Group Estimator (CCEMG) designed by Pesaran (2006). In the presence of heterogeneity in terms of their pooled resources and their sensitivity to aggregate fluctuations, any estimation technique that does not account for unobservable cross-country interdependence might produce misleading inference (Fuleky et al., 2013, Moscone and Tosetti, 2010). The Common Correlated Effects Mean Group Estimator (CCEMG) can address both strong as well as weak forms of cross-sectional dependence in panels (Pesaran, 2006).

Further to the findings of cross-sectional dependence, in this study, among SADC countries a number of researchers have also established the same. An example is Bittencourt et al. (2015) who noted that SADC is a diverse set of nations that differ substantially in terms of economic and institutional development, but they adopt similar macroeconomic policies, and are subject to common unobservable global shocks like the world financial crisis, oil price shocks and slow world economic growth that impact on them with different levels of magnitude. For example, South Africa was hit hardest by the 2008/2009 global financial crisis. The CCEMG estimator developed by Pesaran (2006) lends itself as the ideal estimation technique in this study as it addresses dependences across units caused by common factors in heterogeneous panels.

Another advantage of the panel time series approach is that the study uses annual data which are more informative as it allows for diverse relations between budget deficit and the current account to take place over time rather than taking averages to filter out business cycle fluctuations (Cavalcanti et al., 2011). Following Pesaran (2006), assuming a random coefficient model, $\beta_i = \beta + \psi_i$, where $\psi_i \sim IID(0, V_\psi)$, the study focuses on the estimation of the average value of β_i, namely β. To purge the regression of cross sectional dependence, the study makes use of the Common Correlated Effects Mean Group (CCEMG) estimator developed by Pesaran (2006). The CCEMG estimator allows units to respond differently to the common unobserved shocks while it augments the OLS regression with the cross-sectional averages of the dependent variable and the regressors which act as proxies for unobserved common factors (Cavalcanti et al., 2011) .

The study focuses on two variants of the Common Correlated Effects estimator: the Common Correlated Mean Group Estimator (CCEMG) and the Pooled Common Correlated Effects estimator (CCEP). The CCE Mean group Estimator (CCEMG) is an average of the individual CCE estimators, $\hat{b}_i$ of β_i, defined as:

$$\hat{b}_{CCEMG} = N^{-1} \sum_{i=1}^{N} \hat{b}_i \qquad (4.4)$$

Pesaran (2006) also developed the Pooled Common Correlated Effects (CCEP) to suit situations when efficient gains from pooling of observations over the cross countries can be achieved, when the individual slope coefficients are the same. Such a pooled estimator is called the Pooled Common Correlated Effects (CCEP).

As has been argued, the study prefers results from the Common Correlated Effects Mean Group (CCEMG) developed by Pesaran (2006) but the study presents results from the CCEP as well. The empirical evidence is presented in section 4.6 together with results from the system GMM estimator for robustness purposes.

Arellano and Bond (1991) proposed a first-difference GMM procedure that is more efficient than the Anderson and Hsaio (1982) estimator, while Ahn and Schmidt (1995) derived additional nonlinear moment restrictions not exploited by Arellano and Bond (1991) first-difference GMM estimator. The work of Ahn and Schmidt (1995) was extended by Arellano and Bover (1995) and Blundell and Bond (1998) to propose the system GMM estimator. The reader is referred to the original papers cited for a full account of the mechanics involved. Consistent with the research objectives in this chapter, this study utilises both the first difference GMM proposed by Arellano and Bond (1991) and the system GMM estimator proposed by Arellano and Bover (1995) and Blundell and Bond (1998). The dynamic panel estimation model takes the following form.

$$y_{it} - y_{i(t-q)} = \beta_{0i} + \vartheta y_{i(t-q)} + \beta X'_{it} + \xi_t + \eta_i + v_{it} \qquad (4.5)$$

All the parameters are as explained in equation 4.6 but the interest is to show how the difference GMM estimator addresses the proplem of unobservable country-specific effects. The individual effects (η_i) are assumed to be stochastic, implying that they might be correlated with the lagged dependent variable, $y_{i(t-q)}$, and this correlation does not vanish even if the number of individuals in the sample gets larger. The v_{it} are assumed to have finite momemts and in particular $\mathrm{E}(v_{it}) = \mathrm{E}(v_{it}v_{is}) = 0$ for $t \neq s$. Thus, we assume lack of serial correlation but not necessarily independence over time. All these endogeneity issues imply that least squares based inference estimators (OLS) may be inconsistent and biased upwards Blundell and Bond (1998). Following Arellano and Bond (1991), taking the first differences in equation 4.9 in order to eliminate country specific effects yields the following:

$$\Delta y_{it} = \vartheta \Delta y_{i(t-q)} + \Delta x'_{it}\beta + \xi_t + \Delta v_{it} \qquad (4.6)$$

In the above first differenced model, differencing removes the unobservable time-invariant specific effects as η_i has disappeared from the above transformed model. Assuming that the explanatory variables (x_{it}) are uncorrelated with the error term (v_{it}), the explanatory variables may be correlated with earlier errors $(v_{i(t-q)})$, explanatory variables lagged once or more may be used as valid instruments for current changes in the dependent variable. Two diagnostic tests are perfomed on this estimation technique one being the Sargan test for overidentifying restrictions while the other is the test for serial correlation of order two.

4.6 Empirical Results on the Twin Deficits Hypothesis in SADC:

This section presents the empirical findings on the twin deficits hypothesis in SADC over the period 1980 to 2015. We first present our pre-estimtion tests in both the Common Correlated Effects Mean Group

Estimation technique as well as for the system GMM estimation approach before the panel estimation results for both sets of empirical evidence are then discussed.

4.6.1 Pre-Estimation Tests Evidence from the Common Correlated Effects Mean Group (CCEMG) Approach

We present some initial descriptive inspection of the data before we use it for modelling and inference. This is crucial as it gives us an insight into the relationship between the data and may, as well, uncover some great anomaly in our series. Such information is essential for us as it gives some possible outliers in the data. We start by looking at the descriptive statistics as presented in Table 3.

Table 3: Descriptive Statistics (CCE Approach) in SADC: 1980-2015

	Current Account	Budget Deficit	Exchange Rate	Log GDP per Capita	Population Growth
Mean	-5.84	-1.35	159.14	4.61	2.19
Median	-5.69	-1.24	7.56	4.59	2.55
Maximum	25.58	60.96	2933.50	5.96	4.34
Minimum	-44.73	-50.00	0.06	3.47	-2.62
Std. Dev.	10.95	8.18	454.46	0.63	1.02
Skewness	-0.44	1.43	3.68	0.21	-0.72
Kurtosis	4.17	22.19	16.50	2.23	3.62
Observations	311	311	311	311	311

Notes to Table 3: data are from the IMF's World Economic Outlook and the World Bank World Development Indicators for the period 1980 to 2015

The descriptive statistics show interesting variations among SADC economies on the current account budget deficit movements. While the average current account balance for the fourteen SADC countries included in the panel for the period 1980 to 2015 was a deficit of 5.7 % of GDP, the highest surplus on the current account balance as a ratio to GDP was 25.6 obtained by Angola and the lowest deficit on the current account, from Mozambique was 44.7 % of GDP. While the average of 5.6 % is within the set SADC macroeconomic convergence target of 9 % but the lowest current account deficit of 44.7 % is completely out of the macroeconomic target.

Considering the fiscal balance, the mean fiscal balance as a percentage of GDP is a deficit on the fiscal balance of 1.35%, with the highest fiscal surplus of 60.9%, and the highest deficit on the fiscal balance of 50%. Interestingly, Angola posted both the highest surplus and the lowest deficit on the fiscal balance over the period under review. This may imply that Angola’s performance on the fiscal balance has not been stable and has fluctuated markedly from surplus to negative. The mean fiscal deficit of 1.35 is well below the set SADC target of 5 % may be influenced by recent developments among SADC economies where most countries have managed to contain their fiscal balances within the set targets yet the opposite was true in the 1980s and early 1990s. Like the current account balance and other variables in the analysis, the fiscal balance, exhibits evidence of non-normality of residuals. This is a confirmation of the need to utilise estimation techniques that address issues of cross-sectional dependence, autocorrelation and heterogeneity. Having examined the descriptive statistics between the variables, the next section presents the correlation matrix.

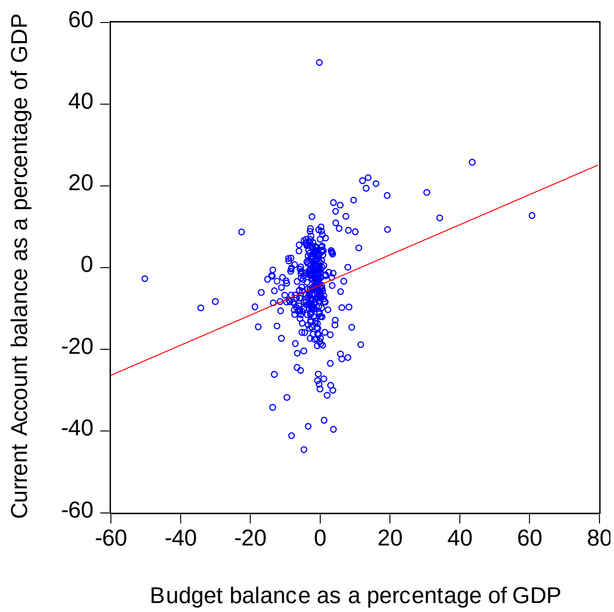
Table 4: Correlation Matrix in SADC: 1980-2015

	Current Account Balance	Budget Deficit	Log GDP per capita	Exchange Rate	Population Growth
Current Account Balance	1.000				
Budget Deficit	0.286	1.000			
GDP per capita	0.037	-0.098	1.000		
Exchange Rate	-0.044	-0.145	0.409	1.000	
Population Growth	-0.022	-0.063	0.149	0.244	1.000

Notes to Table 4: data is obtained from the International Monetary Fund’s World Economic Outlook as well as the World Bank’s World Development Indicators for the period 1980 to 2015. P-values are in parenthesis.

As shown in table 4, all the correlation coefficients are fairly low hence there are no serious concerns of perfect multicolinearity. Having examined the correlation matrix, we proceed to analyse the preliminary relationship between the current account and the budget deficit among SADC economies by plotting a graphical relationship between the data. Illustrating the central positive co-movement between budget deficit and the current account, Figure 5 and Figure 6 present the current account deficit/surplus as a percentage of GDP on the vertical axis with the budget deficit/surplus as a percentage of GDP presented on the horizontal axis. In Figure 5, each dot stands for the observation for each particular country in a specific year. Each country enters with multiple dots depending on the observations for each country over the period 1980 to 2015. Figure 5 reveals that high levels of the current account balance are associated with elevated levels of the budget deficit. This is another preliminary suggestion that the two twins (current account balance and the budget balance) are moving together rather than diverging, thereby providing some informal preliminary evidence in favour of the twin deficit hypothesis. This positive relationship accords with the foundings of Aloryito et al. (2016) in a recent paper on the twin deficits hypothesis analysis of Sub-Saharan Africa.

Figure 5: The Relationship between Current Account and Budget Deficit in SADC: 1980-2015

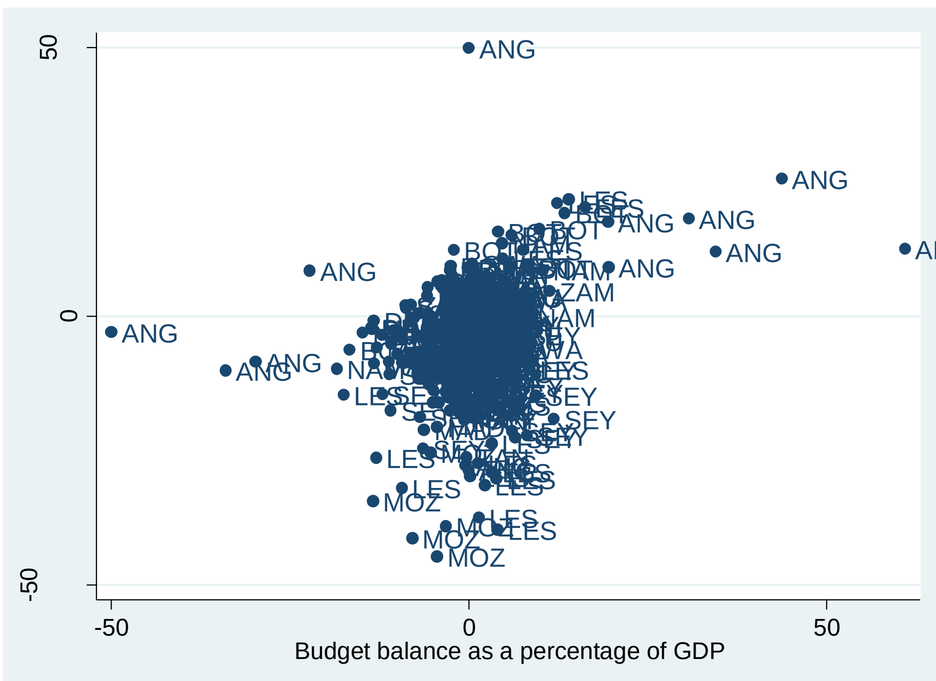


Notes to Figure 5. The variable on the vertical axis is the current account balance as a percentage of GDP for an unbalanced panel from 1980 to 2015. The variable on the horizontal axis is the budget balance as a percentage of GDP. The sample is restricted to the 14 SADC countries included in the analysis. The data are sourced from the IMF's World Economic Outlook and the World Development Indicators.

The current account – budget balance relationship for each of the 14 SADC countries included in the analysis is represented in Figure 6. Labels identify observations for each country. The more the number of observations per country, the more the number of labels appearing per country. Notably, Angola has enjoyed a surplus on the current account balance which has been associated with a surplus on its budget balance for the majority of the time under analysis. A country like Mozambique, for example, has experienced current account deficits which are associated with deficits on its fiscal balances. The bulk of the other countries, namely, Lesotho, Seychelles, Zambia, and Botwsana have been running deficits on their current account balances together with deficits on their budget balances over the period under review.

The data points to a positive relationship between external balances and fiscal balances. Current account surpluses are associated with surpluses on the fiscal balance. This points to some positive co-movement between current account and fiscal balances, thereby providing preliminary evidence in support of the twin deficits hypothesis.

Figure 6: Country Current Account-Budget Balance Relationship



Notes to Figure 6: data are obtained from the International Monetary Fund's World Economic Outlook and the World Bank's World Development Indicators for the period 1980 to 2015. The current account balance as a percentage of GDP is plotted on the vertical axis with the budget balance as a percentage of GDP on the horizontal axis. Each country's observation enters the scatter plot as a label with the name of the country, as abbreviated, next to the country dot.

We tested whether there was cross-sectional dependence of the error term before proceeding to ascertain of the order of integration of the variables. This was instrumental in guiding us on the unit root tests to use as well as the estimation technique we utilised in our analysis of the twin deficit hypothesis in the 14 SADC countries. To achieve this objective we utilise the Breusch and Pagan (1980) LM Test, which is used when T is greater than N, for cross-sectional dependence of the error term. We could have utilised the recent Pesaran (2007) cross-sectional dependence test, as well, but this was not possible as this test is designed for balanced panels. The null of the Breusch Pagan test is that the cross-sections are independent implying that there is no dependence of the error term. Failure to reject the null means the problems of cross-sectional dependence of the error term are not of concern. Our Breusch Pagan test for cross-sectional dependence had an LM test of 428.02 with a p-value of 0.000 thereby providing ample statistical evidence not to accept the null of no cross-sectional dependence.

We have argued earlier in this section that cross-sectional dependence among SADC countries is justified on a number of grounds. Firstly, as we have pointed out earlier, Seleteng and Motelle (2015) argued that SADC countries, by merely belonging to one economic regional grouping, strive to pursue similar macroeconomic policies which justifies the existence of between-country dependence. Secondly, Van Eyden (2011) pointed out that SADC countries are subject to common global shocks like the global financial crisis, fluctuation of global commodity prices and to some extent adverse weather conditions that may affect a number of SADC countries. More specific to the current account dynamics is the fact that SADC countries are engaged in a variety of trade liberalisation initiatives like the European Union (Imoh and Ikechukwu)-South Africa Free Trade Agreement (FTA) and the EU's "Everything but Arms" (EBA) initiative to do away with trade barriers among SADC countries (Lewis et al., 2003). The presence of cross-sectional dependence justifies our use of the Common Correlated Effects Mean Group (CCEMG) which addresses the problem of cross-sectional dependence.

To begin, in order to correctly analyse the co-movement between the external and fiscal balances, we first assessed the stochastic properties of the variables. The underlying stochastic properties of the variables are instrumental in deciding the appropriate estimation technique to be used. If, for example, the variables are non-stationary then cointegration methods are to be adopted in order to assess as to whether a long-run relationship between the current account and the budget deficit controlled on other variables exist.

Also, the underlying stochastic nature of the variables allows us to establish whether the current account or the budget deficit is sustainable. Trehan and Walsh (1991) established that the absence of a unit root in the external balance or the fiscal balance implies that the current account and the budget balance, respectively, are not violating the present value borrowing constraint, leading us to conclude that the current account or the budget balance is sustainable.

Since we have confirmed in the previous section that the cross-sections are inter-dependent among the error term in SADC countries, our choice of the unit root tests have to accommodate cross-sectional dependence. In this spirit, we employ the Im et al. (2003), referred to as the IPS, and the Fisher (1932), ADF-Fisher Chi-square Test and PP-Fisher Chi-square tests as these unit root tests accommodate cross-sectional dependence to some extent (Maddala and Wu, 1999, Baltagi, 2013). Table 5 presents the results of our unit root tests. The three estimation techniques all confirm that the current account balance, the fiscal balance as a percentage of GDP and the population growth rate follow a stationary process. Alternatively, the three unit root tests used all confirm of the presence of a unit root in the GDP per capita and the exchange rate as they become stationary after first differencing.

Table 5: Panel Unit Root Tests

	Current Account Balance	Budget Balance	GDP per capita	Population Growth	Exchange Rate
ADF-Fisher Chisquare					
Levels					
t-statistic	53.167***	87.935***	28.267	489.12***	2.741
First Difference					
t-stat			68.48***		71.72***
PP-Fisher Chi-square Test					
Levels					
t-stat	0.404*	43.49*	36.62	71.03***	19.18
First Difference					
t-stat			99.49***		
IPS Test					
Levels					
t-stat	2.599***	2.58***	0.002	162.57***	4.01
First Difference					
t-stat			3.723***		3.96***

Notes to Table 5: ***, **,* denotes significence at 1, 5, and 10 % respectively. T-statistics are presented.

Overall, our unit root tests confirm that our dependent variable, the current account balance as a percentage of GDP and our explanatory variable of interest, the budget balance as a percentage of GDP follow a stationary process. Given that our variables of interest are generated by a stationary process then by definition such variables can not be cointegrated (Baltagi, 2013; Maddala and Wu, 1999). We are therefore, limited to the short-run analysis.

Cointegration exist if a linear combination of non-stationary variables follow a stationary process.

4.6.2 Pre-Estimation Tests from the System GMM Approach

In addition, we also averaged the data as a complement to annual data and this allowed us to use estimation techniques that are designed for small T and large N particularly the system GMM panel estimation approach. Because the inclusion of variables is based on a stepwise fashion that rely on how variables behave in the model, a mixture of variables was used. Under the system GMM approach, the dependent variable still remains the current account deficit/surplus (ca) and our explanatory variable of interest, budget deficit/surplus as a percentage of GDP(bd), and population growth rate are as explained in the section on the CCEMG estimator.

Trade openness is also added in the system GMM technique in order to capture the influence of the external environment. The most preferred measure of trade openness which is universally acceptable in the literature is the trade share $(\frac{exports+imports}{GDP})$ but we could not make use of this because of data problems. However, following Mohr (2011) our measure of openness $(open)$ is the growth in imports. Trade openness gives valuable insight into a country's macroeconomic policies that could be relevant for the long-term current account movements. Trade openness could be symptomatic of traits such as liberalised international trade, receptiveness of technology transfers, and ability to service external debt through export earnings. Thus, countries with more exposure to trade tend to be relatively more attractive to foreign capital (Chinn and Prasad, 2003, Nkuna and Kwalingana, 2010). We therefore expect higher levels of openness to be associated with a widening of the current account deficit.

Our measure of the macroeconomic conditions is the annual percentage growth rate in gross domestic product. We use the dependency ratio of both the young (below 16 years) and the old (above 65) as a measure of the age-sex dependence ratio. Because of the averaging transformation, we present a different table of summary statistics for data used in the system GMM technique.

Table 6: Descriptive Statistics (System GMMApproach) in SADC: 1980-2015

	Current Account Balance	Budget Deficit	Trade Openness	Economic Growth Rate	Population Growth	Dependency Ratio
Mean	-4.45067	1.35302	6.42403	2023.57	2.21957	6.62373
Median	-3.44621	-1.13449	4.93020	4.6692	2.48645	5.85049
Maximum	15.57860	32.10598	26.9774	64722.25	4.070264	12.06692
Minimum	-33.48683	-10.50869	-18.65360	3.459647	0.201540	4.682152
Std. Dev	9.294896	9.590023	7.72527	10280.53	0.944936	1.847853
Skewness	-0.677086	2.181149	0.317548	5.158750	-0.308468	1.641709
Kurtosis	4.05551	6.863527	4.403010	28.76886	1.941877	4.776518
Observations	74	74	74	74	74	74

The total number of observations has dropped from 311 to 74 which is a result of averaging. Such data transformation smoothes out any potential cyclical movements that may influence the current account dynamics. After averaging, it was ideally expected that each of the fourteen SADC countries included in the analysis would enter into the panel with seven (7) observations to make a total of ninety-eight (98) observations in all. However, owing to the lack of a full and continuous data set for all the variables for all countries over the period under review, this is not the case. Whilst some countries like Mauritius, South Africa and Swaziland enter the panel with the expected seven observations, others like Angola, Malawi and Zambia, for example, entered the panel with only three observations thereby rendering our panel highly unbalanced.

4.6.3 Panel Regression Evidence

Our estimation results for the Common Correlated Mean Group (CCEMG) estimator and the System GMM estimator are presented in Table 7 and Table 8, respectively. The dependent variable in each case is the current account balance as a percentage of GDP(ca). Our regressor of interest is the budget deficit/surplus as a percentage of GDP(bd). We may have to restate at this moment that the objective in this chapter is to analyse the relationship between budget deficit and the current account movement. As has been explained before, a positive and significant association between budget deficit and the current account balance provide evidence in support of the twin deficit hypothesis, whereas a negative and significant co-movement between budget deficit and the current account balance lends support for the twin divergence phenomenon. Lastly, an insignificant relationship between the two suggests evidence of the Ricardian hypothesis.

In both cases, our regressor of interest, the budget deficit/surplus as a percentage of GDP (bd) is controlled by two common control variables, namely population growth rate (pop_g) and the exchange rate($exch$). In addition to the two the system GMM estimator has trade openness, economic growth rate and government consumption which enter the regression in logarythimic form. For the Common Correlated Effect Mean Group estimator the additional control variable is GDP per capita.

We tested for country and time dummies in both estimators. The p-value for our test of time dummies was 0.828 and 0.465 for the CCEMG and System GMMestimators, respectively. In both cases we found no evidence to reject the null that time dummies are irrelevant. Our results imply that the impact of budget deficit-controlled with other variables- on the current account balance is not influenced by time and hence is comparable over time. In other words, failure to reject the null that time dummies are jointly equal to zero leaves us with no justification to include time dummies in our regression as their inclusion would have caused unnecessary overfitting of the model.

This empirical reality is somewhat surprising since one might have expected, for example, the oil price shocks and the economic downturn following the Iranian revolution of 1978 to 1979; the Iran-Irag War of 1980; the first Persian Gulf War in 1990 to 1991, and the oil price spike of 2007/2008 (Hamilton, 2013) to have influenced current account movements among SADC economies. One would also have expected that the 2007/2008 world financial crisis would have influenced current account movements (Rangelova, 2014, Haltmaier, 2014, Joong Shik et al., 2016), but this was not reflected in the data. We, therefore, excluded time dummies in both of our regression.

We also tested for the significance of the country dummies. Our results provide overwhelming evidence to reject the null that country dummies are jointly equivalent to zero. This suggest that there are significant country specific characteristics that confounds the relationship between budget deficit and the current account deficit. For us to get the true relationship between the fiscal balance and the external balance that is not influenced by the country specific features we therefore included country dummies in our regression. Evidence in favour of the significance of country dummies conforms to our Ramsey Reset test suggesting that there are some omitted variables in the regression that are seated in the error term. Inclusion of the country dummies, therefore resolves this problem.

Also, we tested for cross sectional independence using the Breusch and Pagan (1980) Lagrange Multiplier test for cross-sectional dependence. The p-value is 0.000, thereby providing evidence of cross country inter-dependence. In statistical sense, these results imply that there is evidence of spillover mechanism among SADC economies.

We included a time trend in our CCEMG estimator as a deterministic regressor to absorb non-stationary and time dependency of particular explanatory variables. The inclusion of the trend component in this respect allows us to partial out the effect of the exchange rate and GDP per capita on the current account which appear to be generated by a unit root while controlling for their time variance. The relevance of this trend component in absorbing such time dependent noise is evaluated based on the usual tests for statistical significance. The time trend component is highly statistically significant at the 5 % level of significance thereby confirming its relevance in absorbing time dependent noise in the data.

We turn to the results (as presented in Table 7 and Table 8) concerning the purpose of our study- an analysis of the relationship between fiscal balances and external balances. Both the CCEMG and the system GMM estimators confirm the existence of a positive and statistically significant relationship between budget and the current account balance, thereby providing evidence in favour of the twin deficits hypothesis.

The results from the Common Correlated Effects Mean Group (CCEMG) reveal that an increase in the budget deficit as a ratio to GDP of 1 % is associated with a widening of the current account balance by 0.28 %. For the CCEP, budget deficit as a percentage of GDP is highly statistically significant at the 5 % level of significance but all the control variables lose their statistical significance. After correcting for cross-sectional dependence, as is reflected in the results for the CCEMG, all the control variables become statistically significant in explaining movements in the current account balance.

The system GMM results show a positive and statistically significant co-movement between the fiscal deficit and the current account balance. An improvement in the fiscal balance of 1 % is associated with an narrowing in the current account balance of 0.52 %. The Pooled OLS and the fixed effects results all confirm of the existence of a positive and statistically significant relationship between the fiscal and the current account balance. The reliability of the system GMM results, however, depends on two fundamental conditions. The first is that there should not be second order serial correlation, and second, that the instruments used should not be overidentified. Our results (as presented in Table 8) reveal that there is first order serial correlation (with a p-value of 0.029) but there is no statistical evidence of the existence of second order serial correlation (with a p-value of 0.27). The presence of first order serial correlation without second order serial correlation is an ideal condition as it confirms that the instruments used are not only valid but are also relevant. Our Sargan test (with a p-value of 0.27) leaves us with no statistical evidence to reject the null that the instruments used are not valid. We therefore take our results from the system GMM as reliable.

The positive relationship between budget deficits and the current account balance (the twin deficits hypothesis) is consistent with the findings of a number of empirical studies. In a recent paper, Aloryito et al. (2016), employing a system GMM approach for 41 countries in Sub-Saharan Africa countries for the period 2000 to 2012 found a positive and statistically significant relationship between budget deficit and the current account balance. The authors found that a 1 unit improvement in the budget deficit leads to an improvement in the current account deficit by 35 %. Ahmad et al. (2015), in a study of nine African countries using the threshold cointegration approach employing quarterly data over the period 1980 to

2009 found a positive and statistically significant relationship between fiscal balance and external balances for six out of the nine countries included in the study. In a different study, Ahmad and Aworinde (2015) analysed the co-movement between budget deficits and the external balances in 12 African countries by employing the ARDL approach using quarterly data. Their results revealed a positive and statistically significant relationship between budget deficit and the current account balance for eight out of the twelve countries with the other four countries exhibiting a negative relationship- evidence of the twin divergence phenomenon. For Sub Saharan countries, Imoh and Ikechukwu (2015) analysed the twin deficits hypothesis employing the system GMM estinmation technique and established that a one percentage improvement in the fiscal balance lead to an improvement of the current account balance by 27 %. These results are similar to our findings in both confrming the twin deficits hypothesis and in the economic importance of the impact of budget deficits on the current account deficit.

Table 7: Panel Time Series Results in SADC: 1980-2015

Dependent variable is	Current Account Balance (ca)	
	(2)	**(3)**
	CCE Mean Group	**CCEP**
Budget Deficit	0.276**	0.426***
	(0.133)	(0.0850)
GDP per capita	104.475**	12.474
	(50.014)	(9.369)
Exchange Rate	0.640**	-0.0028
	(0.294)	(0.0058)
Population Growth	-10.654*	-0.089
	(5.535)	(0.777)
Constant	-396.47	1.922
Wald chi(2)	9.37	8.07
	(0.053)	(0.000)
Time Dummies	Yes	Yes
Number of groups	14	14
Number of observations	311	311

Notes to Table 7: ***, **, and * signify significance at 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses for the regressors

Table 8: System GMM Estimation Results

Dependent Variable is Current Acount balance (ca)	**(1)** Pooled OLS	**(2)** Fixed Effects	**(3)** System GMM
Lagged Current Account Balance			0.1814 *
			(0.0754)
Budget Deficit	0.447 ***	0.448 ***	0.517 ***
	(0.116)	(0.1164)	(0.1708)
Economic growth rate	-0.684	**-0.684**	-0.76 *
	(0.4280)	(0.428)	(0.321)
Trade Openness	0.234	0.234	0.24 *
	(0.1722)	(0.1722)	(0.1339)
Population growth rate	-0.448	-0.0449	**1.896**
	(1.246)	(1.246)	(1.205)
Governement consumption	-0.1311	-0.131	0.1635
	(0.144)	(0.144)	(0.149)
Constant	-0.895	-0.896	-8.9
Breusch-Pagan Test	**2.67**		
	(0.102)		
Pesaran's CSD	1.442		
	(0.1493)		
Ramsey Reset test	0.16		
	(0.924)		
Time fixed effects	No	No	
Country fixed effects	No	Yes	
Waldi chi(2)	3.13	3.13	40.35
	(0.0134)	(0.0134**)**	(0.0000)
AR(1) test			-2.1883
			(0.0286)
AR (2) test			-1.1142
			(.0.265)
Sargan test			66.399
			(0.2660)
Number of countries	14	14	14
Number of observations	74	74	60

Notes to Table 8: ***, **, and * signify significance at 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses for the regressors. P-values are in parentheses for Waldi Chi (2), Breusch-Pagan test, Ramsey-Reset test, AR (1) and AR (2), Sargan test, and Pesaran CD test. Data are from the IMF's World Economic Outlook and the World Bank World Development Indicators

4.7 Conclusion

This chapter provides empirical evidence on the co-movement between budget deficits and the current account deficit- the so-called twin deficits hypothesis- in fourteen SADC member countries. To attain this objective we augmented results from the system GMM- a panel estimation technique designed for large N and small T- with results from the Common Correlated Mean Group Estimator (CCEMG) - a panel time series estimator. The objective of the study in this chapter is to analyse whether the widening current account deficits for most of SADC member countries, in most cases way beyond the SADC set target can be explained by movements in the fiscal balances. The study intends to provide policy implications that are SADC specific.

This chapter contributes to the literature in many respects. Firstly, we are not aware of any study that has investigated the twin deficits hypothesis within a SADC framework and we, in this chapter, fill in this empirical gap in the literature. Secondly, and equally important, we abstract from the usual practice in the literature of relying heavily on the system GMM estimator in arriving at the empirical findings. While the system GMM addresses the problem of heterogeneity and endogeneity but it does not account for cross-sectional dependence, which is a likely problem in panel estimation. By augmenting results from the system GMM by employing the Common Correlated Mean Group Estimator which accounts for cross-sectional dependence, we contribute meaningfully to the literature as we obtain results which are unbiased and efficient. Use of the CCEMG is not only appealing on account of addressing cross-sectional dependence but, like any panel time series estimator, combines the cross-sectional dimensions and the time-series dimension as well, thereby adding diversity to the analysis.

The results in this chapter show that both the system GMM and the CCEMG are confirmatory to the effect that there is a positive and statistically significant relationship between the budget deficits and the current account deficits. The implications are that a widening fiscal deficit leads to a worsening of the current account deficits. The two deficits, in other words move together and this confirms of the existence of the Keynesian twin deficits hypothesis. The message this gives to the policy makers is that harnessing the budget deficits in SADC helps to improve the widening current account deficits.

CHAPTER 5:

EMPIRICAL RESULTS ON THE RELATIONSHIP BETWEEN PUBLIC DEBT AND ECONOMIC GROWTH IN SADC: A PANEL DATA APPROACH.

5.1 Introduction

Interest on assessing the empirical underpinings between public debt and economic growth rose substantially ever since Reinhart and Rogoff (2010) published their seminal paper entitled “Growth in a Time of Debt” where they claimed that high levels of public debt to GDP ratios-especially those which are 90 % and above- are associated with stagnating economic growth, –see for example, (Herndon et al., 2014, Gómez-Puig and Sosvilla-Rivero, 2015, Wiley, 2013, Chen et al., 2016, Égert, 2015, Kumar and Woo, 2010). A quest to understand whether public debt enhances or retards subsequent economic growth is particularly relevant for developing countries. Sustainable levels of economic growth are a priority for developing economies as this could help to reduce poverty, unemployment and many other undesirable socio-economic features that characterise developing economies. Yet, as paramount as this field of study is, the growth effects of public debt in SADC member countries, as a region, has not received necessary scholarly attention.

Focussing on the SADC region, as has been highlighted in chapter 1, the urgent need for infrastructure development, investment in human capital and technological advancement as engines of sustainable economic growth among SADC countries can not be overemphasised. However, as desirable as these virtues are for the future development of SADC, an ambitious pursuit of high investment in physical and human infrastructure may culminate in high public expenditure well above public revenue which may have considerable impact on the increase in public debt of these countries. Given the fact that most, if not all, SADC member countries have a demand shortfall and an infrastructure deficiency, there is an inevitable trade-off between building up the public capital stock thereby laying the foundations for future sustainable growth and containing public debt to low levels but attaining low levels of economic growth. Lopes (2016) noted that 20 % of Africa's international infrastructure networks are impassable, with flight connectivity being the lowest in the world.

Given this policy dilemma, consideration of the optimal choice to make constitutes one of the contemporary policy dilemmas facing, not only SADC member states, but the entire Sub-Saharan Africa.

This chapter presents the panel empirical evidence on the growth effects of public debt on SADC member countries based on evidence from various panel estimation approaches. Considering that growth regressions are riddled with many estimation drawbacks, the study relies on several panel estimation approaches to circumvent any methodological flaws (Durlauf et al., 2005, Hauk and Wacziarg, 2009). For robustness purposes, the study relies on both macro panel estimation approaches- known in the literature as panel time series estimation techniques-, as well as micro panel estimation approaches- which are appropriate for large N and small T.

Empirical panel growth econometric literature provides three outstanding approaches to the analysis of public debt on subsequent economic growth. The first approach is to use panel time series approaches which make use of the long time spans that adds time diversity to the analysis. To this end, one can make use of the Dynamic Ordinary Least Squares (DOLS) estimator:; the Fully Modified Ordinary Least Squeares (FMOLS) estimator:; the Common Correlated Effects Model (CCEM) estimator, as adopted by Cavalcanti et al. (2011):; the Meam Group (MG) and the Pooled Mean Group (PMG) estimator. The preferred estimator in this study for the panel-time series framework is the DOLS augmented by the FMOLS estimator for robustness purposes. The study discriminates in favour of these panel estimation techniques (DOLS, and FMOLS) due their small sample properties, that they address endogeneity and, lastly that they are most appropriate for nonstationary cointegrating panels.

The other type of panel growth econometric technique which is widely employed in the literature is to make use of estimation techniques which are designed for a large number of cross-sections and a short time frame. These are the traditional fixed and random effects estimators and the Generalised Methods of Moments (system GMM and difference GMM). These techniques can be used by making use of initial values of public debt and other control variables (Fincke and Greiner, 2015, Woo and Kumar, 2015) or the other type using the system GMM estimator from using three, five or ten-year averages of the variables used in the panel. For purposes of robustness we provide empirical evidence by adopting the system GMM from both the use of initial values and the use of five-year averages.

Relying on the above panel estimation techniques the study obtains contradictory results. Whereas, the DOLS and the System GMM when using initial values of public debt-to-GDP ratios are confirmatory in providing evidence in support of the growth enhancing role of public debt, the use of five-year averages-robust to alternative specifications, provides evidence to the contrary. This creates some dilemma as to as to whether public debt has a negative or positive impact on economic growth that is supported by the data. For reasons that will be provided later in this chapter, the study, discriminates in favour of the DOLS results and conclude that public debt has growth stimulating effect on long run economic growth. The use of three year averages turned out to be positive but not statistically signignificant prompting us to conclude that public debt and any other fiscal policy counter cyclical measures may have a delayed effect on economic growth. The study also further experimented on non-linearities of public debt on economic growth and established that debt has a non-linear effect on economic growth. The analysis of the channels through which debt promotes growth provides evidence that debt is growth enhancing when channeled through investment in physical infrastructure.

This chapter provides a number of contributions to the literature both methodologically and empirically. The first remarkable contribution that this chapter provides is empirical. At the time of writing, we are not aware of any study that has analysed the growth effects of public debt in a panel of SADC countries; the non-linearities in the manner in which public debt correlates with economic growth; the analysis of the public debt-physical infrastructure interaction channel through which public debt enhances economic growth; and the public debt-human capital development interaction through channel through which public debt impacts on economic growth. This chapter contributes meaningfully to the literature by analysing the public debt-physical infrastructure and public debt-human capital investment channels through which public debt growth is propagating for SADC member countries- information that is instructive on SADC member countries if they are to make the best out of public debt as well as not to overly rely on excessive public debt . Secondly, by relying on several panel estimation approaches, the study hopes to provide empirical results which are robust to different estimation approaches that, we hope, has important implications on the understanding of the public debt-growth process in SADC. Yet the major failing of previous panel growth studies is that researchers are heavily reliant on a single panel estimation approach and then they carry out inference as if that model has correctly generated the data (Durlauf et al., 2005). Doing so ignores the fundamental model specification uncertainty that is inherent in any growth regression. Thirdly, the study also employs panel time series estimation approaches which take advantage of the flexibility and dynamic public debt-economic growth interactions that go with time series modelling as well as take advantage of the diversity from the panel of SADC economies (Burdisso and Sangíacomo, 2016).

The remaining part of this chapter proceeds as follows: section 5.2 documants some stylised facts on the public debt economic growth-nexus in SADC, while section 5.3 presents the estimation results from the panel time series estimation techniques by making use of high frequency data. The estimation results from the macro-panel evidence which makes use of low frequency data are presented in section 5.4. Finally, section 5.5 concludes the study's empirical evidence on the growth effects of public debt in the fourteen SADC member states included in the analysis.

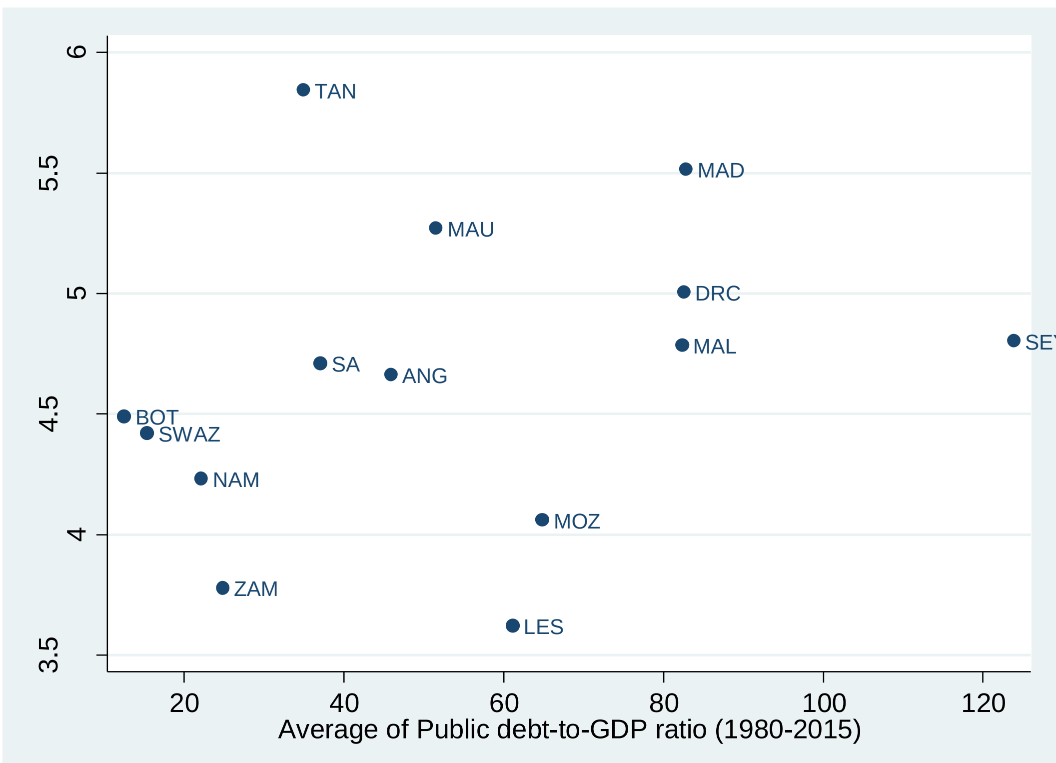
5.2 Public Debt and Economic Growth in SADC: Some Stylised Facts

This section is a precursor to the formal analysis of the relationship between public debt and economic growth in SADC member countries to be presented in sections 5.3 and 5.4. Further to section 3.3 which separately presented the evolution of public debt and economic growth, this section provides a general overview of the evolution of the public debt-economic growth relationship. This overview provides a visual image of the public debt-growth nexus in SADC member countries before the formal econometric analysis.

Consistent with this objective, figure 7 and 8, illustrate the central result of this chapter and illuminate it quite evidently. Each figure shows the relationship between public debt-to-GDP ratio (on the horizontal axis) with the log of GDP per capita as a proxy for economic growth (on the horizontal axis), where both patently show a positive relationship between public debt-to-GDP ratio and economic growth.

For the purposes of presentability of our diagram, in figure7 we have calculated country averages for both the log of GDP per capita (on the vertical axis) as well as country averages for the public debt-to-GDP ratio (on the horizontal axis). Each of the fourteen SADC member states included in the analysis, therefore, entered the analysis with only one observation. From figure7 it is quite evident that countries with moderate to high public debt-to-GDP ratios enjoyed judicious to high levels of economic growth too. This is exemplified by countries like Madagascar, the Democratic Republic of Congo (DRC), Seychelles and Malawi.

Figure 7: Public Debt and Economic Growth in SADC: 1980-2015

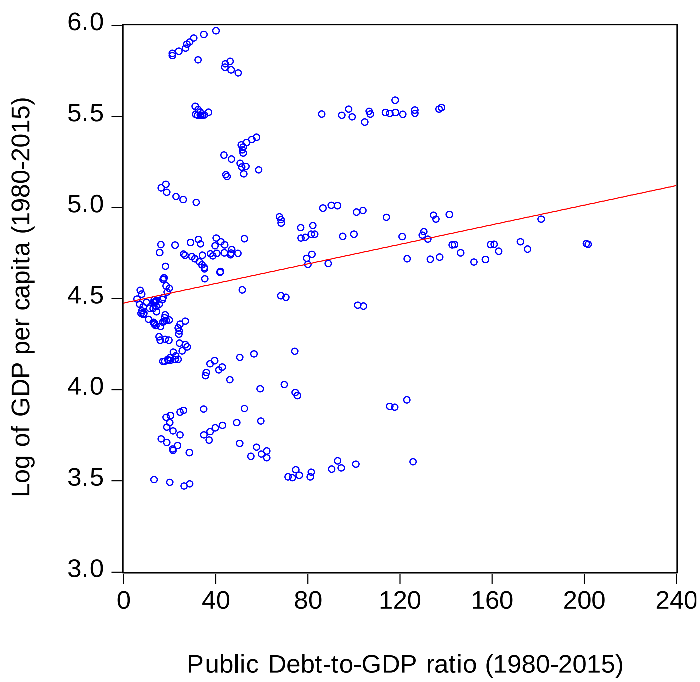


Notes to Figure 7: the variable on the vertical axis is the country average of the log of GDP per capita over the period 1980 to 2015, whereas the variable on the horizontal axis is the country average of public debt-to-GDP ratio for the period 1980 to 2015. The source of data is the IMF World Economic Outlook.

It is, as well evident, from figure 7 that countries with moderate public debt-to-GDP ratios have enjoyed mild economic growth rates. This is epitomised by countries like Lesotho and Mozambique. The central theme from figure 7 is that there is a positive relationship between public debt and economic growth among SADC member states.

In figure 8, the diagram shows the analogous relationship between public debt-to- GDP ratio and the log of GDP per capita for each country. Each dot on this scatter plot represents an observation in a specific country over the period 1980 to 2015. Depending on the data availability over the period under review, each country enters the scatter plot with different amounts of observations. Some countries with rich datasets like Swaziland and Lesotho enter the scatter plot with more observations. The general positive and highly significant trend is unmistakable, demonstrating the positive relationship between public debt and economic growth among SADC economies. As evident in later sections of this chapter, what is striking from figure 8 is the evident strength of the positive relationship between public debt and economic growth among SADC economies.

Figure 8: Relationship between public debt and Economic Growth in SADC: 1980-2015



Notes to Figure 8: the variable on the vertical axis is the log of GDP per capita over the period 1980-2015, while the variable on the horizontal axis is public debt to GDP ratio for the period 1980 to 2015. The data are sourced from the IMF World Economic Outlook.

5.3 Conceptual Framework and Model Specification

Following conventional dynamic growth literature, for example, (Fetahi-Vehapi et al., 2015, Fidrmuc and Kostagianni, 2015, Woo and Kumar, 2015) our analysis, in this section, is based on estimating an augmented neoclassical Solow (1956) model and its extension, for example Mankiw et al. (1992).

At this point, it is imperative for us to restate that the intention of the study is to investigate the extent to which public debt impacts on long-run economic growth. This can be achieved through three alternative ways: using micro-panel estimation techniques by using initial values of the explanatory variables and using three, five or ten-year averages of the public debt and the other variables; and lastly using panel time-series estimation approaches over data which is in panel time-series form. The use of averaging of the data is merited with smoothing any cyclical movements in the data. All the three alternative approaches are explored in arriving at empirical evidence in subsequent sections of this chapter.

To further expore the dynamic interactions between public debt and economic growth in the empirical model, to serve as a representative example for the three alternative approaches, the use of the system GMM relying on initial public debt to GDP ratio $(debt)$, conditioned on other growth determinants, at time $t-q$ for the following three or five years, respectively is further explored here. The reasoning is that the current growth rate is affected by past growth determinants. In order to achieve this objective, the study follows this innovative approach in the literature, that was used by Kumah and Woo (2010) and Fincke and Greiner (2015a) where the total time period is divided into non-overlapping intervals where two sets of lag intervals are considered; a five-year ($q=5$) and a three-year ($q=3$) interval. Subsequently, for the three-year lag, ($t-3$) the nine intervals are generated which cover the periods (1980-1983)… (2011-2015), whereas the five-year lag ($t-5$) generated six intervals covering the periods (1980-1985)… (2009-2015).

In order to investigate the extent to which initial debt, $\left(debt_{i,t-q}\right)$ conditioned on other growth determinants affect subsequent growth performance, the study follows, Fincke and Greiner (2015a), Kumah and Woo

(2010), Fincke and Greiner (2013), and Dreger and Reimers (2013), by adopting the following baseline regression model:

$$y_{it} - y_{it-q} = \varphi y_{i,t-q} + \beta debt_{i,t-q} + \gamma Z_{i,t-q} + \eta_t + \nu_i + \varepsilon_{i,t} \qquad (5.1)$$

where a period is either a three-year time interval $(t-3)$ or a five-year time interval $(t-5)$; t denotes the end of the period and $t-q$ denotes the beginning of the period; i denotes a specific country; y is the logarithm of real per capita GDP; $y_{i,t-q}$ is the initial real per capita GDP; v_i is the country-specific fixed effect; η_t is the time-fixed effect; $\varepsilon_{i,t}$ is an unobservable error term; $debt_{i,t-q}$ is the initial government debt as a percentage of GDP; and $Z_{i,t-q}$ is a vector of control variables that include economic and financial variables. In order to investigate the effect of the initial variable on subsequent economic growth, all regressors are measured at the beginning of the period $t-q$.

So as to take into account conditional convergence, the initial real GDP per capita $(y_{i,t-q})$ is included. The Solow (1956)-convergence theory postulates that if an economy is well below its potential growth level, it will grow quickly as it accumulates more capital. In standard Solow (1956) growth models, the differences in growth rates across countries or regions is predicted by the initial level of income. All other things held constant, poor countries- defined as such on account of lower per capita GDP growth rates - are predicted to grow at a faster rate than the richest countries. For conditional convergence to hold, the associated $\widehat{\beta}$ coefficient should be negative and significant (Solow, 1956; Barro & Salai-i-Martin, 1995). The speed of convergence represents the rate at which poorer economies get closer to their steady-state level of income every year. This can be computed using the following criterion, $b = \frac{\ln(1 + T\hat{\beta})}{T}$. In this analysis, b is the rate of convergence; and T is the time lag. The "half-life" is the time required for an economy to cover half the distance from its steady-state level. The "half-life" can be computed as:

$$\left[\tau = \frac{-\ln(2)}{\ln(1+\widehat{\beta})}\right] \qquad (5.2)$$

For the system GMM results from the use of initial values, the study therefore analyses the effect of public debt on economic growth among SADC economies by estimating the following empirical panel regression model:

$$y_{i,t} - y_{i,t-q} = \varphi_1 y_{i,t-q} + \varphi_2 gdebt_{i,t-q} + \varphi_3 infl_{i,t-q} + \varphi_4 depr_{i,t-q} + \varphi_5 sav_{i,t-q} + \varphi_6 urban_{i,t-q} + \eta_t + \nu_t + \varepsilon_{i,t} \qquad (5.3)$$

It is well established in the literature that use of the fixed effects model within a dynamic framework generates biased estimates when the time dimension of the panel (T) is small (Nickell, 1981, Judson and Owen, 1999). It is with this in mind that the study employs the system GMM dynamic panel data technique as discussed below.

5.4 Selection of Growth determinants

The growth variables used in this study are standard in the growth literature. Levine and Renelt (1992) and Durlauf et al. (2005) analyse growth accounting regressions using Leamer's extreme bounds analysis and found that inflation, initial level of GDP, average annual rate of population growth, secondary school enrolment rate, investment share of GDP and trade openness to robustly explain movements in economic growth.

Following Woo and Kumar (2015) and Fincke and Greiner (2015a), the selection of variables used in the growth performance and its relation to public debt among SADC economies in this study are in line with the findings of Sala- I. Martin (1997) and Sala-i-Martin et al. (2004), and the suggestions by Bosworth and Collins (2003). Confirming the earlier findings of Sala-I. Martin (1997), Sala-i-Martin et al. (2004) conducted a comprehensive cross-country growth regressions in order to determine growth determinants which are significantly and robustly correlated with long-term economic growth. Out of 67 variables, they identified 18 variables that have high likely inclusion probabilities. The 18 variables include initial level of real per capita GDP, initial inflation, initial savings, initial primary school enrolment, the initial government consumption share, trade openness, and the relative price of investment, together with regional and socio-political factors. Socio-political factors include the initial rate of urbanisation, initial dependence ratio, among others. Bosworth and Collins (2003), on the other hand, advised that in order to have parsimonious growth regressions it is judicious to focus on a core set of explanatory variables that have been shown to be dependably associated with growth and evaluate the importance of other variables on inclusion of the core set.

However, Barro (1999) argued that it is difficult to discriminate against variables that affect economic growth because they are too many and what researchers should do is to find the ones which are helpful in explaining growth in a particular context.

Having explored the various growth determinants that are prevalent in the literature, the subsequent sections of this chapter present the empirical findings on the growth effects of public debt from using three growth estimation approaches: first relying on panel time-series estimation techniques; second is use of the system GMM from use of initial values; and third is the the system GMM evidence from relying on five-year averages.

5.5 Empirical Evidence

5.5.1 Panel Times Series Evidence

This section presents the panel empirical evidence on the relationship between public debt and economic growth among SADC member countries over the period 1980 to 2015 based on panel time series estimation techniques. Consistent with the general practice in the literature- see, for example, (Da Veiga et al., 2016, Kumar and Woo, 2010, Seleteng and Motelle, 2015) the empirical analysis in this section is rooted in an augmented neoclassical framework.

The data used in this study consists of an unbalanced panel of fourteen (14) SADC economies with annual data from 1980 to 2015. The panel is unbalanced owing to missing observations for all countries and years. Of the fifteen SADC economies, Zimbabwe is excluded from the analysis due to data unavailability. The data is drawn from the World Bank World Development Indicators (WDI) and the International Monetary Fund (IMF)'s International Financial statistics (IFS).

We also further restate that the choice of the estimators used in this section- the Dynamic OLS (DOLS) and the Fully Modified OLS (FMOLS) as proposed by Stock and Watson (1993) and Phillips and Hansen (1990), respectively, and later extended to panel data by Kao and Chiang (2000)- is motivated by a number of desirable features particularly relevant to this study. As has been more fully detailed in Chapter 4, the major advantages of these estimators is that they correct the standard pooled OLS for serial correlation and endogeneity of regressors that are normally present in long-run relationships. Another advantage of this non-stationary panel approach is that it explicitly estimates low frequency (long-run) relationships among economic growth and public debt controlled on other variables, using annual data rather than taking five-year averages which filter out business cycle fluctuations in the growth literature. The advantages of the DOLS and the FMOLS are particularly suitable to the nature of the underlying data properties of the series in this study. An overview of the asymptotic properties of the DOLS and FMOLS has been given in Chapter4 but for a full and detailed econometric account we refer the reader to the original papers.

The growth determinants used together with public debt in the analysis of the growth impacts of public debt in relying on the DOLS and FMOLS estimation approaches are presented in Table 9.

Table 9: Variable Description

Variable	Acronym	Description	Source	Expected Sign
Public debt	Gdebt	General government gross debt as a percentage of GDP	IMF's WDI	+/-
Population growth	Popg	Annual population growth as a percentage	World Bank WDI	+
Investment	Inv	Total investment: % of GDP	IMF's WDI	+
Education	Educ	Total secondary school enrolment figures: both sexes	World Bank WDI	+
Government Consumption	Lcons	Government consumption expenditure in local currencies	IMF' IFS	+/-

Notes to Table 9: the abbreviation IMF is short form for International Monetary Fund; WDI is for World Development Indicators, and IFS is for International Financial Statistics.

In order to describe the basic features of the data employed in this section, we present the summary statistics in Table 10. This section provides simple summaries about our sample and the measures for the data. The data reveal some interesting features about the public debt-economic growth relationships in the

SADC countries. The high standard deviation of 42.79 for public debt-to- GDP ratio reveal noticeable heterogeneity in the public debt dynamics within SADC over the period under review. The highest public debt-to-GDP ratio recorded during the period under reveal was 202.05 from Seychelles while the lowest public debt-to-GDP ratio was 6.23 from Botswana.

The results, reveal that the non-normality of residuals is confirmed for all the variables in the panel as well, except the education parameter. The non-normality can be due to heterogeneity in the panel. This further reinforces the appropriateness of estimation techniques we have used (the DOLS and FMOLS and the system GMM) as they are best suited to address non-normality in the residuals.

Table 10: Descriptive Statistics

	Public Debt	**Investment**	**Government Consumption**	**Education**	**Population Growth**
Mean	54.95	25.125	12.66	5.35	2.108
Median	40.17	23.97	10.57	5.256	2.235
Maximum	202.05	69.03	39.58	6.69	3.555
Minimum	6.23	4.56	1.66	3.80	-2.629
Std. Dev	42.79	11.46	7.80	0.71	0.99
Skewness	1.21	1.24	2.31	-0.25	-0.801
Kurtosis	3.73	5.60	7.35	2.86	3.780
Jarque-Bera	71.67	144.23	450.91	2.97	35.910
	(0.000)	(0.000)	(0.0000)	(0.23)	(0.000)
Sum Sq. Dev	490608.7	35184.49	16341.04	135.90	567.14
Observations	269	269	269	269	269

Notes to Table 10: data is obtained from the IMF World Economic Outlook and the World Bank World Development Indicators for the period 1980 to 2015. P-Values are in parentheses for the Jarque-Bera test statistic.

Next, in order to infer of the size and direction of the relationship between the variables and long run economic growth as well as the degree of multi-collinearity among the regressors, the results are presented table 11. We note, however, that the primary interest is on the relationship between public debt and economic growth and inference of the degree of collinearity among the regressors. The results show that there is a positive co-movement between public debt and economic growth implying that higher levels of public debt are associated with higher growth rates. This is evidence in support of the Keynesian view on the counter cyclical role of fiscal policy on economic growth.

Education and population growth also have positive associations with subsequent economic growth, which is expected in the literature. This reveals that human capital explains positive movements in subsequent economic growth among SADC economies. Though it is too early to conclude, the positive impact of human capital, as reflected by education and population growth, suggests that meaningful progress on economic growth can be attained by, among other things, any measures that resultantly improve human capital productivity in SADC. However, investment is negatively correlated with economic growth, which is not expected in the literature. The negative association between investment and economic growth could reflect a lagging in technology. This could be a plausible explanation for this empirical anomaly. Government expenditure has a negative sign, which is not surprising as government expenditure can either have positive or negative growth effects.

Table 11: Correlation Matrix

	Economic Growth Rate	Public Debt	Investment	Government Consumption	Education	Population Growth
Economic Growth Rate	1.0					
Public Debt	0.18	1.0				
Investment	-0.44	-0.08	1.0			
Government Consumption	-0.44	0.05	0.48	1.0		
Education	0.27	-0.30	-0.36	-0.11	1.0	
Population Growth	0.206	-0.027	-0.252	0.311	0.531	1.0

Notes to Table 11: data are taken from the IMF's World Development Indicators as well as the World Bank World Development Indicators. We only present the correlation matrix without necessarily worrying about the statistical significance of the variables.

Following standard econometrics practice, we first conduct tests to investigate the underlying data generating process of the series. Such an exercise provides guidance as to whether there are any data transformations to be undertaken so that we may avoid spurious regressions and as well provide direction on the most appropriate model specification to take.

In such an exercise, the first standard procedure is to conduct informal checks by graphical plots. A visual inspection of the graphical plots tells us not only that the data are generated by a unit root process but also a unit root process with a trend, intercept or both. Formal stationarity tests involve estimation of parameters to determine the significance of the drift, trend and the AR term.

A visual inspection of the graphical plots, not reported here in the interest of brevity, but which are available on request, reveal that all the variables exhibit a trend and drift for the individual countries. This understanding is crucial for we have to consider the data generating process of the series when conducting formal unit root tests and in the model specification. However, informal tests are necessary but not sufficient for one to fully understand the underlying data generating process and as such we proceed to perform formal unit root tests, as reported here.

We follow standard econometric practice in recognising that classical regression properties only hold for cases where variables are integrated of order 0 (stationary). The use of panels with a long time dimension (T) necessitates the need to investigate the stationarity properties of the panel data before one can analyse the cointegration relationships since the long time dimension may render panels nonstationary.

In line with this conventional econometric reasoning, we employed a battery of both first generation (Levin et al., 2002, Im et al., 2003, Maddala and Wu, 1999b) and second generation (Breitung and Das, 2005) panel unit root tests. We could have also employed the recent panel unit root test proposed by Pesaran (2007) but we were contstrained by the fact that this panel unit root test is designed for series which are free from autocorrelation. High serial correlation leads to severe size distortions in the Hadri (2000) test, resulting in high chances of rejection of the null. In fact, we carried out the Hadri (2000) unit root tests, not reported but found in Appendix B1, to see if we would get plausible results and as a pretest of the test for the presence of autocorrelation in the series. We find evidence of severe autocorrelation as there was an over-rejection of the null, and we therefore do not report these results here.

As we have noted earlier, our data series follow a trend and drift, and we only report results for the individual linear trend and drift, for convenience of space. The rest of the results are found in Appendix B1.

The first generation tests (Levin et al (2002) and the Im et al (2003)) are confirmatory in that all the variables except the log of secondary school enrolment, as a proxy for education, and population growth are stationary after first differencing. However, the Breitung and Das (2005), a second generation test reveals that all the variables, except investment as a share of GDP, is first-difference stationary. Overall, the majority of the variables are first-difference stationary.

Table 12: Panel Unit Root Tests

	Public Debt	**Investment**	**Education**	**Population Growth**	**Government Consumption**
LLC $\tau - stat$					
Levels					
$\tau - stat$	0.380	0.160	10.1387***	60.386***	0.420
First Differences					
$\tau - stat$	3.630***	1.236*	0.960	1455.76***	6.194***
IPS-W-stat					
Levels					
$\tau - stat$	2.017	0.175	2.564***	125.122***	1.789
First Difference					
$\tau - stat$	3.894***	3.209***	3.978***	1253.84***	4.116***
Breitung $\tau - stat$					
Levels					
$\tau - stat$	2.450	-2.439***	3.576	0.850	2.196
First Difference					
$\tau - stat$	-4.329***	-3.849***	-2.188**	-3.584***	-0.580

Notes to Table 12. ***, **,* reflect significance at 1%, 5% and 10 % levels of siginificance, respectively. Data are taken from the International Monetary Fund (IMF) and the World Bank's World Development Indicators.

These results are particularly of interest since the DOLS and FMOLS are designed for non-stationary panels. To be more specific, the application of the DOLS and FMOLS is meant for a series when the dependent variable follows an I(1) process and at least some of the regressors also follow an I(1) process (Al-Azzam and Hawdon, 1999). Having confirmed that the variables of interest are rendered stationary after first differencing, we proceed to test for the presence of a long run relationship between GDP per capita ($lgdp$) and public debt ($gdebt$) controlled on other regressors, namely, total investment as a percentage of GDP(inv) , general government consumption ($lcons$), and general secondary school enrolment figures which is a proxy for education, and population growth.

Establishing the cointegrating relationship is crucial before the long-run parameters can be efficiently estimated using the FMOLS and the DOLS estimation techniques. In the presence of nonstationary variables, the conventional solution is to express the variables in difference form in order to avoid spurious regressions. Nevetheless, differencing variables is at a loss of useful information contained in level form of variables and not in their differences (Baltagi, 2013; Maddala and Wu, 1999). In this regard, the standard way is to test for a cointegrating relationship among the variables so that if present the short run and long run information can be reconciled through an error correction mechanism.

In line with this orthodox econometric rationale, this section employs the cointegration test procedure as proposed by Pedroni (1999) due to its advantages over other panel cointegration test techniques as outlined in chapter 4. We could also have utilised the recent panel cointegration test by Westerlund (2007), but it is not appropriate in this study due to the small sample properties of the data, and the fact that the panel is highly unbalanced.

Table 13 presents the Pedroni (1999) cointegration test results between the logarithm of GDP per capita ($lgdp$) (economic growth) and public debt as a percentage of GDP ($gdebt$), total investment as a percentage of GDP (inv), the logarithm of general government consumption ($lcons$), the logarithm of secondary school enrolment ($educ$), and population growth ($popg$). We also conducted the Johansen

Fisher type panel cointegration test by Maddala and Wu (1999b) but, in the interest of space, these results are not reported here but are in Appendix B1.

Table 13: Panel Cointegration Results

	Within-dimension (panel)				Between-dimension (group)		
	$v - Stat$	$\rho - Stat$	$PP - Stat$	$ADF - Stat$	$\rho - Stat$	$PPP - Stat$	$ADF - Stat$
All	-0.597	3.985	-3.246***	-3.678***	5.018	--6.209***	-2.156**

Notes to Table 13: *, **, ***, indicate rejection of the null hypothesis of no cointregration at the 10%, 5%, and 1% significance level, respectively, based on the critical values of 1.28, 1.644, and 2.326, respectively. Annual data are from 1980 to 2015. Results with a trend and time-dummies. The test statistics are normalised so that the asymptotic distribution is standard.

Following Pedroni (1999) the statistics falling under the within-dimension contain the computed value of the statistics based on estimators that pool the autoregressive coefficient across different countries for the unit root tests on the estimated residuals. The statistics under the between-dimension report the computed values of the statitistics based on estimators that average individually estimated coefficients for each country. For the within-dimension, the $PP - Stat$ and the $ADF - Stat$ show that the null hypothesis of no cointegration can be rejected at the 1% significant level. For the between-dimension the $PPP - Stat$ and the $ADF - Stat$ reject the null of no cointegration at the 1% and 5 % level, respectively.

Overall, four out of seven test statistics reject the null of no cointegration. Since the majority of the test statistics provide evidence not to accept the null of no cointegration, it can be safely concluded that there exists a cointegrating relationship between the log of GDP per capita ($lgdp$) and the regressors in the model. The existence of a cointegrating relationship was confirmed by the cointegration test results from the Johansen Fisher cointegrating test by Maddala and Wu (1999b), not reported here in the interest of brevity. Infact the cointegration test results by Maddala and Wu (1999b) reveal that there exist up to four cointegrating relationships.

Having confirmed of the existence of a cointegration relationship, we estimate the long-run parameters using the Dynamic OLS estimator by Stock and Watson (1993) as our preferred estimator, the Fully Modified OLS estimator by Phillips and Hansen (1990) and both later extended to panel data by Kao and Chiang (2000). The results of the long-run parameters are reported here.

Following Chao and Chiang (2000), this section specifies the empirical model that we make use of in estimating the growth effects of public debt in SADC based on the DOLS and FMOLS estimation techniques. Some of the recent empirical studies that have utilised the DOLS and the FMOLS in a growth analysis, though in different contexts, include Streimikiene and Kasperowicz (2016), Salahuddin and Gow (2016), and Bangake and Eggoh (2009). Since the mechanics of the two estimators have been discussed in Chapter 4, we specify our empirical model as follows:

$$lgdp_{it} = \alpha_i + \beta_1 gdebt'_{it} + \beta_2 educ'_{it} + \beta_3 inv'_{it} + \beta_4 popg'_{it} + \sum_{j=-q}^{q} c_{ij} \Delta x_{it+j} + u_{it} \qquad (5.4)$$

where $lgdp_{it}$ is the logarithm of gross domestic product per capita at constant prices, for country i at time t; $gdebt_{it}$ is the general government debt as a percentage of GDP for country i at time t; $educ_{it}$ is the log of secondary school enrolment figures for both sexes (as a proxy for human capital) for country i at time t; and inv_{it} is the total investment as a percentage of GDP for country i at time t. Δx is 4×1 of the same variables but this time in the short-run period. We used a vector notation to conserve space. The data for all the variables were obtained from the IMF World Economic outlook, except the log of secondary school enrolment ratio which was obtained from the World Bank's World Development Indicators.

The long-run parameters are β_1; $\beta_2, \beta_3, and\ \beta_4$. Aprior expectation is for both human capital- the log of secondary school enrolment- $(educ)$ and the total investment as a perecentage of GDP to have positive effects on economic growth. General government debt as a percentahe of GDP, the variable of interest, can either have a negative or positive sign depending on whether public debt has positive or negative effects on economic growth in SADC. Our parameter of interest, therefore, is $\beta_1$as we are interested in investigating the average impact of public debt on economic growth among SADC economies.

Of particular interest again is $\sum_{j=-q}^{q} c_{ij}\,\Delta x_{it+j}$ which is the leads and lags of the first differenced endogeneous regressors which is the mechanism to correct for endogeneity, simultaneity and serial correlation. Noteworthy is the fact that the slope coeffcients of the leads and lags are not reported and interpreted since they are treated as nuisance parameters (Stock and Watson, 1993). The period in which they net out their effects defines the short run which absorbs serial correlation and regressor endogeneity.

Following the representation in equation (5.1), our DOLS estimator for heterogeneous panels $\left(\hat{\beta}_D^*\right)$ can be obtained by running the following regression:

$$y_{it}^* = \alpha_i + \beta_1 gdebt_{it}^* + \beta_2 educ_{it}^* + \beta_3 inv_{it}^* + \beta_4 popg_{it}^* \sum_{j=-q_1}^{q_1} c_{ij}\Delta x_{it+j}^* + \dot{v}_{it}^* \qquad (5.6)$$

With this exposition, we then present the empirical evidence on the growth effects of public debt in the fourteen SADC member states.

Before presenting the results of the DOLS and FMOLS estimators we find it worthwhile to explain the panel estimation methods we adopted between the pooled, weighted and grouped panel estimation methods.

Monte Carlo simulations posits that efficiency increases as one estimates from a pooled estimation to a weighted estimation and finally, a grouped estimation panel method. The level of efficiency affects the standard errors and resultantly the statistical significance of the estimated parameters. Under such a general guidance, one is expected to opt for the grouped estimation panel method as it is expected to produce the highest possible level of statistical significance. The issue we wish to stress is that the researcher uses his own intuition to infer which of the three options yields the highest level of efficiency. It may not necessarily mean that the grouped estimation panel always gives the most efficient results thereby leaving the researcher to exercise his own discretion.

In the case of our FMOLS estimation technique, there is significant efficiency gains as one compares the pooled results and the weighted results with some degree of efficiency loss as one progress using the grouped panel method, as shown in Appendix B1. In such a situation, we opt for the results from the weighted panel method. These are the results we report in Table 14.

The same argument holds for the DOLS estimator. There is substantial efficiency gains as one compares our pooled, weighted and grouped panel estimation methods -see Appendix B1. The grouped panel estimation results are the most efficient of the three options. We therefore report results from the grouped panel estimation for the DOLS. Our DOLS results are corrected for heteroscedasticity and autocorrelation.

Table 14: Panel Cointegration Estimations

	FMOLS	DOLS
Public Debt	0.121***	0.0010***
	(3.41)	(7.945)
Investment	0.126***	0.00225*
	(2.771)	(1.88)
Government Consumption	0.018	0.235***
	(1.58)	(495.66)
Education	0.244***	0.623***
	(17.855)	(19.30)
Population Growth	-0.059***	0.739***
	(-3.182)	(19.30)
Number of observations	255	71

Notes to Table 14: the dependent variable is Gross Domestic Product per capita($lgdp$). Data are from 1980 to 2015 and were extracted from the IMF's World Economic Outlook and the World Bank World Development Indicators; t-statistics are in parenthesis; ***, **,* indicate statistical significance of the estimated parameters at the 1%, 5%, and 10% levels of significance, respectively.

Our parameter estimate of interest is the coefficient of the public debt-to GDP ratio. In both cases public debt to GDP ratio has a positive and statistically significant effect on economic growth at the 1% level of significance. However, magnitude improves as one compares the DOLS estimator and the FMOLS estimator. For the DOLS estimator, a 10% increase in public debt-to-GDP ratio improves the level of economic growth among SADC member states by 0.010%, whereas for the FMOLS estimator, a 10% increase in public debt-to-GDP ratio leads to an increase in economic growth by 1.2%. Overall, the results confirm of a positive and significant impact of public debt on economic growth for both DOLS and the FMOLS panel estimation techniques. The conclusion we draw from these results is that the choice between the DOLS and the FMOLS only influences the magnitude not the relevance of the impact of public debt on economic growth. Our empirical results are consistent with the findings of Seleteng and Motelle (2015) who found a positive growth pay-off of public debt in a study of growth determinants in SADC.

The control variables ($inv, lcons, popg, and\ educ$) enter with apriori expected economic signs and are all statistically significant at 1% level of significance with the exception of investment as a share of GDP which is marginally significant at 10%, for the DOLS estimator. For the FMOLS estimator, government consumption loses its statistical significance while all the other control variables (investment as a share of GDP, education, and population growth) are highly statistically significant at 1% level of significant. All the other control variables carry the expected economic signs serve population growth which is highly statistically significant but has a negative impact on economic growth.

General government consumption ($lcons$) has a positive effect on economic growth for both the FMOLS and DOLS estimators. The positive impact of government consumption on economic growth augments the positive impact of public debt on subsequent economic growth. In the economic reasoning, general government consumption can either have a positive or negative effect on economic growth depending on whether government consumption is channeled towards consumption expenditures or long term investment like infrastructure, transportation, communication and education. That the two variables are confirmatory of each other implies that government consumption from public debt is channeled towards growth enhancing activities.

Having estimated the parameter estimates, we conducted diagnostic checks to infer if the residuals are normally distributed and if there is presence of autocorrelation in the residuals. The residuals are not normally distributed indicating prevalence of serial correlation. This necessitated the use of heteroscedasticity and autocorrelated standard errors to regain parameter efficiency. Given this, the results in this study can be interpreted with confidence.

Nevertheless, up to now, our regression estimates assume a linear relationship between public debt and economic growth. This assumption is, however, challenged in recent literature (Reinhart and Rogoff,

2010) who demonstrated the presence of non-linearities in the way debt interacts with growth. The authors, Reinhart and Rogoff (2010), particularly showed that debt is conducive for growth if it is less than 90% of GDP. The authors claimed that debt to GDP ratios above 90% of GDP cause economic growth rate to stagnate.

To test this claim in our SADC context, we add the quadratic term of public debt as an explanatory variable. Two important aspects here are the sign and statistical significance of the quadratic term of public debt. The downsides of testing non-linearities in this way is that the quadratic term is normally correlated with the linear term. This, however, is of no consequence since the exercise here is to merely detect presence or absence of a turning point and not to partial out the effect on growth. An alternative way is to select different debt to GDP ratios in an adhoc way and estimate the samples separately. We are, however, constrained from using this procedure due to limited number of observations.

Table 15 reports the results for the test of non-linearities in the public debt-economic growth interactions in SADC. Apparent in these results is that debt correlates with economic growth in a non-linear fashion which is confirmatory to Reinhart and Rogoff's (2010) claim. The linear term remains positive while the quadratic term enters with a negative and statistically significant sign which is sufficient evidence of threshold effects. These results imply that public debt enhances economic growth up to a certain point beyond which further increase in public debt will hurt economic growth. These results also raise a warning to studies that assume a linear relationship between public debt and economic growth. In this spirit, exclusion of the non-linear term not only results in model underfitting but also an omitted variable bias.

Generally, the test for non-linearities confirm that small to moderate debt promotes growth while high levels of public debt is detrimental to economic growth in the SADC region.

Table 15: Debt-Growth Non-linearities in SADC: 1982-2007

Variable	Coefficient	Std. Error	t-Statistic
Government debt	0.00468***	0.00138	3.403
Quadratic Term (gdebt^2)	-0.000112***	3.93e-05	-2.846
Education	-0.296	0.176	-1.682
Population growth	0.278***	0.0974	2.855
Investment	-0.000217	0.00054	-0.400
Log of Governement Consumption	0.156*	0.0809	1.933
Periods included: 26			
Cross-sections included: 5			
R-squared: -343.37			

Notes to Table 15: the dependent variable is the log of GDP. *, **, ***, denote significance at 10%, 5%, and 1% level of significance, respectively.

Another contentious issue related to the public debt-economic growth nexus relates to the channels through which public debt enhances growth. The accepted understanding in the literature is that public debt is detrimental to economic growth if it is channeled for consumption purposes and promotes growth if it is spend on growth enhancing activities like infra-structure investment, education, and technology.

To validate or refute this claim, we interact our public debt variable with investment together with the level term of investment and debt. The results for this exercise are reported in Table 16.

Table 16: Public Debt-Investment Interaction in SADC: 1982-2015

Variable	Coefficient	Standard Error	t-Statistic
Governement debt	-0.00497*	0.0019	-2.6059
Education	0.83576***	0.17931	4.6609
Population growth	0.3995***	0.0951	4.2008
Government Debt-Investment interaction (gdebt*inv)	0.00035***	0.000102	3.4349
Investment	-0.00788***	0.00179	-4.3874
Log of government consumption	0.093916*	0.05206	1.8038
Periods included: 26			
Cross-sections included: 5			
R-squared: -372.73			

Notes to Table 16: the dependent variable is log of GDP. *, **, and *** signify statistical significance at 10%, 5%, and 1% level, respectively.

Apparent in our findings is that the growth enhancing effect of public debt increases with investment. The coefficient on this interaction term is positive and statistically significant at all levels implying that public debt is more growth promorting in countries that channel public debt towards investment purposes.

Consistent with both neoclassical and endogenous growth theories whose common proposition is that investment in human capital is one pre-requisite for the attainment of sustainable economic growth (Lewis, 1956, Kuznets), we also experimented with an analysis of the impact of public debt-human capital interaction on economic growth. Simply put, our aim in conducting this exercise was to analyse the association between economic growth and public debt channeled towards human capital investment. The findings of this exercise are presented in Table 17.

The results show that public debt-education interaction has a positive relationship with economic growth but is not statistically significant. The literal intepretation of these results could be that public debt channeled to economic growth has great potential to stimulate economic growth in the SADC region although the real growth benefits from human capital investment do not have a meaningful impact. This appears a bit perplexing as it is common belief that an educated populacy contributes immensely to economic growth as education and training brings with it not only efficiency and innovation but profound positive externalities to the extent that average income, from human capital investment, should rise by even more than the sum of the individual effects.

Nonetheless, such an anomalous association between human capital and economic growth has been documented in a number of studies such as those by Islam (1995), Gregorio (1992),and Pritchett (2001). Islam (1995), for example, noted that outcomes of either statistical insignificance or negative sign have been a common feature for temporal dimensions of human capital development in many growth regressions. Pritchett (2001) offered three possible explanations to the atypical results in literature regarding the role of human capital development in economic growth: First, if the governance environment becomes too adverse to the extent that educational capital accumulation may not have a meaningful impact in promoting economic growth. Second, the marginal returns to education may fall as markedly as education institutions churn out graduate at a rate far outweighing the available jobs. Third, quality of educational might have been so low that increased years of schooling might have created no meaningful improvement in the quality of human capital.

Table 17: Public Debt-Education Interaction in SADC: 1982-2015

Variable	**Coefficient**	**T-statistic**
Government Debt	-0.083	-0.883
Public Debt-Education Interaction (GDEBT*EDUC)	0.0165	0.872
Education	-0.687*	-1.974
Population Growth Rate	0.005***	3.491
Log of Government Consumption	0.229***	4.806
Investment	0.0004	0.821
R-squared	-543	
Adjusted-R-squared	1563	
S.E. of regression	25.68	

Overall, inference from Pritchett's (2001) claim could be that while investment in human capital has great potential to stimulate economic growth but, either the quality of governance or the quality of education and training needs to be reconsidered if at all investment in human capital development is to yield positive growth effects in the SADC region.

5.5.2 System GMM Initial Values Evidence

We now turn to our empirical evidence on the growth effects of public debt based on the system GMM estimator which makes use of initial values. An overall conclusion on the empirical evidence of the growth effects of public debt in SADC member states presented in this section will then be presented after the system GMM results.

The results presented in this section and the arguments contained herewith are part of a research paper entitled "*Public Debt and Economic Growth among SADC Economies: A System GMMApproach"* that we have submitted and which is under review with the South African Journal of Economics. The empirical findings from this section draws on the use of initial values of public debt-to GDP ratio together with other control variables in the analysis of the growth effects of public debt. This approach, as opposed to the use of averages of the explanatory variables, was adopted by, among other researchers, (Fincke and Greiner, 2015b, Fetahi-Vehapi et al., 2015, Woo and Kumar, 2015, Fidrmuc and Kostagianni, 2015). The approach makes use of the initial values of the explanatory variables to account for changes in economic growth. This is based on the understanding that public debt-to-GDP ratios together with other control variables do not have a contemporaneous effect on economic growth but impact on economic growth with a lag. In this spirit, we use both three-year and five-year lags in the analysis of public debt on economic growth using the system GMM Approach.

The data used in this study consists of an unbalanced panel of fourteen (14) SADC economies with annual data from 1980 to 2015. The panel is unbalanced owing to missing observations for all countries and years. Of the fifteen SADC economies, Zimbabwe is excluded from the analysis because of data unavailability. The data are drawn from the World Bank's World Development Indicators (WDI) and the International Monetary Fund (IMF)'s International Financial statistics (IFS). More specifically, the dependent variable is the gross domestic product per capita (y) which is drawn from the International Monetary Fund (IMF)'s World Economic Outlook. The main explanatory variable of interest, general government gross debt as a percentage of GDP $(gdebt)$ and other control variables, namely, gross national savings as a percentage of GDP(sav); inflation- average consumer prices as an Index$(infl)$; were all drawn from the International Monetary Fund (IMF)'s World Economic Outlook. On the other hand, urban population growth as an annual percentage change$(urban)$; and age dependency ratio as a percentage of the working age population $(depr)$ were taken from the World Bank's World Development Indicators (WDI).

Since the system GMM estimator and other panel dynamic estimation techniques have been considered in greater detail in Chapter 4, this section provides a brief overview of these estimation techniques with the overall objective of justifiying our preferred estimator and placing it into a growth context.

It is well established in the literature that estimation of growth regressions is beset by a number of problems (Bond et al., 2001) which include measurement errors, omitted variable bias and reverse causality that may raise problems of endogeneity. The OLS estimator can not address all these problems. More so the OLS estimator of the coefficient on the lagged dependent variable φ_1 is likely to be biased upwards in the presence of the country specific effect, η_t, since the lagged dependent variable is positively correlated with the country specific effect, η_t (Blundell and Bond, 1998b).

One approach advanced in the literature to address the problem of country specific effects could be the fixed effects estimator. However, the fixed-effects estimator can provide biased estimations if the number of time periods is small, and if the lagged value of the dependent variable $y_{i,t-q}$ is correlated with the individual effects (Matyas and Sevestre, 2008). The fixed effects estimator has been shown to give estimation parameters that are inconsistent and biased downwards in the presence of endogeneity (Nickell, 1981).

An alternative to the fixed effects estimator is the difference GMM estimator as proposed by Arellano and Bond (1991) and Arellano and Bover (1995b). To address the problems of possible unobserved time and country-specific effects, and as well permit for some certain degree of endogeneity in some explanatory variables, the difference (GMM) estimator uses all possible lagged levels as instruments. Differencing equation eliminates unobserved country specific effects.

The difference estimator is based on the fact that previous data observations of regressors and the lagged dependent variable are used as instruments. Alonso-Borrego and Arellano (1999) and Blundell and Bond (1998a) however show that the difference GMM estimator suffers from weak instruments when the regressors are persistent over time, thereby compromising the asymptotic and small sample performance of the difference estimator.

In response, Blundell and Bond (1998a) and Arellano and Bover (1995a) suggests a system GMM estimation procedure which combines the equations in first differences with equations in which the level variables are instrumented by their first difference estimators. Using Monte Carlo simulation, Blundell and Bond (1998a) found the system GMM to be more efficient than the first difference GMM estimator.

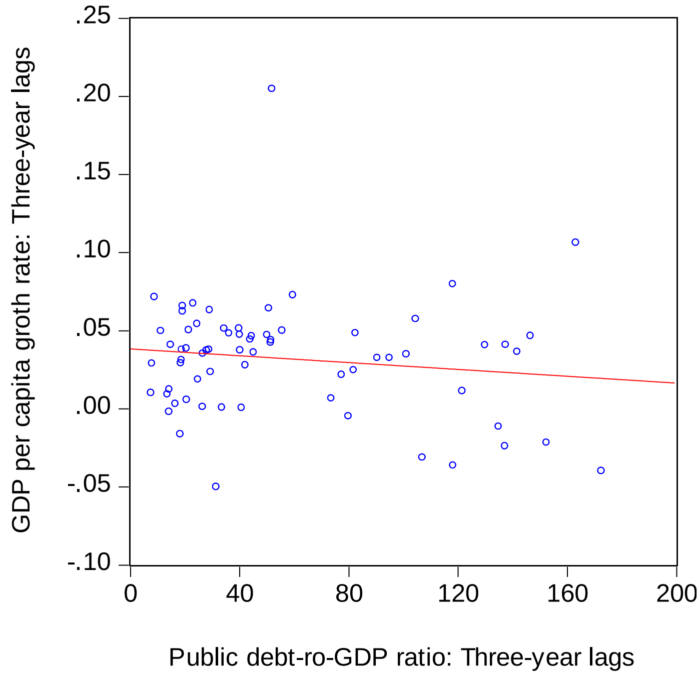
Nevertheless, the consistency of the system GMM estimator is dependent on two fundamental hypotheses. Firstly, the set of instrumental variables must be uncorrelated with the error term (the set of instruments must be valid). This hypothesis is tested using the Sargan and Hansen test of over identifying restrictions. We make use of the Sargan Test in this section. Secondly, the absence of second order autocorrelation (AR2) in residuals must be verified, while a negative first order autocorrelation (AR1) may be detected. This hypothesis is tested using Arellano-Bond tests for AR1 and AR2. We use one step with robust standard errors to guard against potential heteroscedasticity.

Our discussion in this section has amply demonstrated that the system GMM is the most appropriate estimation method which addresses the triple problems of endogeneity of regressors, measurement errors and unobservable country heterogeneity that are characteristic of economic growth regressions in particular and dynamic panel estimations in general. In this spirit, our preferred estimation results are those from the system GMM. Purely for comparison purposes only, we have conducted the pooled OLS estimation as well as the fixed effects estimation but not much attention will be placed on these two estimators.

We proceed to present our estimation results from the system GMM estimation technique where we use initial values of the dependent variables. We first present the preliminary data analysis followed by our empirical results on the impact of public debt on economic growth among SADC economies.

In order to analyse how public debt-to- GDP ratio is correlated to economic growth in the sample, we plotted Figures 9 and 10 for both the three-year and five-year lags, respectively. Each dot in both figures represent an observation for the fourteen countries included in the sample. Overall, public debt-to GDP ratio is shown to be negatively related to economic growth in both the three and five-year lag periods.

Figure 9: Public debt and Economic growth in SADC: Three-year Lags

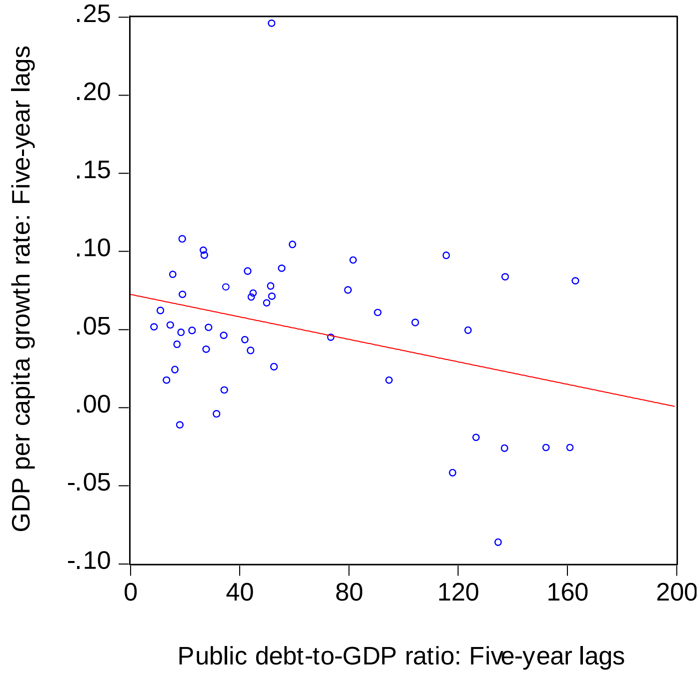


Notes to Figure 9: the scatter plot was drawn in Eviews from annual data on gross public debt to-GDP-ratio, as the independent variable on the horizontal axis and GDP per capita growth rate obtained from the IMF's World Economic Outlook. Each dot represents an observation for the 14 SADC member states included in the sample. It was expected that each of the fourteen countries would enter the scatter plot with nine (9) observations from 1980-1983; 1984-1987… and lastly 2012-2015 and thereby amount to 126 observations in our scatter plot. However, this is not the case due to data unavailability. Data for public debt-to-GDP ratio for most of the countries is available as from the 1990s at best.

The negative correlation between public debt-to-GDP ratios and economic growth, however, is more pronounced in the five-year lag than in the three year lag. These results reveal that, public debt and economic growth among SADC member states included in the sample are inversely related.

The revelation that the regression line is relatively steeper in the five-year lag period than the three-year lag period is consistent with economic theory that public debt impacts on economic growth with a lag. Economic reasoning holds that the impact of public debt does not have a contemporaneous impact on economic growth, but takes some time to filter into the system. The results, as displayed from Figure 9 and 10, reveal that though the negative impact of public debt is felt after three years, the full impact takes more than three years to be felt. After five years, the full detrimental effect of public debt on economic growth is evidently felt among SADC economies. This is quite interesting and relevant for policy making.

Figure 10: Public debt and Economic Growth in SADC: Five-year Lags



Notes to Figure10: the scatter plot was drawn in Eviews from annual data on gross public debt to-GDP-ratio, as the independent variable on the horizontal axis and GDP per capita growth rate obtained from the IMF's World Economic Outlook. Each dot represents an observation for the 14 SADC member states included in the sample. It was expected that each of the 14 countries would enter the scatter plot with 9 observations from 1980-1985; 1986-1991… and lastly 2010-2015 and thereby having 84 observations in the scatter plot. However, this is not the case due to data unavailability. Data for public debt-to-GDP ratio for most of the countries are available as from the 1990s at best.

Table 17 and 18 report the summary statistics for the 14 SADC member states included in our sample for the period 1980 to 2015 for both the three-year lag and the five-year lag periods, respectively. The summary statistics report the mean, median, standard deviation, minimum and maximum values for the variables included in the analysis. Since our interest is to assess the impact of public debt-to-GDP –ratio on economic growth as proxied by the growth rate of GDP per capita, we primarily focus our attention on the two variables. On average, a SADC member state enjoyed a GDP per capita growth rate of 0.03 and 0.05 for the three and five-year growth lag period, respectively.

Table 18: Summary Statistics: Three-year Lags

	$y_{i,t} - y_{i,(t-3)}$	$y_{i,(t-3)}$	$infl_{i,(t-3)}$	$gdebt_{i,(t-3)}$	$depr_{i,(t-3)}$	$sav_{i,(t-3)}$	$urban_{i,(t-3)}$
Mean	0.0320	4.623	170.67	57.95	80.079	20.02	4.746
Median	0.0367	4.660	97.95	40.61	84.22	20.17	3.48
Maximum	0.0205	5.903	2710	172.56	102.61	51.045	25.746
Minimum	-0.050	3.467	2.707	7.65	41.06	0.487	-0.239
Std. Dev	0.037	0.636	357.46	45.69	17.82	10.987	5.39
Skewness	1.102	0.095	5.857	0.95	-0.719	0.357	2.652
Kurtosis	8.9	2.2903	40.03	2.644	2.336	2.667	9.548
Jargue-Bera	105.68	1.53	4273	10.576	7.107	1.764	201.27
Probability	0.0000	0.465	0.0000	0.0005	0.029	0.414	0.000
Observations	68	68	68	68	68	68	68

Notes to Table 18: the summary statistics were computed from Eviews based on annual data sourced from the IMF's World Economic Outlook and the World Bank's World Development Indicators.

A country with the highest public debt-to-GDP ratio for the three and five-year periods, respectively had 172.56 and 163.23. On the other hand, an average public debt-to-GDP ratio was 58 and 61, respectively for the three and five-year lag periods. These figures are relatively high if one considers the SADC convergence requirements that debt-to-GDP ratio should be at most 60% of GDP. Such fairly high public debt to GDP ratios for SADC member countries, therefore, warrants an investigation of the impact of public debt on economic growth among SADC member states.

The majority of the variables, except, savings and economic growth in the three-year lag exhibit non-normality in residuals. This could signal heterogeneity in the panel which need to be addressed by the system GMM estimation techniques we employ in this section.

Inflation in the five-year lag period has a maximum of 2 296.74 and a standard deviation of 334.16. There is a big deviation in inflation performance among the 14 SADC member states included in the panel. This could warrant adoption of sound monetary policies in those countries with high levels of inflation so as to keep inflation under control in some of the SADC member countries.

Table 19: Summary Statistics: Five-Year Lags

	$y_{i,t} - y_{i,(t-5)}$	$y_{i,(t-5)}$	$infl_{i,(t-5)}$	$gdebt_{i,(t-5)}$	$depr_{i,(t-5)}$	$sav_{i,(t-5)}$	$urban_{i,(t-5)}$
Mean	0.050	4.63	149.8	61.165	81.21	18.8	3.31
Median	0.052	4.65	85.76	44.95	85.85	17.17	3.54
Maximum	0.25	5.87	2296.74	163.23	103.82	50.41	5.88
Minimum	-0.087	3.51	0.18	8.91	41.99	-2.05	-0.27
Std. Dev	0.052	0.63	334.16	45.84	17.92	11.09	1.63
Skewness	0.44	0.11	5.769	0.85	-0.76	0.63	-0.48
Kurtosis	6.32	2.27	37.17	2.43	2.42	3.29	2.53
Jargue-Bera	23.62	1.16	2600	6.43	5.40	3.38	2.29
Probability	0.000	0.56	0.000	0.040	0.067	0.18	0.32
Observations	48	48	48	48	48	48	48

Notes to Table 19 the summary statistics were computed from Eviews based on annual data sourced from the IMF's World Economic Outlook and the World Bank's World Development Indicators.

Having examined the summary statistics, we proceed to look at the correlation matix as is presented in Tables 19 and 20 for the three and five-year lag periods, respectively. Our interest is threefold: to infer the pairwise correlation between public debt and economic growth in the sample; investigate the possible growth convergence in our sample,; and as well, evaluate the degree of multi-collinearity.

Table 20: Correlation Matrix: Three-Year Lags

	$y_{i,t} - y_{i,(t-3)}$	$y_{i,(t-3)}$	$infl_{i,(t-3)}$	$gdebt_{i,(t-3)}$	$depr_{i,(t-3)}$	$sav_{i,(t-3)}$	$urban_{i,(t-3)}$
$y_{i,t} - y_{i,(t-3)}$	1.0000						
$y_{i,(t-3)}$	-0.21	1.000					
$infl_{i,(t-3)}$	0.097	0.19	1.000				
$gdebt_{i,(t-3)}$	-0.135	0.224	-0.055	1.000			
$depr_{i,(t-3)}$	-0.0045	-0.125	0.0456	-0.030	1.000		
$sav_{i,(t-3)}$	0.126	-0.44	-0.279	-0.342	-0.179	1.000	
$urban_{i,(t-3)}$	-0.05	-0.165	-0.089	-0.23	0.152	0.135	1.000

Notes to Table 20 the Correlation Matrix were computed from Eviews based on annual data sourced from the IMF's World Economic Outlook and the World Bank's World Development Indicators.

Both the three and five year lag periods confirm a negative and statistically significant relationship between public debt and economic growth among SADC member states included in the sample. This is confirmatory to the earlier scatter plot which suggests a negative correlation between public debt and economic growth for both periods. These results provide preliminary evidence of the negative relationship between public debt and economic growth. Again, confirming the earlier results from the scatter plots, the magnitude of the detrimental impact of public debt on economic growth is more manifest in the five-year lag period (with a coefficient of -0.319) than the three year lag period (with a coefficient of -0.135) period. The same reasoning holds that the impact of public debt on economic growth is more apparent after five years than three years as three years is too short a period for the full detrimental impact of public debt to have had its full influence on economic growth.

The two sets of results are also complementary in suggesting the presence of growth convergence among SADC economies. This is reflected by the negative sign on the coefficient of the initial level of GDP per capita $(y_{i,t-3}, and\ y_{i,t-5})$ for the three and five year lag periods, respectively. Presence of convergence among SADC member states is consistent with the view that economies with lower levels of GDP tend to grow faster in the long run (Barro, 2015, Barro, 1991, Barro, 2013).

Table 21: Correlation Matrix: Five-Year Lags

	$\boldsymbol{y_{i,t} - y_{i,(t-5)}}$	$\boldsymbol{y_{i,(t-5)}}$	$\boldsymbol{infl_{i,(t-5)}}$	$\boldsymbol{gdebt_{i,(t-5)}}$	$\boldsymbol{depr_{i,(t-5)}}$	$\boldsymbol{sav_{i,(t-5)}}$	$\boldsymbol{urban_{i,(t-5)}}$
$y_{i,t} - y_{i,(t-5)}$	1.0000						
$y_{i,(t-5)}$	-0.258	1.000					
$infl_{i,(t-5)}$	0.155	0.163	1.000				
$gdebt_{i,(t-5)}$	-0.319	0.262	-0.116	1.000			
$depr_{i,(t-5)}$	-0.047	-0.124	0.011	0.047	1.000		
$sav_{i,(t-5)}$	-0.0088	-0.261	-0.102	-0.27	-0.14	1.000	
$urban_{i,(t-5)}$	-0.068	0.080	-0.010	0.12	0.64	0.043	1.000

Notes to Table 21 the Correlation Matrix were computed from Eviews based on annual data sourced from the IMF's World Economic Outlook and the World Bank's World Development Indicators.

Both sets of results reveal no presence of multi-collinearity whose degree is too high to warrant some multi-collinearity concerns. This reflects that there are no two or more predictor variables in our sample that are highly correlated hence we can partial out the effect of each regressor on subsequent economic growth. We now proceed with the panel estimation results.

The panel regression results for the three and five year lags are presented in Tables 21 and 22, respectively. As is standard in the literature, we estimated the Pooled OLS and tested for the presence of heteroscedasticity for both the three and five-year lag periods. The Breusch-Pagan tests for heteroscedasticity for the three and five-year lags (with p-values of 0.012 and 0.3844, respectively) are presented in Table 21 and 22, respectively. The results reveal presence of heteroscedasticity among the three-year period wheres there is no heteroscedasticity among the five-year lag period. Presence of heteroscedasticity implies that there is unequal variability of omitted variables in the stochastic error term (Baltagi, 2013). The concequences of heteroscedasticity is loss of efficiency which later distorts statistical inferences, with the resultant effect of failing to reject every null hypotheses.

We therefore followed standard procedure in the literature (Masunda, 2012, Baltagi, 2013) by estimating a Feasibile Generalised Least Squares (FGLS) for the three year lag period for us to avoid committing Type II errors but proceeded to estimate the fixed effects (within effects) estimator before estimating the system GMM estimator.

We also tested for cross-sectional dependence using Pesaran's cross sectional dependence test (with p-values of 0.4301 and 0.376, respectively), for the three and five-year lags. The results reveal no evidence to suggest presence of cross sectional dependence for both the three and five year lag periods. These results are somewhat surprising as SADC economies would be expected to be subject to common world wide shocks which may not rule out the possibility of cross-sectional dependence across the SADC region.

We now turn to the analysis of the impact of public debt-to-GDP ratio on subsequent economic growth among the fourteen SADC member states included in our panel. As we have noted before, our preferred estimator is the system GMM estimator on which we focus much of our attention.

The system GMM results for the three-year lag period reveal that initial debt impacts positively on subsequent economic growth, though not statistically significant. These results are also confirmed by the Feasible Generalised Least Squares (FGLS) estimator. The lack of statistical significance of initial debt on economic growth might be revealing that three years might be too short for initial debt to filter into the system to the extent that any meaningful influence of public debt on economic growth can significantly be felt after three years. The Wald test with p-value of 0.0000 implies that all the variables are statistically different from zero, and hence the whole model is jointly relevant in explaining subsequent economic growth at 1% significance level. However, most of the variables are not statistically significant, except for the initial values of inflation($infl - 3$) and initial GDP per capita($y_{i,t-3}$). It is also interesting to note that inflation is positively related to economic growth. This might seem puzzling but Barro (2013) argued that inflation only starts to have a detrimental effect on economic growth at high levels of, say, 40%.

Table 22: Three-year Lag Regression Results

Variable	Pooled OLS	FGLS	System GMM
Log of initial GDP	-0.123	-0.274***	-0.0445**
	(-1.49)	(-4.10)	(-3.11)
Initial public debt to GDP ratio	-0.000068	0.000036	0.000019
	(0.62)	(0.21)	(0.12)
Initial inflation	0.000014	0.000024	0.000017*
	(1.07)	(1.52)	(2.30)
Initial savings	0.00018	-0.00047	-0.00048
	(0.35)	(-0.89)	(-0.62)
Initial dependence ratio	-0.000032	-0.00049	0.000064
	(-0.12)	(-0.41)	(0.13)
Initial urbanisation	-0.00066	-0.00082	-0.00021
	(0.75)	(-0.31)	(-0.40)
Constant	.092	1.504	.25
Breusch-Pagan test	6.32		
	(0.0120)		
Pesaran's CD test	-0.789		
	(0.43)		
Waldi chi2	0.89	85.38	64.11
	(0.51)	(0.000)	(0.000)
L1			-0.193*
			(-2.08)
Time dummies		YES	
AR (1) test			-1.8214
			(0.068)
AR(2) test			1.6034
			(0.1089)
Sargan test			39.009
			(0.9085)
Number of countries	14	14	14
Number of observations	68	68	54

Notes to Table 22: the dependent variable is the growth rate of the log of GDP per capita. Annual data covers the period 1980 to 2015 and were obtained from the International Monetary Fund (IMF)'s World Economic Outlook and the World Bank's World Development Indicators. Robust standard errors are in parentheses for the specification tests while p-values are in parentheses for the Breusch-Pagan test, Waldi chi2, AR (1), AR (2), and Sargan test. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively. The Pooled OLS, FGLS, and Blundell and Bond (1998) system GMM estimator with Windmeijer finite-sample correction are reported in columns 2, 3, and 4 respectively.

The statistical significance of the initial values of GDP per capita and inflation may suggest that these variables individually have a significant influence on economic growth within a three-year lag period. All the variables, however, have expected signs from an economic theory perspective.

The negative and statistically significant sign (with a p-value of 0.002) on the coefficients of the initial per capita real GDP is evidence of convergence among SADC economies for the three-year lag period. However, the presence of convergence among SADC member states contradicts a number of earlier findings on growth within an African conetext such as studies by Kumo (2011) and Zyuulu (2009) which did not found evidence of convergence in the data. A number of factors justifying the lack of convergence among SADC economies have been cited in the literature (Zyuulu, 2009, Kumo, 2011). These include, but are not limited to, differences in tariff systems, inflation rates, debt-to-GDP ratios, monetary growth, lack of financial deepening of markets with the exception of South Africa, inadequate and substandard transport systems, and insignificant production and manufacturing capability. Regardless of such convincing justification for a lack of convergence, the data generating processes of our sample show significant presence of convergence among SADC member states.

As has been discussed, the consistence of the system GMM depends on the lack of second order autocorrelation and the validity of the instruments. Our results reveal presence of first order serial correlation and no evidence of second order autocorrelation, as per the results of the Arellano-Bond test for zero correlation (with a p-value of 0.0686 and 0.1089, respectively). The presence of first order autocorrelation is confirmatory evidence of the fact that the instruments, as will be formally confirmed by the Sargan test, are not only valid but relevant, while the presence of second order autocorrelation is one condition to be fulfilled if the system GMM parameter estimates are to be consistent. The Sargan statistic of the test of overidentifying restrictions is insignificant, with a p-value of 0.9085. This leaves us with no evidence to reject the hypothesis that the instruments are valid. We can safely conclude that our three-year lag parameter estimates from the system GMM are consistent as they pass the two key conditions.

Our panel estimation results for the five-year lag period are presented in Table 23 Considering the five-year lag period, all the explanatory variables are statistically significant, with the exception of initial savings. This is confirmed by the F-Test which is also highly statistically significant (with a p-value of 0.0000), implying that the model jointly explains subsequent economic growth. This attests to the fact that public debt and the rest of the other control variables in the model individually and collectively help to explain movements on subsequent economic growth among SADC economies over a five-year period. All the variables carry the expected signs as guided by economic theory.

With regard to the main objective of this study; initial public debt has a statistically significant positive relationship on subsequent economic growth among SADC economies over the five-year lag period. For the five-year lag period, a 10% increase in public debt is associated with a subsequent economic growth payoff of 0.003%. These results contradict those of a recent study by Da Veiga et al. (2016) in a study of public debt and inflation on economic growth in 52 African economies

Table 23: Five-year Lag Regression Results

Variable	Pooled OLS	Fixed Effects	System GMM
Log of initial GDP	-.023*	-0.453**	-0.054*
	(-1.77)	(-3.39)	(-2.31)
Initial public debt to GDP ratio	-0.0003*	-0.00085*	0.000299**
	(-1.80)	(-2.35)	(2.45)
Initial inflation	0.000024	7.75e-07	0.0000424***
	(1.06)	(0.02)	(5.54)
Initial savings	-0.00078	-0.00054	6.45e-06
	(-1.06)	(-0.68)	(0.01)
Initial dependence ratio	-0.00045	-0.0011	-0.00109***
	(-0.79)	(-0.60)	(-4.04)
Initial urbanisation	0.003	0.0047	0.01045*
	(0.49)	(0.55)	(1.70)
Constant	.214	2.24	0.34
Breusch-Pagan test	0.76		
	(0.38)		
Pesaran's CD test	-0.885		
	(0.3760)		
L1			-.0746
			(-0.42)
Wald chi2	1.57	3.41	127.21
	(0.1805)	(0.0067)	(0.000)
Time dummies		YES	
AR (1) test			-3.35245
			(0.7245)
AR(2) test			-.84428
			(0.3985)
Sargan test			8.1265
			(0.985)
Number of countries	14	14	14
Number of observations	48	48	34

Notes to Table 23: the dependent variable is the growth rate of the log of GDP per capita. Annual data covers the period 1980 to 2015 and were obtained from the International Monetary Fund (IMF)'s World Economic Outlook and the World Bank's World Development Indicators. Robust standard errors are in parentheses for the specification tests while p-values are in paretneses for the Breusch-Pagan test, Waldi chi2, AR (1), AR (2), and Sargan test. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively. The Pooled OLS, Fixed, and Blundell and Bond (1998) system GMM estimator with Windmeijer's finite-sample correction are reported in columns 2, 3, and 4 respectively.

The positive relationship between public debt and economic growth is in support of the Keynesian view. The insight one might get is that public debt among the 14 SADC member states included in the panel is used for developmental purposes like research and development (R&D), education, infra-structure development, and health thereby leading to positive results on economic growth unlike situations when public debt were to be used for consumption purposes thereby negatively impacting on subsequent economic growth.

As is well established in the literature, the consistence of the system GMM estimator rests on the absence of second order serial correlation and the validity of the instruments used. The second order autocorrelation is above 10% (39.85) thus confirming that the model does not suffer from second order serial correlation. Furthermore, the validity of the instruments was formally tested using the Sargan test of overidentifying restrictions for us to accept the null that the overidentifying restrictions are valid as the p-value is above 10% (p-value of 0.994). Hence, it may be concluded that our five-year lag system GMM estimators are consistent as they have fulfilled the two paramount conditions required for the consistence of system GMM estimators to hold.

There are striking similarities between the results of our three-year and five-year lag periods. The first major noteworthy similarity is that public debt has a positive and statistically significant impact on economic growth among the 14 SADC member states included in our analysis. Nevertheless, the economic impact of public debt on economic growth is less prominent in the three-year lag period (with a coefficient of 0.0000191) as compared to the five-year period with a coefficient of 0.000299. This is not surprising as it is well established in the literature that public debt together with any other growth determinant take time to filter into the system and for its effect to have a noteworthy impact on economic growth. Another salient similarity is that there is convergence in both the three and five-year lag periods in our sample.

Notable differences, however, exist between the three-year lag and the five-year lag period results. While most of the control variables used in the analysis are not individually statistically significant over a three-year lag period, the majority of these are statistically significant over a five-year lag period. The intuition behind these results is that initial values of most of the variables take time to filter into the system and their impact on economic growth is discernible only after three years and can be meaningfully felt within a five-year horizon. This is crucial for policy makers as it has to be known that the impact of growth determinants is not felt immediately but take time to filter into the system and their impact on subsequent economic growth is felt well over a three- year's period.

5.5.3 System GMM Five-year Averages Evidence

This section presents our empirical results on the relationship between public debt and economic growth based on the system GMM results from utilising five-year averages of the variables. The use of averages is predominantly appealing in the literature as it smoothes out cyclical movements in the data. This approach was adopted by, among others, Fukase (2010) and Caselli et al. (1996).

As is the case with other growth regressions in the earlier sections of this chapter, our panel consists of observations from 14 SADC member states with Zimbabwe excluded due to data unavailability. The dependent variable is the growth rate of GDP per capita (y) which is in this case a five-year growth average expressed in logarithmic form. The dependent variable, GDP per capita and our explanatory variable of interest, general government gross debt expressed as a percentage of GDP $(gdebt)$ are sourced from the IMF's World Economic Outlook. The other explanatory variable is the government consumption expenditure measured in local currencies which is transformed into logarythimic form; and the exchange rate defined as the period average of the national currency per US$ is obtained from the IMF's International Financial Statistics IMF's (IFS).

Conversely, our indicator of inflation is the GDP deflator expressed as a percentage change and the trade share expressed as the sum of exports and imports expressed as a percentage of GDP are obtained from the World Bank's World Development Indicators.

We make use of five-year averages in this section so as to address any possible cyclical movements in the data. Given its superiority over other micro-panel estimators, our preferred estimation technique is the system GMM estimator. For robustness we also estimate a series of panel growth regressions using the following estimation techniques: pooled OLS estimator, fixed effects estimator, first-differenced GMM, and system GMM estimator. Like in the earlier sections, of this chapter, our empirical model is rooted in a neoclassical growth model. We specify our baseline estimation model as follows:

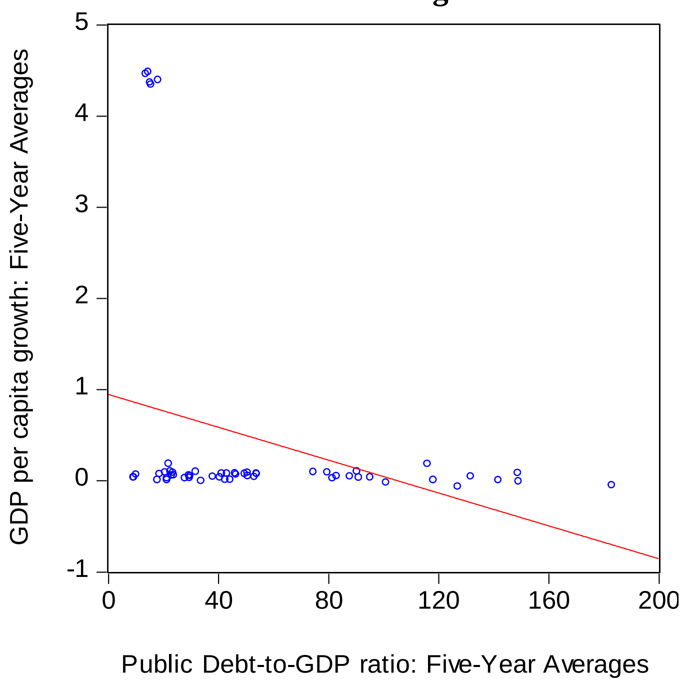
$$y_{it} - y_{i(t-q)} = \beta y_{i(t-q)} + \acute{x}_{it}\gamma + \omega_t + \eta_i + v_{it} \qquad 5.6$$

where y_{it} is the logarythm of real per-capita GDP in country i in year t; $x_{it}$is a vector of explanatory variables; ω_t is the time specific effects which captures common global shocks; $\eta_i$is the country-specific effects; and v_{it} is the error term. $y_{i(t-q)}$ is the initial five-year real per capita GDP and all the other variables are five-year averages. Following this modelling framework we specify the empirical model in this section as follows:

$$y_{it} - y_{i(t-5)} = +\beta_0\beta_1 y_{i(t-5)} + \beta_2 trade_{it} + \beta_3 gdebt_{it} + \beta_3 exch_{it} + \beta_4 lcons_{it} + \beta_4 deflator_{it} + \omega_t + \eta_i + v_{it} \qquad 5.7$$

We now present the preliminary analysis of the relationship between public debt-to-GDP ratio. Figure11 illustrates the central findings of this section on the growth effects of public debt in the 14 SADC member states used in this panel from using the five-year averages approach.

Figure 11: The Relationship between Public Debt and Economic Growth in SADC: 1980-2015: Five Year Averages



Notes to Figure 11: the scatter plot was drawn in Eviews from annual data on gross public debt to-GDP-ratio, as the independent variable on the horizontal axis and GDP per capita growth rate obtained from the IMF's World Economic Outlook. Each dot represents an observation for the five-year averages for the 14 SADC member states included in the sample for the period 1980 to 2015. It was expected that each of the 14 countries would enter the scatter plot with 9 average observations from 1980-1985; 1986-1991… and lastly 2010-2015 and thereby having 98 observations in the scatter plot. However, this is not the case due to data unavailability. Data for public debt-to-GDP ratio for most of the countries are available as from the 1990s onwards, at best. Each country ended up with different five-year average observations depending on the availability of data.

The insight from Figure11 is that public debt is negatively related to subsequent economic growth among the 14 SADC member states included in the sample. The fitted regression line is significantly trending downwards revealing that low levels of public debt-to-GDP ratios are associated with high levels of economic growth. This is yet to be formally confirmed by our panel estimation results in the subsequent discussions. We consider discussion of the summary statistics next.

Table 23 reports the summary statistics for the 14 SADC member states included in the sample for the period 1980 to 2015 using the five-year averages approach. The summary statistics report, among other measures, the mean, median, standard deviation, minimum and maximum values for the variables included in the analysis. Since the interest in this study is to investigate the impact of public debt-to-GDP –ratio on economic growth as proxied by the growth rate of GDP per capita, the study primarily focuses on the two variables.

Table 24: Descriptive Statistics: Five-year Averages

	$y_{it} - y_{i(t-5)}$	$y_{i(t-5)}$	$gdebt$	$trade$	$exch$	$lcons$	$deflator$
Mean	0.446	4.56	55.597	97.82	273.356	9.907	23.090
Median	0.055	4.53	42.52	89.62	30.98	10.083	8.701
Maximum	4.48	5.869	182.96	196.83	2310.87	12.92	550.93
Minimum	-0.067	3.45	9.178	36.95	3.004	2.26	1.039
Std. Dev	1.266	0.64	43.11	45.017	525.72	2.021	75.845
Skewness	2.841	0.166	1.121	0.668	2.367	-1.969	6.425
Kurtosis	9.085	2.32	3.351	2.337	7.847	8.221	44.502
Jargue-Bera	158.83	1.311	11.79	5.098	105.23	98.02	4325.6
Probability	0.0000	0.52	0.003	0.078	0.0000	0.000	0.000
Observations	55	55	55	55	55	55	55

Notes to Table 24: annual data covers the period 1980 to 2015, and were obtained from the International Monetary Fund (IMF)’s World Economic Outlook and the World Bank’s World Development Indicators.

The maximum and minimum five-year averages of public debt-to-GDP ratio over the period under analysis are 182.96 and 55.6, respectively. The maximum five-year average is way above the SADC’s threshold of 60% public debt-to-GDP ratio. Judging by this SADC set target, it can be inferred that the average public debt-to- GDP ratios for SADC member countries are reasonably high. Moreso on average SADC economies’ minimum five-year average of public debt-to-GDP ratio of 55.6 is very close to the 60% target. In general, the public debt-to-GDP ratio can be characterised as fairly high over the entire period under review. This, therefore, warrants the need for an investigation of the possible growth effects of public debt among SADC economies.

We present the results of the correlation matrix in Table 24. Our motive is threefold: to infer of the pairwise correlation between public debt and economic growth in our sample; investigate the possible growth convergence in the sample; and as well, detect any possible occurrence of multi-collinearity whose degree warrants some estimation concerns.

Table 25: Correlation Matrix

	Economic Growth Rate	**Initial Income**	**Trade Openness**	**Public Debt**	**Exchange Rate**	**Government Consumption**	**Deflator**
Economic Growth Rate	1.000						
Initial Income	-0.091	1.000					
Trade Openness	0.236	-0.397	1.000				
Public Debt	-0.307	0.195	-0.015	1.000			
Exchange Rate	-0.17	0.628	-0.34	0.018	1.0000		
Government Consumption	-0.112	0.38	-0.457	-0.0037	0.467	1.000	
Deflator	-0.057	0.072	-0.163	0.311	-0.011	-0.072	1.000

Notes to Table 25: annual data covers the period 1980 to 2015, and were obtained from the International Monetary Fund (IMF)'s World Economic Outlook and the World Bank's World Development Indicators

Table 25 shows that the five-year average public debt-to-GDP ratio is negatively correlated with subsequent economic growth. To be more precise, a 10% increase in public debt-to-GDP ratio is associated with a slowdown on subsequent economic growth by 3%. The coefficient of the initial level of real per capita GDP is negatively signed thereby suggesting evidence of convergence among the 14 SADC economies included in the sample. This is a subject to be confirmed by the panel regression results to be presented in later in this section.

An analysis of the pairwise correlation reflects that there is no pairwise correlation which is close to one or above 90% thereby ruling out any problems of multicollinearity. We then proceed to present our panel regression results.

We present the empirical results from various estimation techniques in Table 25. As is standard procedure in the literature, we first estimated the Pooled OLS estimation and tested for the presence of heteroscedasticity. As reflected in Table 25, the Breusch-Pagan test reveals presence of heteroscedasticity (with a p-value of 0.000). In principal, our results imply that the variability of GDP per capita is unequal across the explanatory variables. Proceeding with our estimation in the presence of heteroscedasticity has the consequence of loss of efficiency which distorts the statistical inferences, with the resultant problem of failing to reject the null hypothesis.

Table 26: Panel Estimation Results: Five-Year Averages

Variable	Pooled OLS	FGLS	Differenced GMM	System GMM
Log of initial GDP	.3968619	.3968619	-.3059	.022264
	(1.12)	(1.20)	(-1.20)	(1.15)
Public debt-to-GDP ratio	-.0107004*	-.0107004**	-0.0010733**	-.0008313***
	(-2.58)	(-2.76)	(-2.44)	(-4..39)
GDP deflator	.0014	.0015	1.10e-06	.003320
	(0.61)	(0.65)	(0.00)	(1.33)
Trade share	.0076*	.00757*	-.00043**	.000517***
	(1.72)	(1.85)	(-3.00)	(4.48)
Exchange rate	-.00052	-.00052	-.0001008	-.0000409*
	(-1.21)	(-1.30)	(-1.61)	(-1.81)
Log of government consumption	.0245	.0245	.0787	.0231**
	(0.24)	(0.26)	(1.61)	(2.99)
Constant	-1.644	-1.644	1.237	-.351
L1			-.043	.998***
			(-0.16)	(217.94)
Breusch-Pagan test	27.19			
	(0.000)			
Pesaran's CD test		-.624		
		(0.533)		
Wald chi2	1.81	12.44	51.58	407681.03
	(0.117)	(0.0529)	(0.000)	(0.0000)
Time effects		Time effects		
Arellano-Bond AR(1)			-.52083	-1.3154
			(0.6025)	(0.1884)
Arellano-Bond AR(2)			.47662	1.3704
			(0.6336)	(0.1706)
Sargan test			23.38378	24.10522
			(0.2703)	(0.9779)
Number of countries	14	14	14	14
Number of observations	55	55	27	41

Notes to Table 26: the dependent variable is the growth rate of the log of GDP per capita. Annual data covers the period 1980 to 2015 and were obtained from the International Monetary Fund (IMF)'s World Economic Outlook and the World Bank's World Development Indicators. Robust standard errors are in parentheses for the specification tests while p-values are in parentheses for the Breusch-Pagan test, Waldi chi2, AR (1), AR (2), and Sargan test. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively. The Pooled OLS, FGLS, Arellano-Bond (1991) Difference GMM and two-step Blundell and Bond (1998) system GMM estimator with Windmeijer's finite-sample correction are reported in columns 2, 3, 4, and 5 respectively.

Following Baltagi (2013), we estimated a Feasible Generalised Least squares (FGLS), which addresses the problem of heteroscedasticity. We also conducted tests for cross-sectional dependence using the Pesaran's Cross-Sectional dependence test. From our results, we do not have enough evidence to reject the null of no cross-sectional dependence (with a p-value of 0.5327). Having confirmed absence of cross-sectional dependence we proceed to estimate the Arellano and Bond (1991) difference GMM estimator and the two-step Blundell and Bond (1998b) system GMM estimator with Bond et al. (2001) finite-sample correction.

The coefficients on the initial log of real per capita GDP (lagged dependent variable) is positive in all cases and only serve for the difference GMM estimator, is not statistically significant for all the four estimators. This provides strong evidence in favour of conditional divergence. Lack of conditional convergence in the results is in line with earlier findings (Kumo, 2011, Zyuulu, 2009) in growth studies within an African context.

Reiterating the objective of this study; an analysis of the impact of public debt on economic growth in the 14 SADC member states included in the sample, the results reveal a negative and statistically significant relationship between public debt and economic growth among the 14 SADC member states included in the panel. These findings are consistent with the neoclassical view that public debt has detrimental effects on economic growth. For our preferred estimator, the system GMM estimator, a 10% increase in public debt-to-GDP ratio is associated with a subsequent growth slowdown of 0.008%. The findings in this is consistent with other earlier studies (Woo and Kumar, 2015, Afonso and Jalles, 2013, Adam and Bevan, 2005, Schclarek, 2005, Panizza and Presbitero, 2014) who also documented the growth retarding impact of public debt.

Nonetheless, the consistency of the first-differenced and system GMM estimators is dependent on the validity of the instruments used and the presence of second order serial correlation. Both the first difference GMM and the system GMM results show presence of second order serial correlation with p-values of 0.633 and 0.17, respectively, thereby fulfilling one of the conditions for the consistency of the difference and system GMM estimators in this study. We apply the Sargan test of over-identifying restrictions and find no grounds to reject the validity of the instruments for both the first difference and system GMM estimators - with p-values of 0.27 and 0.978, respectively.

Our findings in this section are in sharp contrast to those we obtain in previous sections when using different estimation approaches. We, therefore have tried alternative specifications so as to confirm if the detrimental effects of public debt on economic growth using the five-year averages is robust to different specifications.

Using a series of different specifications, we estimated a number of panel regressions using the system GMM to test the sensitivity of the results to the conditioning variables included. The full results are attached in Appendix B5. In our first specification we estimated public debt-to-GDP ratio conditioned on the exchange rate$(exch)$, developmental assistance aid (aid), general government consumption$(lcons)$, ratio of total investment GDP(inv), and inflation $(infl)$. We tried different specifications but all confirm a negative relationship between public debt and economic growth. This leads us to conclude that the adverse effects of public debt on economic growth based on five-year averages is robust to various model specifications.

The next section concludes our panel empirical findings on the growth effects of public debt on subsequent economic growth in SADC presented in this chapter, based on various estimation approaches.

5.6 Conclusion

This chapter presents the empirical analysis of the impact of public debt on subsequent economic growth in an unbalanced panel of 14 SADC member countries observed from 1980 to 2015 using alternative panel growth estimation approaches. Holding a number of country specific characteristics constant, the data revealed interesting findings on the nexus between public debt and economic growth among SADC member countries.

We rely on both panel time series (DOLS and FMOLS) estimation approaches as well as macro-panel estimation approaches (system GMM from use of initial values as well as averages) for the empirical evidence. The empirical evidence from the three estimation approaches used provide contradictory results. Whereas, the DOLS and the system GMM when using initial values of public debt-to-GDP ratios are confirmatory in providing evidence in support of the Keynesian view on the growth payoff of public debt-to- GDP ratio, the use of five-year averages- robust to alternative specifications, provides evidence to the contrary. This leads us into some dilemma as to which of the two is the real impact of public debt on economic growth that is supported by the data. We have, however, discriminated in favour of the DOLS results and conclude that public debt has growth stimulating effect on long run economic growth. The use of three year averages turned out to be positive but not statistically signignificant prompting us to conclude that public debt and and any other fiscal policy measure may have a delayed effect on economic growth. We further experimented on non-linearities of public debt on economic growth and establish that debt has a non-linear effect on economic growth. Our analysis of the channels through which debt promotes growth provides evidence that debt is growth promoting when channeled through investment in infrastructure.

This chapter provides a number of contributions to the literature both methodologically and empirically. Firstly, the SADC region has been sidelined as far as the analysis of the growth effects of public debt is concerned. Ours is the first study to empirically assess the growth effects of public debt in a panel of SADC countries. Secondly, by relying on several panel estimation approaches, we hope we have provided empirical results which are robust to different estimation approaches that, we hope, have important implications in an understanding of the public debt-growth process in SADC. Yet the major failing of previous panel growth studies is that researchers are heavily reliant on a single panel estimation approach and then carry out inference as if that model has generated the data (Durlauf et al., 2005). Doing so ignores the fundamental model specification uncertainty that is inherent in any growth regression. Thirdly, we also employ panel time series estimation approaches which take advantage of the flexibility and diversity that goes with time series modelling as well as take advantage of the dynamic growth interactions that is inevitable among SADC economies (Burdisso and Sangíacomo, 2016). Another notable contribution of this chapter is that we analysed the existence or absence of a threshold beyond which public debt hurts economic growth. This is crucial for it provides instructive information for policy makers in the SADC region of the need not to overly rely on public debt. Further to that, a notable contribution of this chapter is to analyse the channels through which public debt is growth enhancing. Ascertaining of the positive role public debt plays to economic growth is one thing and establishing the channels through which fiscal policy is growth supportive is another. We contribute meaningfully in this chapter by analysing and establishing that public debt is growth propagating if it is dedicated towards physical capital investement.

CHAPTER SIX:

THE IMPACT OF BUDGET DEFICITS ON ECONOMIC GROWTH IN SOUTH AFRICA, MADAGASCAR AND LESOTHO: A TIME SERIES APPROACH

6.1 Introduction

The high and persistent federal deficits of the 1980s sparked debate over the long-run effects of budget deficits on economic growth (Shaviro, 1997), resulting in two competing ideological camps. Critics of budget deficits argue that fiscal deficits are akin to "operating in a fool's paradise that will come crushing one day" (Nadler, 2006) or to "borrowing from our kids" (Augusta, 2008),; with the overall argument being that budget deficits are corrosive to long-run economic growth (Greenspan, 1989; Conason, 2010).

Yet, contrary to this negative perception of budget deficits, those who support budget deficits contend that fiscal deficits are growth stimulating as they are an essential instrument for fighting recessions and depressions. They argue that deficit spending is a tool used by the government to fuel public investments in education, health and infrastructure, and that it lays the groundwork for future economic growth (Shaviro, 1997; Barth et al., 1984). Barth et al. (1984) concluded by saying that the long-run effects of budget deficits on economic growth are ambiguous, as not all deficits have similar economic effects. Economic literature is therefore not conclusive on the impact of budget deficits on economic growth.

Turning to SADC economies,; by their very nature, SADC member countries, like any developing economies, have dire needs to combat poverty, and redress the colonial legacy which is characterised by gross inequality. Given this background, most SADC countries, on average, have experienced moderate to high budget deficits over the period under review. Yet, as important as the analysis of the impact of budget deficits on long run economic growth is to SADC member countries, empirical evidence to vindicate the role budget deficits play on SADC member countries is still in its infancy. We contribute to this debate by providing empirical evidence on the impact of budget deficits on three of SADC member countries, namely, South Africa, Lesotho and Madagascar.

This chapter presents our empirical findings on the impact of budget deficit on economic growth on three SADC countries based on a single country analysis. Chapter two laid the theoretical framework on the relationship between fiscal policy (public debt and budget deficits), and economic growth, which provides the theoretical justification for the variables to be used in both this chapter and those used in chapter five. While chapter five presented panel empirical evidence on the analysis of the public debt-growth nexus for 14 SADC countries, this chapter offers empirical evidence based on single country analysis.

We noted earlier that our panel empirical evidence presented in chapter 5 provides a generalised understanding of the impact of public debt on economic growth in SADC. Considering that SADC countries are inherently heterogeneous in their growth dynamics (Bittencourt et al., 2015; Van Eyden, 2015), it is paramount to augment our panel empirical evidence in chapter 5 with single times series, country-specific, analysis of the impact of fiscal policy on economic growth in this chapter. We therefore, hope, from the estimates from this chapter, to provide empirical evidence which is country-specific, from which we can devise policy recommendations tailored to the particular countries analysed in this chapter.

The key empirical results in this chapter reveal that there is a positive association between budget deficit and economic growth in South Africa, Madagascar and Lesotho. The three estimation techniques we relied on were all confirmatory, to the effect that budget deficit is positive, and statistically significant. These results may be suggestive of the fact that budget deficit is channeled towards growth supportive uses, like education, health, and infrastructure in South Africa, Madgascar and Lesotho. Related to this empirical reality is the fact that, compared with the other regressors we used in our growth regressions, budget deficit accounts for the largest variation in economic growth in South Africa and Madagscar, while the economic impact of budget deficit in Lesotho is second after investment in human capital. This bolsters the importance budget deficit plays on long-run economic growth, and in some way, justifies the need and urgency of this study.

The study further shows that the growth enhancing effect of budget deficit was more evident during the democratic era, than during the apartheid regime in South Africa. This could be a reasonable justification for the South African democratic government to incur fiscal deficits, as it is more growth engendering. Contrary to this, our findings show that budget deficit has adverse effects on economic growth under the inflation targeting administration. This could be providing evidence to substantiate South Africa's largest trade federation, Congress of South African Trade Unions (COSATU)'s arguments that inflation targeting adversely affected how macroeconomic fundamentals interact with growth in South Africa,; COSATU's claim is that inflation targeting is solely to blame for South Africa's sluggish growth, and escalating unemployment rates.

Our results, further show that, the interaction between budget deficit and gross fixed capital formation, as well as education, in South Africa and Lesotho is redundant, but the empirical evidence for Madagascar is worth noting. The evidence shows that dedicating budget deficit to physical capital accumulation in the case of Madagscar is growth stimulating. The empirical findings in this chapter further refutes the claim by Reinhart and Rogoff (2010) that budget deficit, at some high levels, impedes economic growth, in the case of South Africa and Madagascar. While our empirical evidence is in support of the absence of a threshold, beyond which further deficits retard economic growth for South Africa and Madagascar, evidence to the contrary was established in the case of Lesotho. For Lesotho, policy makers have to sparingly rely on budget deficit as a counter cyclical measure, as budget deficit is growth supportive at low and moderate levels, but reaches a certain level beyond which budget deficits hurts economic growth. There is need for further studies though to unveil the threshold at which budget deficit starts to retard growth, in the case of Lesotho.

This chapter contributes to the literature in both empirical and methodological respects. Firstly, it adds to the scanty empirical evidence on the impact of budget deficit on economic growth in SADC member countries, particularly, South Africa, Madagascar and Lesotho. Secondly, given the apparent incidence of structural breaks in our series, we depart from the traditional practice of making use of standard unit root, cointegration, and parameter estimation techniques by adopting techniques that remain valid in the presence of structural breaks, in both our unit root and cointegration tests, as well as our parameter estimation techniques. Thirdly, by making use of the DOLS, FMOLS, and the CCR estimation techniques, we make use of some of the recent developments in time series cointegration literature, which are robust to serial correction, and endogeneity problems, that are characteristic features of any growth regression.

This chapter contributes immensely to the literature. By analysing the impact of budget deficit on economic growth on a single country basis, we do not only augment our panel analysis of the impact of public debt on economic growth, in 14 SADC countries, that we presented in chapter five, but we also acknowledge that SADC countries, just like any other group of countries, have deep seated differences that make a “one-policy-fits-all” not feasible. In this spirit, we hope to draw policy recommendations that are country-specific. This chapter adds to the insufficient empirical literature on the relationship between budget deficit and economic growth in South Africa, Madagascar and Lesotho.

More so, we are not aware of studies that have analysed the non-linear effects of budget deficit on economic growth in South Africa, Madagascar and Lesotho. This is crucial, for it provides meaningful policy advice as to the extent to which policy makers have to exercise restraint in their reliance on fiscal policy as a counter cyclical measure. Further to that, particularly for South Africa, we are not aware of any work that has analysed the impact of budget deficit on economic growth in the pre- and post-independent South Africa, save for the work by Mavodyo and Kaseeram (2016), which is still under review with the Journal of Economics. More to that, unlike the majority of previous studies, we arrive at our parameter estimates by employing econometric approaches, that take into consideration structural breaks in our unit root, cointegration tests and parameter estimation techniques. Further to that, our parameter estimation is based on some of the recent developments in econometrics; the Dynamic Ordinary Least Squares (DOLS), Fully Modified Ordinary Least Squares (FMOLS) and the Canonical Cointegration Regression (CCR); which are superior in that they correct for endogeneity, serial correlation, allow for the immediate visualisation of the cointegration vectors, and are generally more robust compared to methods based on Johansen methodology (Chen et al., 1999).

Consistent with our objective of providing empirical evidence on the impact of budget deficit on economic growth in South Africa, Madagascar and Lesotho. We put our analysis in its proper context: section 6.2 justifies our selection of the three countries analysed in this chapter, as well as providing an overview of the budget deficit-economic growth evolution in those countries. This is followed by a discussion of the framework of analysis that is presented in section 6.3, which includes data source and description, unit roots and cointegration tests, the theoretical framework and model specification, the estimation procedure, and lastly, the post-estimation diagnostic checks. Section 6.4 presents our single country empirical evidence on the impact of budget deficits on economic growth in South Africa, Madagascar and Lesotho. Section 6.5 concludes the chapter.

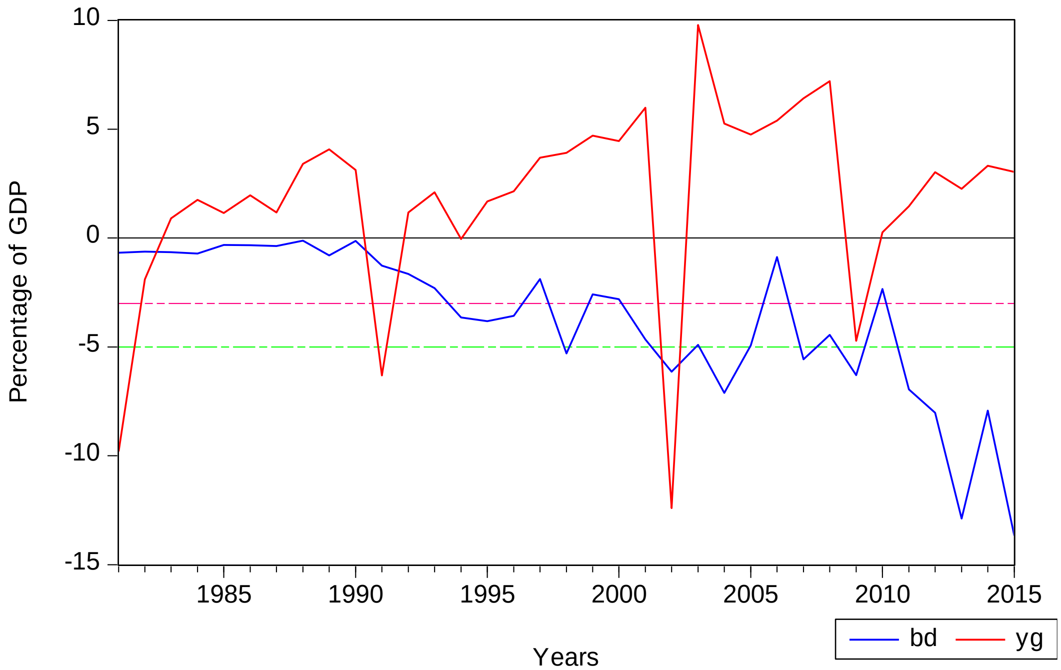
6.2 Budget Deficits and Economic Growth Evolution in South Africa, Madagacsar and Lesotho

This section presents a brief evolution of budget deficits and economic growth in Madagascar, South Africa and Lesotho, and our justification for choosing these three countries out of a total of fifteen SADC member countries.

Of the 15 SADC member countries, Madagascar presents the most compelling case study for our analysis in many respects. Madagascar, by IMF. (2009) and IMF (2015) classification, is a low income country which has consistently had budget deficits over the entire period of our study (1980 to 2015). According to the United Nations Development Program (UNDP) Country Economic Outlook (Dabire and Bi, 2014), Madagascar has one of the highest poverty levels in SADC, with over 70% of the populace living below the absolute poverty datum line. Madagascar, as well, has one of the highest unemployment rates well above 81% (Dabire and Bi, 2014). Given that Madagascar has run consistent budget deficits since 1980, of all the SADC member countries, and has a historic poverty and unemployment, a closer look at the analysis of the possible impact of budget deficits on economic growth that also has a direct impact on poverty reduction and employment generation, is well deserving.

Figure 12 shows the evolution of budget deficits and economic growth in Madagascar for the period 1981 to 2014. Madagascar attained positive economic growth for most of the years since 1980 with economic growth noticeably dipping in the years 1991, 2002 and 2009. The sharp falls in the economic growth performance in 2002 and 2009 could be attributed to the political instability in that country during these years (Dabire & Bi, 2014).

Figure 12: Budget Deficits-Economic Growth Evolution in Madagascar: 1981-2015

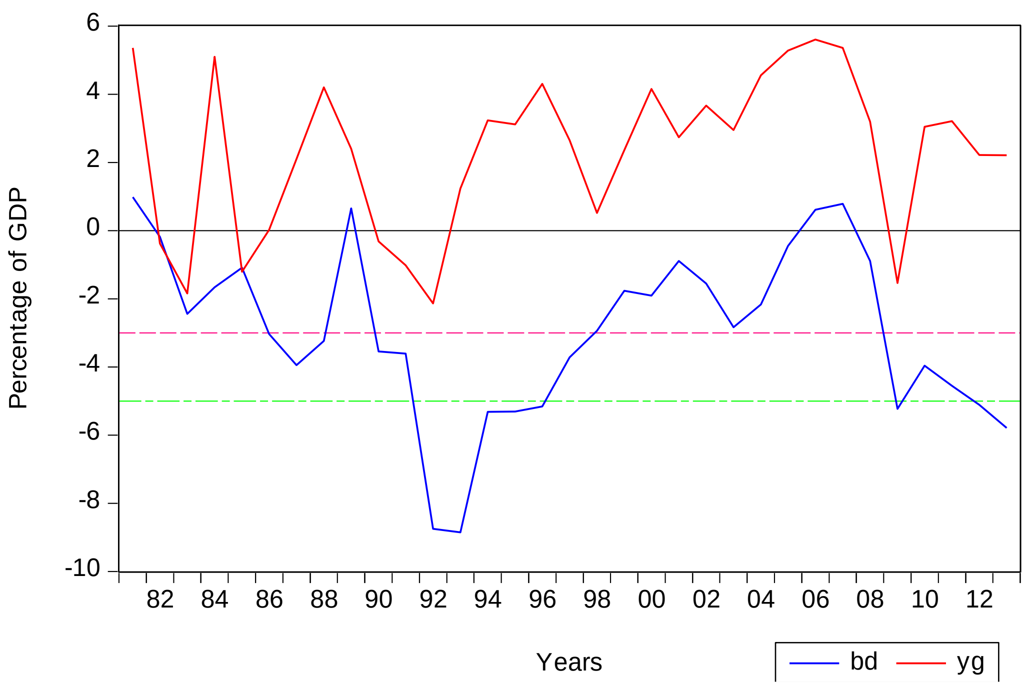


Notes to Figure 12: the figure is drawn based on data obtained from the IMF's World Economic Outlook. The abbreviations, bd and yg stand for budget deficits expressed as a percentage of GDP and economic growth expressed as a year-on-year percentage change in gross domestic product, respectively. The bold line on the zero axis is there to show when the two variables were either in the positive or negative, range with the green dotted line along the -5, and red dotted line along the -3 horizontal lines showing the budget deficit threshold set for SADC member countries for 2008 and 2012; respectively. This is meant to see by how much the budget deficit was falling within or outside the set SADC targets.

Turning to South Africa, we found various compelling reasons for choosing it to be one of the countries analysed in this chapter. Owing to its economic importance in SADC, and arguably in the rest of Africa, we found South Africa to be another interesting candidate in our single country analysis of the impact of budget deficits on economic growth. South Africa, is classified by the IMF (2009) and IMF (2015) as a middle income country, that is best described as the "economic powerhouse of Southern Africa" (IMF, 2012, IMF, 2015), and as such, we feel it is justified to be included in our analysis. South Africa contributes the largest to the regional GDP, whose contribution is $^{2}/_{3}$ of total SADC output, although Botswana and Mauritius have the highest per capita GDP (Burgess, 2009). We found it highly meritorious for us to analyse the impact of budget deficits on economic growth in South Africa, together with other countries, since it contributes immensely to the economy of SADC. Given South Africa's economic importance in the region, economic slowdown to it is likely to have negative spillover effects in the rest of SADC, hence sound macroeconomic policies to South Africa are not only vital to it alone, but to the rest of the SADC region.

Turning to the evolution of the budget deficits and economic growth in South Africa, there are striking similarities between South Africa and Madagascar. Just like Madgascar, South Africa has been characterised by moderate budget deficits since 1980, with the highest budget deficits in the years 1992, 1993 and 2009. The economic growth rate, save for the year 2009, has been in the positive range, but well below the 7% target set by SADC for 2008 and 2012. Figure 13 shows the evolution of budget deficits and economic growth in South Africa over the period 1981 to 2014.

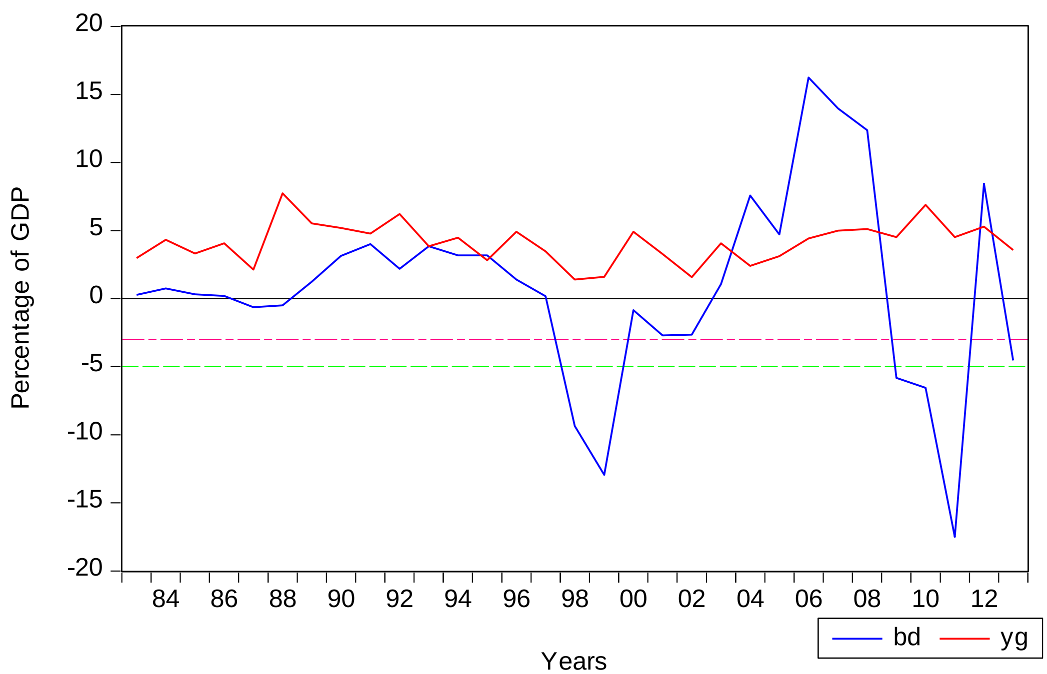
Figure 13: Budget Deficits-Economic Growth Evolution in South Africa: 1981-2014



Notes to Figure 13: the figure is drawn based on data obtained from the IMF's World Economic Outlook. The abreviations, bd and yg stand for budget deficits expressed as a percentage of GDP and economic growth expressed as a year-on-year percentage change in gross domestic product, respectively. The bold line on the zero axis is there to show when the two variables were either in the positive or negative with the green dotted line along the -5 and red dotted line along the -3 horizontal lines which shows the budget deficit threshold set for SADC member countries for 2008 and 2012, respectively. This is meant to show by how much the budget deficit was falling within or outside the set SADC tragets.

The final SADC country unders study is Lesotho, which is arguably the smallest SADC member country in geographical size and population. Lesotho is characterised by widespread poverty, heavily dependant on very volatile revenues from the Southern African Customs Union (SACU) (IMF, 2016), and is the third country we use to nalyse the impact of budget deficit on economic growth. As figure 14 shows, the budget deficit evolution for Lesotho is very unstable, revealing, in part, that the country's reliance on very volatile revenue sources from SACU (IMF, 2012, IMF, 2016). We were relatively motivated in this choice by the impressive data availability in Lesotho, compared to other SADC member countries, and the need to analyse the impact of budget deficit on economic growth in a country with such unstable revenue sources, yet which has achieved robust economic growth since 1980.

Figure 14: Budget Deficits-Economic Growth Evolution in Lesotho: 1983-2014



Notes to Figure 14: the figure is drawn based on data obtained from the IMF's World Economic Outlook. The abreviations, bd and yg stand for budget deficits expressed as a percentage of GDP and economic growth expressed as a year-on-year percentage change in gross domestic product, respectively. The bold line on the zero axis is there to show when the two variables were either in the positive or negative with the green dotted line along the -5 and red dotted line along the -3 horizontal lines which show the budget deficit threshold set for SADC member countries for 2008 and 2012, respectively. This is meant to show by how much the budget deficit was falling within or outside the set SADC tragets.

Nonetheless, it would also have been particularly interesting to have analysed the impact of budget deficits on economic growth in other SADC member countries not analysed in this chapter. An exceptionally remarkable example is Botswana, which exercised exceptional fiscal prudence, consistently attaining fiscal surpluses, well above 20% of GDP, on its fiscal balances since 1980 (Burgess, 2009). It would have been thought-provoking, therefore, to found out the role fiscal austerity plays on long run economic growth. Another interesting example that deserved analysis in this chapter would have been Mozambique. Mozambique, on the backdrop of sizeable foreiegn direct investments, has attained impressive economic growth rates coinciding with low to moderate budget deficits for the entire period under our study (IMF., 2012). It would have, therefore, been noteworthy to comprehend the role budget deficits plays in the striking growth rates attained in a country characterised by consistent levels of fiscal deficits and foreigh direct investments.

We were, however, constrained to this end by the unavailability of data on budget deficit from over 30 observations that would warrant econometric analysis in a time series framework. We hope to make a follow up in this regard in our future research endevours if this task is not accomplished by other researchers in the field.

6.3 Methodology

6.3.1 Theoretical Framework Model Specification and Variable Description

This section first presents, briefly, the theoretical model we employ in this chapter to analyse the growth effects of budget deficits in South Africa, Madagascar and Lesotho, before we present our empirical model specification, as well as a description, and justification, of the variables employed in our analysis.

Our growth analysis in this chapter is rooted in the endogenous growth model, which is premised on the firm understanding that long-run economic growth is generated from within the system, as a direct result of deliberate internal processes like enhancement in physical and human capital, innovation, and research and development.

In the spirit of Kassu et al. (2014), Buscemi and Yallwe (2012), and Keho (2010), we consider a multiplicative model of the economy in Cobb-Douglas fashion. Our model differs from the traditional production functions considered in the literature in that budget deficit is also incorporated as a determinant of long-run economic growth in addition to capital and labour. Our theoretical model takes the form:

$$lnY = AL^{\beta_1}K^{\beta_2}BD^{\beta_3}X^{\beta_4}e^{\mu_1} \qquad (6.1)$$

Where; lnY; denotes the log of GDP per capita as a measure of the growth rate of the economy, L is investment in human capital, K denotes investment in physical capital, A denotes total factor productivity, and, lastly, X is a vector of other growth determinants. On the other hand, β_1, β_2, β_3, and β_4 are the output elasticities of labour, capital and budget deficits (BD), and other growth determinants, respectively. As usual, e^{μ_i} represents the stochastic error term (μ_i) in exponential form.

Given this background, we specify our endogenous empirical model, encompassing budget deficits, investment in human and physical capital and an array of other growth determinants, as follows:

$$lny_t = \gamma_0 + \gamma_1 bd_t + \gamma_2 gfc_t + \gamma_3 pger_t + \gamma_4 X_t + \varepsilon_t \qquad (6.2)$$

where γ_0 is the constant, and γ_1 to γ_4 are partial derivatives with respect to each of the explanatory variables, respectively,; and ε_t is the stochastic error term, with usual properties of zero mean, normal distribution, and a constant variance $\left(\varepsilon\ iid{\sim}N(0,\delta^2)\right)$, while t signals time.

Following standard practice in the literature, (Seleteng and Motelle, 2015, Bittencourt et al., 2015) our endogenous variable; lny_t, in every case, is the natural logarithm of GDP per capita which is the proxy for economic growth. We log transform the GDP per capita for us to control for extreme values in the series.

Taking the first partial derivative of equation 6.2, with respect to budget deficits (bd) yields; γ_1, which is our slope coefficient of interest. This; allows us to asssess the impact of fiscal policy, as proxied by budget deficits, on subsequent economic growth which is the main purpose of this chapter. Apriori economic theory anticipates three possible outcomes along this exercise.

A positive and statistically significant coefficient of budget deficit confirms a Keynesian standpoint that fiscal policy, through the workings of the multiplier, has growth enhancing effects on subsequent economic growth for the particular country under analysis. Conversely, a negative and statistically significant; γ_1, in our case, means that fiscal policy, specifically budget deficit, has detrimental effects on subsequent economic growth, thereby giving empirical evidence in support of the neoclassical viewpoint on the impact of fiscal policy on subsequent economic growth. The third alternative is when the coefficient of budget deficit is statistically insignificant, giving empirical evidence in support of the Ricardian perspective that fiscal policy is indifferent to economic growth. Empirically discriminating between these three possible relationships between budget deficit and economic growth is the core purpose of this chapter.

Due to data unavailability for Madagascar and Lesotho, budget deficit was computed from the difference between total government revenue (in local currency) and the total government expenditure figures (again in local currency) as a percentage of GDP, all obtained from the IMF's World Economic Outlook. For South Africa, the budget deficit series was obtained from the South African Reserve Bank (SARB)'s Statistical Online Querry described as budget deficit/surplus as a percentage of GDP.

The neoclassical and endogenous growth models are founded on the reasoning that the physical capital savings rate of a nation help explain the rate of economic growth. In this respect, our measure of the physical capital savings rate, in all the three countries, is the gross fixed capital formation (gfc), obtained from the World Bank's World Development indicators. Apriori expects a positive relationship between physical capital savings rate and economic growth.

The neoclassical and endogenous growth theories are also grounded on the influence of human capital on economic growth (Mankiw et al., 1992; Romer, 1986). Higher expenditure on education, training, and research and development (R&D) could have positive effects on economic growth, if accompanied by innovation which gravitates to a faster rate of technological progress (Arrow, 1962). In this regard, we employ formal education that can either be defined as primary/secondary school enrolment ratio, or primary/secondary school enrolment figures as a proxy for human capital (Bittencourt et al., 2015;

Seleteng and Motelle, 2015). We, therefore, have made use of the gross primary enrolment ratio, expressed as a percentage of the total number of students expected to be enrolled in the primary schools. For consistency, that allows comparison, we employ this as a proxy for human capital for the three countries used in our analysis. This variable was obtained from the World Bank's World Development Indicators.

We also note, that our South African series for the primary gross enrolment ratio had missing figures for the years 1983 to 1985, 1992, 1993 and 1996. To obtain a complete series, we employed the commonly accepted Hodrick and Prescott (1997) filter method (Kydland & Prescott, 1990; Backus & Kehoe, 1994) to interpolate the missing values.

Following standard literature (Durlauf & Aghion, 2014; Levine & Renelt, 1992), for our purposes, we employ a measure of inflation as one of the control variables. Inflation reflects the macroeconomic stability of a country. Inflation can either have a negative or positive relationship with economic growth. Fischer (1993) postulated a detrimental effect of inflation on economic growth, while Barro (2013) argued that inflation only affects economic growth negatively when it reaches a certain high threshold. Barro (2013), maintained that a positive relationship between inflation and economic growth can actually be envisaged at lower levels.

Given this account, we present a summary of the variable description in Table 27. Emphasis is placed on the variable description, the abreviation we assign to it, the source, and the expected appriori sign, as discussed.

Table 27: Variable Description

Variable	**Abreviation**	**Description**	**Source**	**Expected Sign**
Real GDP growth	Lny	The natural log of Real GDP per capita	IMF's WDI	Dependent variable
Physical capital saving	Gfc	Gross fixed capital formation as a percentage of GDP	World Bank's WDI	+
Human capital saving	pger	Primary gross enrolment ratio	WDI	+/-
Budget deficits	Bd	Budget deficit/surplus as a percentage of GDP	IMF's WDI and SARB Statistical Online Querry	+/-
Inflation	CPI	Consumer price index	WDI	+/-

Notes to Table 27: the abreviations IMF, WDI, and SARB stand for International Monetary Fund, World Development Bank and South African Reserve Bank, respectively.

6.3.2 Data Description and Econometric Procedure

We make use of annual time series data to analyse the relationship between budget deficit and economic growth in this chapter. The period of analysis differs for the three countries analysed, depending on the availability of data. The period for Madagascar spans from 1983 to 2014, while Lesotho is analysed for the period 1985 to 2012, and lastly, the period of analysis for South Africa is 1981 to 2015. In every case, however, attempt has been made to make use of as long a time span as possible so as to incorporate the most recent macroeconomic developments in each country. The country with the least observations is Madagascar, which has 32 observations, which is sufficient enough for us to undertake a time series analysis.

When dealing with time series data, it is natural to start with stationarity tests on the variables, in order to avoid estimation of dubious regressions (Maddala & Wu, 1999; Gujarati & Porter, 2014; Wooldridge, 2010). A variable is said to be stationary if its stochastic properties are time invariant (Asteriou and Hall, 2011). In testing for the stationarity of the variables, an issue of concern relates to structural breaks. It is well established in the literature that SADC countries have gone through many economic policy reforms (SADC, 2016; Bittencourt et al., 2015), and, as well, have not been immune to global shocks like the oil price shocks of 1979 and 1989, and the global financial crisis of 2007/2008, that are likely to have induced structural breaks in the data.

Conventional tests for stationarity (Phillips & Perron, 1988; Kwiatkowski et al., 1992; Dickey & Fuller, 1979; Ng & Perron, 2001), do not accommodate the presence of structural breaks, and as a result, their conclusion has been put into question, as they may lead to erroneous inference (Suresh & Vikas, 2015). In particular, these standard tests may be biased towards a false unit root null, in cases where a series is trend stationary, with a structural break (Perron, 1989). Against this background, we invoke recent developments in time series modelling, by using a break point unit root test, which is essentially a modified version of the Augmented Dickey-Fuller test (ADF) that takes into account the potential presence of structural breaks in the data. The ADF approach has a null of a unit root process, and it allows us to test whether or not the break exists in the trend, intercept, or both.

Having evaluated the univariate time series properties of the variables, the usual procedure is to difference all the non-stationary variables, in order to avoid the problem of spurious regression. Although differencing nonstationary variables to render them stationary reduces the problem of spurious regressions, it is associated with a key drawback of loss of the long-run information that is contained in the level form of the variables, and not in their differences (Hayash, 2000; Hamilton, 1994). Avoiding loss of this long-run information can be achieved by testing, if there is a cointegrating relationship among the non-stationary time series variables.

Engle and Granger (1987) noted that a cointegrated series exists if a linear combination of nonstationary variables follows a stationary process. Most studies in the literature have used the Johansen test for cointegration in a system of equation setup. The Johansen test is merited on grounds of not only detecting presence of cointegration, but also the number of cointegrating vectors. Its weakeness however is that it is asymptotic, and is therefore more appropriate in large sample sizes. In our case, we have just over 30 observastions for each country, and this renders the Johansen test less appropriate.

We therefore use three tests for cointegration, namely the Hansen (1992) instability test (which is immune to the presence of structural breaks in data), the Engel Granger test, and the Phillips Quliaris (1990) approach. The mechanic of the Hansen (1992) approach lies in finding evidence of parameter instability in the null of no cointegration. The test is essentially based on the L_c test statistic, whose distribution is nonstandard, and depends on the number of cointegrating regressors, less the number of deterministic trend regressors excluded from the cointegrating equation, and the number of trending regressors.

For robustness purposes, over and above the Hansen (1992) cointegration test, we also rely on the Engle-Granger (1987) two-step residual based approach in our test for the existence of cointegration, as well as the Phillips and Ouliaris (1990) cointegration test. Like the Phillips and Ouliaris (1990), the Engle-Granger (1987) test, is based on the test of stationarity on the residuals obtained from running a spurious regression, that is assumed to be cointegrated. The Phillips and Ouliaris (1990) and the Engle-Granger (1987) differ in the way in which they account for serial correlation in the residuals. While the Engle-Granger (1987) test is based on a parametric augmented Dickey-Fuller (ADF) approach, the Phillips

Ouliaris (1990) uses a non-parametric Phillips-Perron methodology. Having discussed the pre-estimation checks on our data, we next specify the estimation procedure which we use to analyse how budget defects interact with economic growth in the three countries.

6.3.3 Estimation Procedure: Dynamic Ordinary Least Squares (DOLS), the Fully Modified Ordinary Least Squares (FMOLS), and Canonical Cointegration Regression (CCR)

There are many time series estimation techniques that are suitable to make use of in our analysis. We, however, want to empasise that our choice of the estimation techniques employed in this chapter is informed by the nature of the estimation problems that are inherent in any growth regression. As we have argued in chapter four, the predominant problem in any growth estimation is that of economic endogeneity (reverse causality).

The problem of economic endogeneity can arise from a number of reasons. Firstly, slow economic growth may lead to low levels of government revenue collected that, holding public expenditure constant, may explain a rise in budget deficits (Seleteng et al., 2013). This implies that, whereas budget deficit may explain movements in economic growth, budget deficits may, in turn, be influenced by the growth performance of the economy. In the same spirit, Bittencourt (2012) argued that higher growth may generate inflationary pressures thereby alluding to the existence of reverse causality in any growth regression. Earlier on, Temple (2000) forcefully argued that economic growth, investment, and inflation are three endogenous variables. To buttress the point even further, Barro (1999) argued that citizens consider the rate of economic growth in their decisions to have more or less children. With high levels of economic growth, citizens become more optimistic about the future and have more children leading to higher fertility levels and population growth during periods of high economic growth. During periods of stagnating economic growth, citizens become pessimistic about the future and reduce their birthrate. It is therefore apparent in the literature that any growth estimation needs to take into account the problem of economic endogeneity.

Secondly, the problem of endogeneity may arise from omitted variables that are nested in the error term, which, in actual fact, affect investment, budget deficits, and economic growth (Barro, 1989). Such variables can be the rule of law, and inflation which has been dropped in the regression, partly in line with the principle of parsimony (Bittencourt et al., 2015). Given these estimation challenges, our choice of the estimation technique is guided by the ability of the estimation approach to deal with endogeneity in our growth model. Parameters of the ordinary least squares technique may be heavily biased since it categorises variables into endogenous and exogenous (Gujarati and Porter, 2014).

A popular way of dealing with regressor endogeneity in the literature has generally involved the use of instrumental variable regression techniques, such as the two and three stage least squares. The instrumental method of dealing with regressor endogeneity involves finding a variable that is correlated with budget deficit and investment (in our case), but uncorrelated with economic growth (Chernozhukov & Hansen, 2008; Belloni et al., 2010). Though the instrumental variable technique is effective in addressing the problem of endogeneity, the major hurdle is to found appropriate instruments, given that most of the variables that affect budget deficits and investment have also a direct effect on economic growth.

An alternative approach has been the Johansen (1991, 1995) maximum likelihood, which is imbedded in the use of a system of equations. The key drawback, given our case is that the Johansen (1991, 1995) technique is an asymptotic, full information approach, which suffers the problem of outliers in small samples like ours (Masunda, 2012).

Given this background, this study uses the Saikkonen (1992), and Stock and Watson (1993) Dynamic Ordinary Least Squares (DOLS) as our benchmark estimation technique. As a robustness check, we also employ the Fully Modified Ordinary Least Squares (FMOLS) proposed by Phillips & Hansen (1990) and the Canonical Cointegration Regression, proposed by Park (1992). These estimation techniques address the problem of regressor endogeneity, and serial correlation and have asymptotic small sample properties like ours.

The DOLS approach has several advantages over the OLS and the Johansen (1991, 1995) approach. The DOLS improves the OLS by having asymptotic, small sample properties, and corrects for endogeneity, as well as dynamic sources of parameter bias (Stock and Wtason, 1993). Alternatively, while the Johansen (1991, 1995) maximum likelihood approach is a full information technique, whose major shortcoming, particularly in our case, is that if estimates in one equation are grossly affected by a misspecification it will affect estimations in other equations.

The DOLS, instead, is a robust single-equation estimation approach, which solves the problem of endogeneity and regressoor simultaneity through the leads and lags of first differenced endogenous covariates, which absorb serial correlation through the generalised least squares procedure (Masunda, 2012). In addition, the DOLS retains the same asymptotic properties as the OLS and the Johansen (1991; and 1995) distribution. In the spirit of Stock and Watson (1993), we specify our model to be estimated in the analysis of the impact of budget deficit on economic growth in South Africa, Madagascar and Lesotho as:

$$lny_t = X_t'\vartheta + D_{1t}'\omega_1 + \sum_{j=-k}^{r} \Delta X_{t+j}'\delta + v_{1t} \qquad (6.3)$$

where lny_t is the natural logarithym of GDP per capita; and; X_t' is a vector of explanatory variables, that include budget deficit, gross fixed capital formation and primary gross enrolment ratio, as a proxy for investment in human capital. Importantly, $k \; and \; r$ are the lags and leads, respectively, of the differenced regressors, which soaks up the problem of endogeneity and regressor simultaneity. The length of the leads and lags is determined by the Schwarz Information Criteria, and the best model is one which produces the lowest AIC value.

It is customary in applied econometric research to rely on other alternative estimation techniques, as well, so as to affirm the results from the baseline estimation approach. In this spirit, we consider the FMOLS and the CCR as alternative estimation techniques. Like the DOLS, the FMOLS proposed by Phillips and Hansen (1990) - employs a semi-parametric correction of endogeneity and serial correlation with its long-run estimator is given by:

$$\phi = \begin{bmatrix} \beta \\ \widehat{\omega}_1 \end{bmatrix} = \left(\sum_{t=2}^{T} Z_t Z_t' \right)^{-1} \left(\sum_{t=2}^{T} Z_t y_t^{+} - T \begin{bmatrix} \hat{\lambda}_{12}^{+} \\ 0 \end{bmatrix} \right) \tag{6.4}$$

where, by definition, $Z_t = (X_t' D_t')'$. The resulting FMOLS long-run estimator is asymptotically unbiased, and has a fully efficient mixture of normal asymptotics that allow for standard Wald tests, relying on conventional asymptotic Chi-square statistical inference.

Our second alternative single-equation estimation approach is the Canonical Cointegration Regression (CCR), developed by Park (1992). Just like the Fully Modified Ordinary Least Squares (FMOLS), the Canonical Cointagration Regression approach follows a mixture of normal distribution, which is free of non-scalar nuisance parameters, and permits asymptotic Chi-square testing. In the spirit of Park (1992), the CCR estimator, defined as OLS that is applied to the transformed data, takes the form:

$$\hat{\beta}_{CCR} = \begin{bmatrix} \hat{\beta} \\ \widehat{\varpi}_1 \end{bmatrix} = \left(\sum_{t=1}^{T} Z_t^{*} Z_t^{*\prime} \right)^{-1} \sum_{t=1}^{T} Z_t^{*} y_t^{*} \tag{6.5}$$

where, $Z_t^{*} = (Z_t^{*\prime}, D_{1t}')'$. The CCR effectively corrects for endogeneity and concurrently correct for asymptotic bias resulting from the contemporaneous correlation between the regression and stochastic regressor errors. Parameter estimates from the CCR are fully efficient and have the same unbiased, mixture normal asmptotics as the FMOLS and DOLS.

In conclusion, this chapter employs some of the recent developments in time series cointegration literature, the Dynamic Ordinary Least Squares (DOLS), the Fully Modified Ordinary Least Squares (FMOLS) and the Canonical Cointegration Regression (CCR), as the more suitable estimation techniques, because they are more robust to serial correction and endogeneity problems, which are characteristic features of any growth regression. The same estimation techniques have been used, recently, within a growth context by, among others, (Paradiso et al., 2013; Mehmood & Shahid, 2014; Bibi et al., 2014). We perfom a number of diagnostic tests inorder to validate our estimates from these long-run estimators. These include the Jarque Bera test for normality of residuals, Ramsey RESET test for model specification, the Breusch Pagan test for heteroscedasticity and the Bresuch Godfrey serial LM test for autocorrelation.

The degree of multicollinearity is also measured using the pairwise correlation matrix while parameter instability is detected using the CUSUM test. The next section presents the empirical findings.

6.4 Empirical Results

This section continues to build on the previous sections in this chapter and presents, interprets and discusses our empirical findings on the impact of budget deficits on subsequent economic growth in South Africa, Madagascar and Lesotho. Among other things, the section presents the summary statistics which describe the nature of the data in the three countries: stationarity tests, cointegration tests and finally the regression estimates.

6.4.1 Pre-Estimation Analysis

This section presents the summary statistics and a check for the degree of multicollinearity in the data for South Africa, Madagascar and Lesotho. Conducting summary statistics is important because it gives a quick image of the data at hand, which gives us an idea of the data variability, and any possible outliers in the data. The summary statistics for South Africa, Madagascar and Lesotho are shown in tables 28, 29, and 30, respectively.

Table 28: Summary Statistics - South Africa

	Log of GDP per capita	**Budget deficits**	**Gross fixed capital formation**	**Primary gross enrolment ratio**	**CPI**
Mean	4.669	-2.940	19.155	81.621	44.727
Median	4.659	-2.940	18.733	88.146	41.850
Maximum	4.746	0.984	27.496	101.663	103.949
Minimum	4.606	-8.853	15.150	47.889	6.192
Std. Deviation	0.044	2.478	3.422	19.841	29.424
Skewness	0.432	-0.468	1.073	-0.476	0.408
Kurtosis	1.940	2.982	3.343	1.661	2.047
Jargue-Berra	2.57	1.203	6.496	3.711	2.164
Probability	0.27	0.548	0.039	0.156	0.339
Observations	33	33	33	33	33

Notes to Table 28: the summary statistics were computed in Eviews based on data obtained from the IMF's World Development Indicators and the World Bank's World Development Indicators.

The summary statistics show that for South Africa, the highest budget deficit was almost close to 9 as a ratio to GDP, while Madagascar had its worst budget deficit of close to 14 as a ratio to GDP, and Lesotho having its lowest budget deficit of close to 18 as a ratio to GDP over the period under review. On average, South Africa and Madagascar had a budget deficit of close to 3 and 4 as ratios to GDP, respectively, while

Lesotho, on average had a budget surplus of close to 1 as a ratio GDP over the sample period. It is also interesting to note that Lesotho had the largest variablility in its budget deficit evolution (with a largest surplus of 16 and a lowest budget deficit of above 17 as a ratio to GDP); Madagascar consistently incurred deficits on its fiscal balances over the period under review, and South Africa experienced moderately low fiscal deficits over the period under review.

Table 29: Summary Statistics - Madagascar

	Log of GDP per capita	Budget deficits	Gross fixed capital formation	Primary gross enrolment ratio
Mean	5.536	-3.723	16.015	116.304
Median	5.519	-2.809	14.780	112.06
Maximum	5.626	-0.124	40.318	149.952
Minimum	5.464	-13.672	7.918	83.805
Std. Deviation	0.04	3.421	7.553	22.864
Skewness	0.607	-1.205	1.640	0.139
Kurtosis	2.256	4.230	5.379	1.384
Jargue-Berra	2.958	10.684	23.94	3.922
Probability	0.228	0.0047	0.000	0.141
Observations	35	35	35	35

Notes to Table 29: the summary statistics were computed in Eviews based on data obtained from the IMF's World Development Indicators and the World Bank's World Development Indicators

It would also be interesting to infer the impact of fiscal balances on economic growth for a country like Madagascar, which incurred successive deficits on its fiscal balances, and a country like South Africa, which sustained moderately low deficit balances on its fiscal position, and Lesotho, whose fiscal balances at one time were very high surpluses and at some point dipped remarkably over the period under review

Table 30: Summary Statistics- Lesotho

	Log of GDP per capita	Budget deficits	Gross fixed capital formation	Primary gross enrolment ratio	Consumer Price Index (CPI)
Mean	3.580	0.781	42.892	111.312	60.864
Median	3.561	0.746	37.305	110.3310	61.179
Maximum	3.800	16.234	74.821	120.834	116.927
Minimum	3.420	-17.510	21.117	105.004	15.955
Std. Deviation	0.120	7.047	16.932	4.413	28.118
Skewness	0.473	-0.213	0.529	0.662	0.204
Kurtosis	2.150	3.845	1.957	2.480	2.246
Jargue-Berra	2.091	1.157	2.848	2.614	0.948
Probability	0.35	0.560	0.241	0.271	0.622
Observations	31	31	31	31	31

Notes to Table 30: the summary statistics were computed in Eviews based on data obtained from the IMF's World Development Indicators and the World Bank's World Development Indicators

Turning to the normality of residuals, Lesotho enjoys normality of residuals for all the variables employed in our regression, while for South Africa, all the other variables are normally distributed only serve for gross fixed capital formation. For Madagascar, the null of residual normality is rejected at 1% for gross fixed capital formation, as well as budget deficits.

By implication, the inference about the parameter estimates we make for Lesotho could not be questionable, while the residual non-normality for Madagascar could be source of some concern. The non-normality could be arising from some outliers in the budget deficit and gross fixed capital formation series, or simply from some heteroskedasticity. However, we note that the sample size for Madagascar is 35 observations which can be defined as fairly large. Having detected residual non-normality, we however, invoke the central limit theorem, where it is well established that non-normality of residuals in a large sample is inconsequential, as the law of large numbers states that the sample average converges to a population mean, which will converge to a normal distribution (Brooks, 2008). Given this argument, we are less concerned with the non-normality for budget deficits and gross fixed capital formation for Madagascar, and gross fixed capital formation for South Africa, since our sample sizes are above 30 observations, and this can reasonably be judged as fairly large.

Having examined at the summary statistics, we then present our empirical findings for the detection of the degree of multicollinearity among the regressors. Our goal in this respect is to infer if any of the regressors could have a linear relationship of a degree, beyond which precision would be grossly jeopardised. As we have discussed earlier, we adopt a threshold of 0.9, which is generally accepted in applied research, beyond which there would be remarkable loss of precision, if one proceeds to do inference in the presence of near perfect multicollinearity.

In this regard, table 31 presents the pairwise correlation matrix for South Africa, Madagascar and Lesotho. A visual inspection of the pairwise correlates reveals that the highest degree of collinearity (of 0.88) exists between primary CPI and gross enrolment ratio for South Africa. As we have noted earlier, we have adopted a generally accepted benchmark pairwise collinearity of 0.9, and any other degree of collinearity below that is taken to be benign, as it is acceptable in empirical literature that some degree of association will almost always exist between time series variables, but may not cause any loss of precision (Brooks, 2008). The pairwise collinearity between consumer price index and the dependent variable, the log of GDP per capita for Lesotho is 0.93. This, however, is not considered as multicollinearity, as it is between a regressor and a dependent variable. Given the results in table 31, we can conclude that the regressors used in our estimation models are orthogonal to one another. The implications is that we can safely partial out the effect of each of the regressors in our model, on the dependent variable, the log of GDP per capita.

A preliminary analysis of the impact of budget deficits on economic growth, which is our goal in this chapter, reveals that there is a positive relationship between budget deficit and economic growth in South Africa and Madagascar, whereas budget deficits is inversely related with economic growth in the case of Lesotho. Whilst this is just a preliminary analysis, which may not be taken seriously, representation thus far is that the relationship between budget deficit and economic growth among SADC countries is dissimilar, thereby warranting the need to compliment panel data analysis, with single country time series analysis, for individual countries.

Table 31: Correlation Matrix for South Africa, Madagascar and Lesotho

South Africa

	Log of GDP per capita	Budget deficits	Gross fixed capital formation	Primary gross enrolment ratio	CPI
Log of GDP per capita	1.00				
Budget deficits	0.29	1.00			
Gross fixed capital formation	0.43	0.42	1.00		
Primary gross enrolment ratio	0.34	-0.03	-0.55	1.00	
CPI	0.67	-0.13	-0.28	0.88	1.00

Madagascar

	Log of GDP per capita	Budget deficits	Gross fixed capital formation	Primary gross enrolment ratio
Log of GDP per capita	1.00			
Budget deficits	0.68	1.00		
Gross fixed capital formation	-0.32	-0.34	1.00	
Primary gross enrolment ratio	-0.10	-0.51	0.54	1.00

Lesotho

	Log of GDP per capita	Budget deficits	Gross fixed capital formation	Primary gross enrolment ratio	Consumer Price Index
Log of GDP per capita	1.00				
Budget deficits	-0.04	1.00			
Gross fixed capital formation	-0.54	-0.07	1.00		
Primary gross enrolment ratio	0.27	0.27	-0.32	1.00	
Consumer Price Index	0.93	-0.003	-0.27	0.16	1.00

Notes to Table 31: the correlation matrix were computed in Eviews based on data obtained from the IMF's World Development Indicators and the World Bank's World Development Indicators. The probability values were not included as our chief goal is to detect presence, if any, of multicollinearity.

A quick visual inspection of table 30 reveals no serious concerns of multicollinearity, since all the correlation coefficients are fairly low, except CPI, and the primary gross enrolment ratio in the case of South Africa. The next section is devoted to our report of the unit root tests, an exercise which is paramount to have an understanding of the data generating process, otherwise we would report on spurious regressions.

6.4.2 Econometric Evidence

We first present the results of the univariate time series properties of the series used in our analysis in Table 32. In the interest of brevity, we did not conduct informal unit root tests, but conducted the Perron (1989) breakpoint stationarity tests immediately. In conducting breakpoint unit root tests, we consider specifications with either a trend and intercept, or an intercept only. Such an unrestricted specification allows us to determine whether or not the series in question follows a random walk with a drift and a trend. In the event of the trend being statistically insignificant, we only consider the drift parameter in our specification. The breakpoint unit root test has a null of a unit root, against an alternative of stationarity. By implication, higher than the conventional probability value of 10% implies a lack of evidence to reject the null, that the series is characterised by a unit root. Following standard procedure, all the series which are found to be non-stationary are tested for their non-stationarity in first difference form to infer if they are intergrated of order one.

Table 32 presents the results of our unit root tests for South Africa, Madagascar and Lesotho. For South Africa, all the other variables are first difference stationary (the log of GDP per capita, budget deficits, and gross fixed capital formation) and serve the primary gross enrolment ratio which is stationary in levels. For Lesotho, the dependent variable, the log of GDP per capita, and primary gross enrolment ratio are charactarised by a unit root and are integrated of order one, whereas budget deficits, gross fixed capital formation and consumer price index (CPI) are level stationary. In the case of Madagascar, the dependent variable, the log of GDP per capita, and gross fixed capital formation are stationary after first differencing with the other two: budget deficits and primary gross enrolment ratio being stationary in levels.

The first important conclusion that can be drawn from our unit root tests is that at least one of the variables in our three cases contains a unit root. This invalidates the use of the OLS in a regression function, as that will only give spurious results. Facing such a problem, one option could be to take the first differences of all the non-stationary variables, I (1), and then to use these first differenced variables in any of our subsequent modelling process. Appealing as this is, the problem of spurious regressions is resolved at a loss of the long-run relationship among the variables, as pure first difference models have no long-run solution (Enders, 2008). We can-not consider this option, primarily because our main goal is to investigate the long-run relationship between budget deficits and economic growth. To adopt the option of first differencing, all the I(1) variables would therefore invalidate the whole purpose of our study.

The second option that we can adopt is to infer if a linear combination of a mixture of our stationary and non-stationary variables is stationary. The implication of a stationary linear combination of our variables is that a combination of our series is bound by some relationship in the long-run. The presence of a long-run relationship among our series would imply that they do not wander apart without bound. This is the option that is appropriate given our goal of establishing a long-run relationship between budget deficits and economic growth in South Africa, Madagascar and Lesotho. However, an important condition in order for there to be cointegration, is that the dependent variable, and at least some of the regressors should be integrated of order one.

Table 32: Breakpoint Unit Root Tests

	SOUTH AFRICA		
	t-statistics		
Series	**Level Form**	**First Difference**	**Order of Integration**
Log of GDP per capita!	-3.069	-4.410**	I (1)
Budget deficits!	-3.678	-6.760**	I (1)
Gross fixed capital formation!	-4.281	-6.465**	I (1)
Primary gross enrolment ratio #	-5.652**		I (0)
	MADAGASCAR		
Log of GDP per capita #	-3.975	-8.014**	I (1)
Budget deficits #	-6.984**		I (0)
Gross fixed capital formation #	-4.553	-7.648**	I (1)
Primary gross enrolment ratio #	-5.561**		I (0)
	LESOTHO		
Log of GDP per capita #	-2.075	-7.600**	I (1)
Budget deficits #	-5.071*		I (0)
Gross fixed capital formation #	-6.076**		I (0)
Primary gross enrolment ratio #	-3.944	-6.835**	I (1)
Consumer Price Index (CPI) #	-5.935**		I (0)

Notes to Table 32: *, **, *** denote $p< 0.1$, $p< 0.05$ & $p<0.01$, respectively. The # denotes specification with trend, and intercept; ! denotes specification with intercept only. Probability values correspond to Vogelsang (1993) asymptotic one-sided p-values.

In this respect, a second conclusion that can be drawn from our stationarity tests is that the three cases (South Africa, Madagascar and Lesotho), the log of GDP per capita, and some of the regressors are integrated of order one, thereby giving room for some possibility of a long-run cointegrating relationship. The next thing is for us to test for the presence of cointegration.

An understanding of the existence, or lack of, a long run relationship, between the log of GDP per capita, and the other variables used in the analysis, is crucial as it informs the next, appropriate, econometric strategy to take. If there is found to be no evidence of cointegration among the series, then the appropriate econometric strategy would be to employ specifications of non-stationary variables in first differences. The resultant effect is that such a specification would not have a long-run relationship. With this in mind, we present our empirical cointegration results in Table 33.

Table 33: Cointegration Test Results

South Africa			**Madagascar**			**Lesotho**		
Hansen	Engel-Granger	Phillips-Quliaries	Hansen	Engel-Granger	Phillips-Quliaries	Hansen	Engel-Granger	Phillips-Quliaries
0.321	-4.848*	-4.907**	0.069	-5.125**	-5.188**	0.097	-4.684	-4.606**
(>0.2)	(0.051)	(0.046)	(>0.2)	(0.012)	(0.010)	(>0.2)	(0.037)	(0.039)

Notes to Table 33: * denotes rejection of the null at 10% level. Figures in parenthesis denote probability values derived from MacKinnon (1996).

The Hansen Parameter Instability cointegration test, with a null of cointegration, takes into account any possible structural breaks in the series. On the other hand, the Engle-Granger has a null of no cointegration. For all the three cases, South Africa, Madagascar and Lesotho, the Hansen parameter cointegration null of a cointegrated vector can not be rejected at the conventional 10% level of significance, as the probability values are way above 20%. These results are confirmed, again in the three cases, by the Engle Granger cointegration test as there is sufficient evidence at the conventional 10% not to accept the null of no cointegration.

Having confirmed of the presence of cointegration in our three cases, we proceed to employ the recent cointegrating regression techniques, the Dynamic Ordinary Least Squares (DOLS), the Fully Modified Ordinary Least Squares (FMOLS), and the Canonical Cointegrating Regression (CCR), to infer of the long-run relationship between budget deficits and economic growth in South Africa, Madagascar and

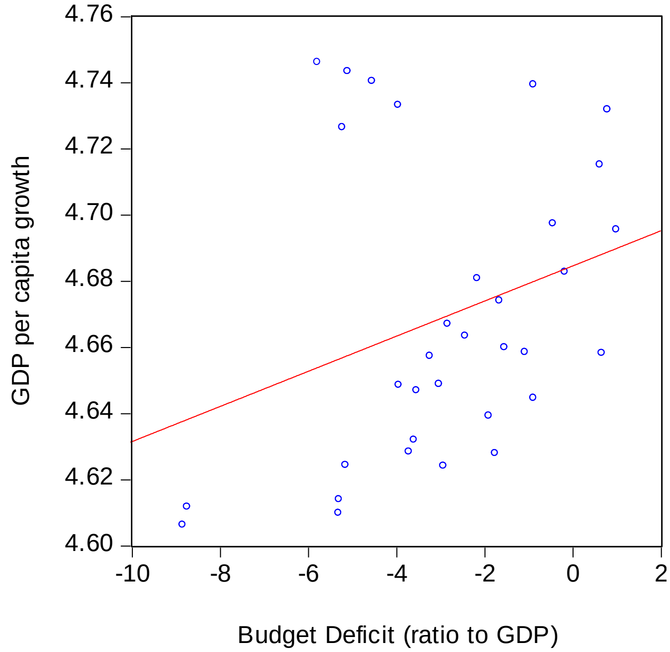
Lesotho. As we have pointed out earlier, based on the Monte Carlo simulations by Kao and Chiang (2000), our baseline estimator is the DOLS, as the authors found that the DOLS outperforms both the FMOLS and the CCR in terms of efficiency, unbiasedness and consistency in small samples. The three estimation techniques are designed for cointegrating vectors, and are not dependent on the use of instrumental variables in addressing regressor endogeneity. In this spirit, we present the parameter estimates in the analysis of the impact of budget deficit and economic growth in South Afrca, Madagascar and Lesotho, using the DOLS, FMOLS, and the CCR.

Having perfomed stationarity tests that address structural breaks in the data, the next step was to test for structural breaks in the estimated regression models, using multiple breakpoint test developed by Bai and Perron (1998), and Bai and Perron (2003). Due to the limited number of observations, only the intercept is allowed to vary across break dates. The trimming percentage is set at 5, using the Bai-Perron sequential breaks method. The results of these tests are attached in the appendix. Overall, they show the presence of structural breaks across the three countries, albeit with various breakdates, and the standard solution is to incorporate a dummy for each break date, with the pre-dummy period being treated as the control group. We found the chow procedure less appropriate as its use would result in micronumerosity given our small sample size that does not allow sample decomposition.

In all regression variants, the DOLS method is used as the baseline technique, while the FMOLS and the CCR techniques are only considered for robustness purposes. The DOLS augments the cointegrating model with leads and lags of first differenced endogenous regressors, and, in this case, we have treated all right hand variables as endogenous regressors, with 1 lead and 1 lag in most cases selected based on information provided by the aikaike information criteria. Before proceeding with cointegrating regression results, it is customary to first infer informally how budget deficits correlate with economic growth in these countries. Figure 15, 16 and 17 in this respect display scatter plots for each country, where GDP per capita growth is plotted against budget defits as a ratio to GDP.

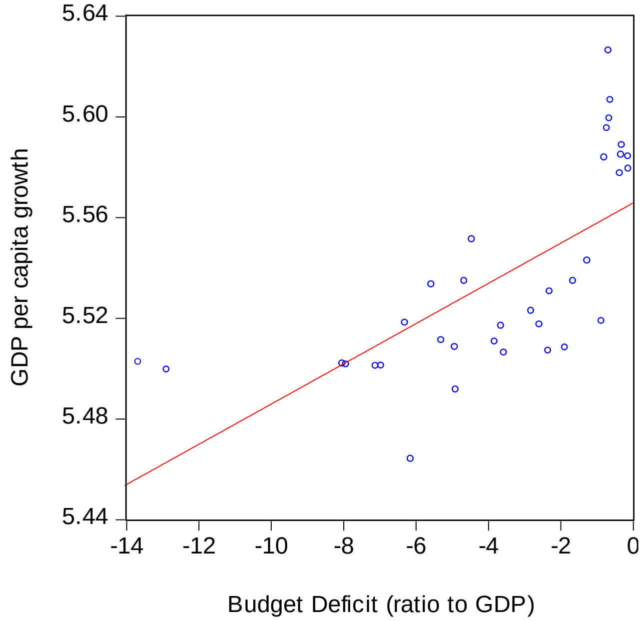
Each dot in these figures represents the level of economic growth for every given value of budget deficit ratio to GDP. In all the three cases, a visual inspection of the graphs reveals a positive linear correlation between budget deficits, and economic growth, suggesting positive comovements between the two variables of interest. A high budget deficit to GDP ratio coincides with high economic growth, but this observation must not be interpreted with too much excitement since the graphs are not holding constant with other possible determinants of economic growth.

Figure 15: Budget Deficits and Economic Growth: South Africa



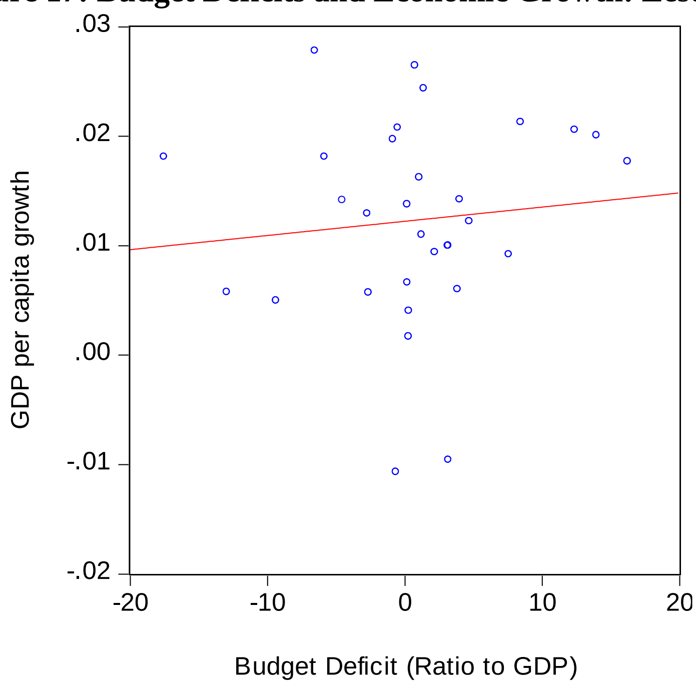
Notes to figure 15: the dependent variable is the log of GDP per capita, on the vertical axis, while the explanatory variable is the budget deficit/surplus as a ratio to GDP, on the horizontal axis. Both the variables were obtained from the IMF's World Economic Indicators.

Figure 16: Budget Deficits and Economic Growth: Madagascar



Notes to figure 16: the dependent variable is the log of GDP per capita, on the vertical axis, while the explanatory variable is the budget deficit/surplus as a ratio to GDP, on the horizontal axis. Both the variables were obtained from the IMF's World Economic Indicators

Figure 17: Budget Deficits and Economic Growth: Lesotho



Notes to figure 17: the dependent variable is the log of GDP per capita, on the vertical axis, while the explanatory variable is the budget deficit/surplus as a ratio to GDP, on the horizontal axis. Both the variables were obtained from the IMF's World Economic Indicators.

The linear line is much steeper for South Africa and Madagascar, but is considerably less so in the case of Lesotho. Although this approach is often necessary, it is not sufficient in understanding the relationship between macroeconomic variables, it does have the virtue of giving insights regarding the nature of the relationship between the two variables. As it appears from all the figures for instance, there does not seem to be an inverted U-shaped relation between budget deficits and economic growth, as claimed in other studies (Reinhart and Rogoff, 2010). The correlates are scattered along a line, informally implying the absence of threshold effects. Given that this exercise does not control for other regressors of economic growth, table 34 reports cointegrating results from the three estimation techniques, the DOLS, FMOLS and CCR. Unlike the simple scatter plots, table 34 allows us to partially differentiate each growth function in order to isolate the effect of budget deficit on economic growth.

Across all the variants, the dependent variable is the growth rate of GDP per capita, while the inclusion of explanatory variables is done in a step wise fashion. The number of regressors is country specific, and the inclusion of a few, but relevant, variables is in a bid to abide by the principle of parsimony. In cases where serial correlation was a problem, as is normally expected in time series regression, the solution was to estimate the model with heteroscedasticity, and autocorrelation, consistent (HAC), standard errors to guide against efficiency loss. The first striking evidence is that for all countries, there is overwhelming statistical evidence of a positive and highly significant (in most cases at 1% significance level) relationship between budget deficits and long-term economic growth which is consistent with the Keynesion view.

The three, single equation cointegrating regression techniques (DOLS, FMOLS, and CCR) are confirmatory to the fact that budget deficits have positive growth enhancing effects on economic growth in all the three countries. For South Africa, these results are confirmatory by earlier studies by Mavodyo and Kaseeram (2016), who employed a different estimation technique (VAR/VECM), but found a positive and statistically significant relationship between budget deficits and economic growth. With respect to the DOLS, which is the baseline technique, a percentage increase in budget deficit ratio to GDP is estimated to raise economic growth on impact by a magnitude of 0.007% in South Africa. For Madagascar, a 1% widening in the fiscal balance will promote growth by 0.0027%, an economic magnitude lower than that for South Africa. For Lesotho, a 1% increase in budget deficit is associated with improvement in economic growth performance by 0.001%, a magnitude lower than that for South Africa and Madagascar. Thus, the empirical evidence with respect to the three countries in this study is in support of a Keynesian view that fiscal policy (in this case budget deficits) can be effectively used to promote economic growth.

Although budget deficits do correlate positively and significantly with economic growth, we found evidence that the effect is more sizeable in the case of South Africa. Importantly, there is weak statistical evidence that budget deficits enhance economic growth in the case of Madagascar (i.e $p<0.05$) as compared to South Africa and Lesotho (where $p<0.01$). For Madagascar in particular, the effect is actually insignificant in the case of alternative estimation techniques. Thus, the impact of fiscal deficits on subsequent economic growth is similar in signs, but not in relevance across the three countries. The coefficients on dummy variables intended to capture structural breaks are not reported in table 34, for the interest of saving space, but can be found in the appendices. What is important is that, in most cases, the dummy variables enter significantly, corroborating the presence of structural breaks.

Table 34: DOLS, FMOLS, and CCR Parameter Estimates

	SOUTH AFRICA		
The dependent	**variable in every case**	**Is the Log of GDP per**	**Capita**
Variable	**DOLS**	**FMOLS**	**CCR**
Budget deficits	0.007*** (0.001)	0.006*** (0.000)	0.006*** (0.001)
Gross fixed capital formation	0.002* (0.001)	0.001* (0.000)	0.0016 (0.0009)
Primary gross enrolment ratio	-0.0024*** (0.0003)	-0.002*** (0.000)	-0.002***(0.000)
CPI	0.002*** (0.0002)	0.001*** (0.000)	0.0018*** (0.0002)
Constant	4.72	4.72	4.73
Adjusted R-squared	0.98	0.96	0.96
	MADAGASCAR		
Budget deficits	0.0027** (0.001)	0.0003 (0.0004)	0.0004 (0.0005)
Gross fixed capital formation	0.001*** (0.000)	0.0013*** (0.000)	0.0013*** (0.000)
Primary gross enrolment ratio	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)
Constant	5.42	5.46	5.46
Adjusted R-squared	0.98	0.98	0.98
	LESOTHO		
Budget deficits	0.001*** (0.0004)	0.0005*** (0.000)	0.0005** (0.000)
Gross fixed capital formation	0.0003** (0.0001)	0.0001*** (0.000)	0.0002** (0.000)
Primary gross enrolment ratio	0.008*** (0.0004)	0.0098*** (0.001)	0.009*** (0.000)
Constant	3.24	3.22	3.22
Adjusted R-squared	0.99	0.98	0.98

Notes to Table 34: *, **, *** denote significance at 10%, 5%, and 1 % significance level, respectively. Figures in parenthesis are standard errors.

Though there is dissimilar empirical evidence on the economic relevance of on the impact of budget deficits on economic growth, our findings also unmask a similar pattern in the importance of budget deficit in influencing economic growth. The results show that, of all the variables included in our models, the budget deficit variable has the largest influence in explaining subsequent economic growth in South Africa and Madagascar while budget deficit is second place, after education, in influencing economic growth in Lesotho. In South Africa, a one percentage increase in budget deficit bolsters long-run economic growth by 0.007% other regressors held constant, whereas in Madagascar, a percentage increase in budget deficit augments long-run economic growth by 0.0027%. These interpretations are true for the baseline specification.

The other salient feature of our empirical results is that the explanatory power of our model is remarkably high in the three cases. This is suggestive of the fact that our models explain the majority of the variations in economic growth, thereby allaying any doubts of the significant extent to which our chosen models help to account for changes in long-run economic growth.

Other explanatory variables enter with expected signs, except education, which has a negative sign in the context of South Africa. Although this result is quite uncanny at a glance, as regards the role of human capital in the growth dynamics, but this has been a more frequent than a rare feature in most recent empirical studies (Islam, 1995a, Pritchett, 2001, Gregorio, 1992).

Islam (1995), for example, noted that incorporation of measures of human capital in a growth analysis have always been problematic, as empirical results on the measure of human capital have turned out either to be insignificant or negative. In acounting for this anomaly in the data, the author cited the discrepancy between the theoretical variable measuring human capital in the production function, and the actual variable used in growth regressions. Enrolment figures often used in growth regressions are partial measures of the rate of investment in human capital, and do not account for differences in the quality of schooling. The author further noted that whereas most developing countries have progressed quite significantly in school enrolment figures, the quality of education has not improved equally as much, resulting in the negative temporal correlation between such measures of education and economic growth. In a recent paper, Pritchett established a negative association between human capital investment, and the rate of growth of output per worker. The author proffered three explanations for this empirical irregularity. Firstly, Pritchett (2001) argued that the governance systems of the particular country could be so bad that the accumulation of educational capital lowers economic growth. The second reasoning the author gave was that the productivity of human capital might have fallen rapidly, as the supply of labour enlarges, while demand remains unchanged. Thirdly, Pritchett (2001) claimed that the quality of education could be so low that years of schooling, or enrolment figures, could not be a true measure of improvement in human capital.

Given such an anomaly in our empirical findings on the role of human capital in economic growth rate in South Africa, we invoke the explanations given. Particularly, a pertinent argument raised in the recent literature which could be relevant in our case, is that investment in education at times may not be reflective of the quality contribution to human capital. Most measures of education do not capture the quality of human capital, as argued recently by Barro (2015). In our case, we used a primary gross enrolmemnt ratio as a proxy for investment in human capital. Yet, primary school education may not have meaningfully positive impact on long-run economic growth, as primary school education may not instill the desired qualities to have positive effects on subsequent economic growth. Better measures of education could have been those based on international test scores, but this data is not available. The second possibility, specifically for the South African case, might be in relation to the fairly high unemployment levels. In this sense, the negative effect of education on economic growth could be reflective of human capital that is not being absorbed by firms. The high levels of unemployment in South Africa may imply that the country has an abundance of labour, more than the industry can absorb, thereby adversely affecting the productivity of labour.

Another noticeable empirical reality from our results is that inflation, proxied by the CPI, emerges with a positive relationship with economic growth in South Africa. The variable CPI is dropped in the case of Madagascar and Lesotho, due to collinearity problems with the education variable. Had we included the two variables concurrently, it would have been impossible to isolate the effect of education on economic growth, and this would be less appealing taking into account the importance of human capital on long-run economic growth, as compared to inflation which is generally more relevant in the short-run from a theoretical perspective. Notwithstanding the exclusion of CPI, in the case of Madagascar, the positive sign on CPI is contrary to the empirical evidence by Bittencourt et al. (2015), in a panel time series analysis of the effect of inflation on economic growth among SADC economies for the period 1980 to 2009, who found that inflation had detrimental effects on economic growth. In spite of this empirical contradiction, this positive correlation between inflation and economic growth that we found in the context of South Africa could be a reinforcement to an argument raised by Barro (2013), that inflation is only detrimental if it exceeds the 25% mark. During the sampling period, inflation has been fairly low in South Africa, thanks to the inflation targetting regime introduced in 2000.

Physical investment, proxied by gross capital formation, enters with a positive and significant sign, predicted by both neoclassical and endogenous growth theories. An increase in capital is theoretically expected to increase output, assuming a low labour-capital ratio. The countries under considerations are still developing, and are therefore more likely to experience increasing returns to capital. Empirically, a percentage increase in gross capital formation is expected to translate into a 0.001%, 0.002%, and 0.0003% per cent increase in economic growth in Madagascar, South Africa and Lesotho, respectively. This empirical finding is in tandem with standard economic theory and it reiterates the importance of capital accumulation in fostering economic growth.

We also experimented by including interactions, and testing for non-linearities, in the way budget deficits interact with economic growth. Inclusion of interactions and non-linear terms is aided by redundant and omitted variable tests. For South Africa, the budget deficit is interacted with the two structural breaks, one for the 1994, and the other one being for 2002. Since the former break marked the end of the apartheid administration, and the inception of the democratic government, the latter dummy coincided with the introduction of inflation targeting. One can view the interactions as effects of budget deficits on economic growth: 1) pre- and post- apartheid, and 2) pre- and post- inflation targeting, respectively. The interaction between the 1994 dummy and budget deficit is interestingly positive, and statistically significant at the 1% level. This result suggests the effect of budget deficit on economic growth is much more positive under the democratic government, relative to the apartheid government. Alternatively, the interaction between budget deficits and the 2002 dummy is negative and significant at 1% level. This outcome reveals that budget deficit correlates negatively with economic growth under inflation targeting, since the pre-inflation taggeting period is the base period. This is in line with COSATU's argument that inflation taggeting has been negatively affecting how macroeconomic fundamentals interact with economic growth in the South African economy.

It would have been more revealing to include the interaction between budget deficit and gross capital formation in order to trace how the effects of budget deficit on growth are shaped by the level of investment in each economy. In most cases however, this exercise is restrained by econometric tests which suggests that this interaction is redundant, and therefore its inclusion in the model would result in unnecessary model overfitting. It is only in the case of Madagascar, where the interaction term of budget deficit and gross capital formation appears to be relevant in the model. The coefficient is significantly positive, implying that the positive effect of budget deficit on economic growth increases with capital accumulation, which is encouraging.

For interest sake, we also further explored the existence of threshold effects among the three countries. This exercise requires us to include as an additional regressor the squared term of budget deficits to capture the potential non-linear effect. In this regard, the presence of non-linear effects will be detected by a positive and negative sign on the linear and squared term, respectively. For South Africa and Madagascar, both the linear and quadratic terms enter with positive signs, implying absence of non-linearity in the way budget deficits correlates with economic growth. Based on this finding, the claim by, among others, Reinhart and Rogoff (2010), that high budget deficits beyond 90% of GDP causes the growth rate of the economy to stagnate, is not supported by the data, in the case of South Africa and Madagascar.

Contrary to this finding, Lesotho demonstrates the presence of non-linearities of budget deficits. The linear term emerges with a positive sign, while the quadratic term turns out to be significantly negative. This result indicates that budget deficit in the case of Lesotho enhances growth up to some point, beyond which further increases in budget deficit reduces the level of economic growth. In the same spirit, one may argue that low to moderate fiscal deficits may be growth enhancing for Lesotho, while large deficits may actually undermine the growth rate of the economy.

The estimated models were subjected to a number of diagnoastic tests, and table 35 summarises the results. It is apparent from table 35, that no critical assumptions were violated, except for Madagascar, where residuals are non-normally distributed, indicating the presence of heteroscedasticity. As a corrective measure for Madagascar, the long-run model was re-estimated with robust standard errors in order to regain parameter efficiency, as the presence of heteroscedasticity would result in unbiased, consistent but inefficient estimates. As shown by Stock and Watson (1993), these single equation cointegrating regressions are immune to non-normality of residuals, using the generalised least procedure that we invoked for correcting the standard errors.

Table 35: Post-Estimation Diagnostic Checks

Diagnostic Check	South Africa	Madagascar	Lesotho
Ramsey RESET	t-statistic 0.36 (0.72) F-statistic 0.13 (0.13)	T-statistic 0.46 (0.64) F-statistic 0.24 (0.64)	t-statistic 1.52 (0.19) F-statistic 2.33 (0.16)
Breusch-Godfrey Serial Correlation LM test	F-statistic 1.07 (0.35)	F-statistic 0.49 (0.61)	F-statistic 0.72 (0.49)
Breusch-Pagan-Godfrey Heteroscedasticity test	F-statistic 1.32 (0.27) Scaled SS 3.58 (0.99)	F-statistic 3.39 (0.009)	F-statistic 1.34 (0.27)
Jarque-Bera test	JB-statistic 0.55 (0.75)	JB-statistic 13.5 (0.00)	JB-statistic 4.57 (0.10)

Notes to Table 35: Figures in parenthesis denote probability values.

The last diagnostic check that we conducted was to check for parameter stability. Our results for the CUSUM stability test, not presented here in the interest of space, but found in Appendix C, reveal that our models are stable as the line is within the confidence bands. Having presented the post-estimation diagnostic checks, the next section concludes the chapter.

6.5 Conclusion

This chapter presents the empirical evidence on the impact and nature of fiscal policy, specifically making use of budget deficit, on three of SADC’s member countries namely, South Africa, Madagascar and Lesotho. Realising and appreciating that panel regression analysis just gives an average effect and hence a generalised picture, we augment our panel empirical findings on the impact of public debt on economic growth in chapter 5, with a single-country time series analysis in this chapter. The chief motive was to assess if the impact of budget deficits on economic growth is uniform across all SADC member countries, given their apparent diversity, to the extent that blanket fiscal policy measures can be advocated for all SADC member countries. From this standpoint, we intend to offer country specific policy inference on the impact and nature of fiscal policy, particularly budget deficits, on economic growth in the three selected SADC countries. In arriving at our inference, we make use of the DOLS, the FMOLS, and the CCR estimation techniques.

The key empirical results in this chapter reveal that budget deficit is growth enhancing for the three SADC countries under our review. The three estimation techniques we made use of were all confirmatory to the effect that budget deficit was positive, and statistically significant. These results may be suggestive of the fact that budget deficit could be channeled towards growth supportive uses, like education, health and infrastructure in South Africa, Madgascar, and Lesotho, and not towards consumption purposes. Related to this empirical reality is the fact that in all the three cases we have analysed, compared with the other regressors we used in our growth regressions, budget deficit accounts for the largest variation in economic growth in South Africa and Madagscar, while the economic impact of budget deficit in Lesotho is second after investment in human capital. This bolsters the importance budget deficit plays on long-run economic growth, and in some way justifies the need and urgency of this study.

Incidental to our main objective, our empirical findings also establish evidence in support of a positive relationship between inflation and economic growth, a finding which is contrary to earlier panel evidence among SADC member countries. We use the consumer price index for both South Africa and Lesotho, and in both cases, there was overwhelming evidence of a positive and statistically significant relationship between our measure of inflation and economic growth. Both in the context of SADC countries, Seleteng and Motelle (2015), as well as Bittencourt et al (2015), found panel evidence of the adverse effects of inflation on economic growth. Our empirical findings, contrary to previous panel empirical evidence, again accentuates the need to augment panel evidence with individual country analysis, as the growth dynamics in each country are bound to be non uniform.

In a bid to infer the imact of budget deficit in a pre- and post- democracy, as well as the pre- and post-inflation targeting regime in South Africa, our empirical evidence is interesting. The empirical evidence shows that the growth enhancing effect of budget deficit was more evident during the democratic era than during apartheid. This could be a reasonable justification for the democratic government to incur fiscal deficits, as it is more growth engendering. Contrary to this, our findings show that budget deficits have adverse effects on economic growth, under the inflation targeting regime. This could be providing evidence to substantiate COSATU's arguments that inflation targeting adversely affected how macroeconomic fundamentals interact with growth in South Africa, hence COSATU's claim that inflation targeting is solely to blame for South Africa's sluggish growth, and escalating unemployment rates.

We also inferred as to whether the positive growth effects of budget deficits in South Africa, Madagascar and Lesotho are explained through investment in physical and human capital. While the interaction between budget deficit and gross fixed capital formation, as well as education, in South Africa and Lesotho proved to be redundant, the empirical evidence for Madagascar is worth noting. The evidence shows that dedicating budget deficit to physical capital accumulation, in the case of Madagscar is growth stimulating. We also inferred as to whether there exists any threshold beyond which budget deficit adversely affects growth in South Africa, Madagascar and Lesotho. While our empirical evidence is in support of the absence of a threshold beyond which further deficits retard economic growth for South Africa and Madagascar, evidence to the contrary was established in the case of Lesotho. For Lesotho, policy makers have to sparingly rely on budget deficit as a counter cyclical measure, as budget deficit is growth supportive at low and moderate levels, but reaches a certain level beyond which budget deficits hurts economic growth. There is a need for further studies though to unveil the threshold at which budget deficit start to retard growth in the case of Lesotho.

From the inference from our empirical results in this chapter, particularly making reference to our findings that budget deficit has dissimilar, non-linear effects on economic growth, one is left inconclusive as to whether budget deficit is unconditionally good or bad to economic growth, and this remains a controversial issue both in theory and empirical reality. The only plausible response could be that it depends on individual country characteristics. This, therefore, throws into attention any "one size fits all policies."

This chapter contributes to the literature in both empirical and methodological respects. It adds to the scanty empirical evidence on the impact of budget deficit on economic growth in SADC member countries, particularly, South Africa, Madagascar and Lesotho. Given the apparent incidence of structural breaks in the series, we depart from the traditional practice of making use of standard unit root, cointegration, and parameter estimation techniques, by adopting techniques that remain valid in the presence of structural breaks, in both our unit root and cointegration tests, as well as our parameter estimation techniques. By making use of the DOLS, FMOLS, and the CCR estimation techniques, we make use of some of the recent developments in time series cointegration literature, which are robust to serial correction, and endogeneity problems, that are characteristic features of any growth regression. More so, we are not aware of studies that have analysed the non-linear effects of budget deficit on economic growth in South Africa, Madagascar and Lesotho. This is crucial for it provides meaningful policy advice as to the extent to which policy makers have to exercise restraint in their reliance on fiscal policy as a counter cyclical measure. Further to that, one of our notable contributions is that we are the first study to analyse the economic growth impact of budget deficit in a pre and post apartheid era as well as the pre- and post- inflation targeting regime in South Africa.

CHAPTER 7

Conclusion and Policy Recommendations

7.1 Summary of Findings

This thesis focuses on an analysis of the twin deficits hypothesis, and the impact of fiscal policy (public debt and budget deficits) on economic growth, among SADC member countries, by making use of both panel and time series evidence. Our empirical evidence is discussed in three chapters (chapters 4, 5, and 6). Chapter 4 presents our panel empirical evidence on the twin deficits hypothesis in 14 SADC member countries, while chapter 5 discusses our panel estimation evidence on the impact of public debt on subsequent economic growth in 14 SADC member countries, and lastly, chapter 6 discusses our single country, time series evidence on the impact of budget deficits on economic growth in South Africa, Madagascar and Lesotho.

The twin deficits hypothesis among SADC member countries is discussed in chapter 4, where we entirely rely on panel estimation evidence. In this chapter, motivated by the widening current account deficits in most of SADC member countries, our objective is to provide empirical evidence to analyse the nature of relationship between the widening current account deficits, and budget deficits. In this chapter, our thesis contributes to the literature in many ways. Primarily, ours is the first attempt to analyse the twin deficits hypothesis in SADC, and to have empirical evidence with SADC-specific policy implications. Furthermore, we abstract from the previous practice, of relying, solely, on the system GMM, but in this chapter we supplement our system GMM empirical evidence with those from the Common Correlated Effects Mean Group estimator, a recent development in panel time series literature that does not only account for endogeneity, and heterogeneity, but also provides results that are robust to cross-sectional dependence. Hence, this chapter contributes both empirically, and methodologically to the literature.

The results from chapter 4 provide evidence in support of the twin deficits hypothesis. Both results from the CCEMG, and the system GMM are confirmatory to a positive, and statistically significant, relationship between budget deficits and the current account deficits. This is in support of the Keynesian proposition that the two deficits move together with the implications that curtailing fiscal deficits has meaningful impacts on harnessing the current account deficits. In some way, these results imply that the widening current account deficits can be accounted for, in part, on the grounds of widening budget deficits.

Our panel analysis of the impact of public debt on economic growth is presented in chapter 5. In view of the numerous methodological shortcomings surrounding any growth regression, we employ a vast array of panel estimation approaches, consistent with the literature, to arrive at our empirical evidence. Our intention is to circumvent the numerous downsides as regards the proper way of undertaking growth regressions, as we hope to produce empirical evidence that is robust to different panel estimation approaches. This chapter contributes immensely to the literature in many respects. Firstly, we are not aware of any empirical work that has analysed the impact of public debt on long-run economic growth, or a study that has inferred the non-linear effects of public debt on economic growth, or a study that has explored the interplay between public debt, and investment, within a SADC context. Secondly, we make use of a vast array of panel growth estimation approaches that include the system GMM estimators with use of both initial values, and three and five year averages, as well as panel time series approaches which are all consistent with the literature. By distancing ourselves from the usual practice of solely depending on one panel growth estimation approach, we hope to present results that are robust to different panel estimation techniques. Thirdly, by incorporating panel time series estimation techniques, an approach that is fast gaining momentum in panel regressions, we take advantage of the diversity emanating from a panel of SADC countries, as well as the dynamic growth interactions that are characteristic of time series modelling. This chapter, therefore, contributes both empirically and methodologically.

The three panel estimation techniques we utilise in chapter 5 provide contradictory results on the impact of public debt on economic growth. For reasons detailed in chapter 5, we finally discriminated in favour of the DOLS, which provides evidence in support of the Keynesian growth-promoting role of public debt. We, therefore, conclude that public debt has growth enhancing effects in the 14 SADC member countries, used in our panel, thereby supporting the Keynesian view. The other finding from our results is that public debt has a positive, but statistically insignificant, in explaining subsequent economic growth from use of three year averages in a system GMM approach. This could imply that the impact of public debt on economic growth, though positive, is not instantaneous, as it takes time to filter through the system. The evidence of non-linear effects of public debt on economic growth show that public debt correlates with economic growth in a non-linear fashion. This implies that there is a certain threshold beyond which public debt impacts negatively on economic growth. Our results also show that the interaction between public debt and investment is positive, and statistically significant, and correlates to long run economic growth in the SADC context, implying that public debt channeled towards investment is significantly promoting growth in SADC countries.

Our last set of analyses is an assessment of the relationship between budget deficit, and economic growth, in three SADC member countries (South Africa, Madagascar and Lesotho), whose empirical evidence is discussed and presented in chapter 6. This chapter contributes to the literature both in empirical and methodologically means. The first notable contribution this chapter makes is to add to the scarce empirical literature that exists on the analysis of the impact of budget deficit on economic growth, an exploration of the interplay between budget deficit and investment, as well as an assessment of the non-linear effects of budget deficit on economic growth, in South Africa, Madagascar and Lesotho. We abstract from the common practice by making use of unit root and cointegration test techniques that consider the possibility of structural breaks in the series, as well as incorporating structural breaks in our regression analysis. Another contribution this chapter makes is that we employ recent developments in time series regression, the DOLS, FMOLS, and the CCR, estimation techniques which, over and above their small sample properties, are robust to endogeneity and serial correlation.

The three estimation techniques we rely on in chapter 6, with the DOLS as our preferred estimation technique, and the FMOLS and the CCR serving as robustness checks, are all confirmatory that budget deficit has growth reinforcing effects in South Africa, Madagascar and Lesotho. The results in chapter 6 also reveal that budget deficit accounts for the largest variation in economic growth in Madagascar and South Africa, and then second largest for Lesotho. This underscores the importance fiscal policy plays on steering long run economic growth. The role of fiscal policy on driving long run economic growth, therefore, can not be underestimated. In the case of South Africa, the results show that, whereas budget deficit is more growth promoting in the post- independence era compared with the pre- democratic South Africa, budget deficit slows economic growth in the post-inflation targeting era. This provides empirical justification for the advocates of expansionary fiscal policy in the post-independence South Africa as it addresses the socio-economic colonial imbalances and, resultantly promotes growth. In the same manner, our findings in this chapter provide justifiable evidence for the critics of inflation targeting, as the data show that the interplay of budget deficit, and other macroeconomic variables, slows down economic performance during the inflation targeting regime. Finally, our results in chapter 6 show that budget deficit for Mdagscar is growth promoting, if channeled towards investment in physical capital.

7.2 Policy Implications of the Findings

The thesis's empirical findings in chapter 4, confirm that shocks to the fiscal balance move the external balance in the same direction, thereby giving empirical evidence in support of the twin deficits hypothesis. To this end, policy makers in SADC member countries may adopt domestic fiscal consolidation measures, and keep budget deficits under control, as this appears to be a necessary measure to contain the widening current account deficits. SADC policy makers are therefore advised to implement sound and prudent fiscal measures that result in increased revenue mobilisation and rationalisation of government expenditure. Concurrent with the policy of managing the budget deficits, it is also advisable for SADC policy makers to increase export promotion efforts through export diversification, and enhancing labour productivity in the country's export base, for both traditional and non-traditional exports, for these can also offer scope for containing the widening current account balance. In line with harnessing the broadening current account deficits, policy makers in SADC may consider concentrating their efforts to ease international trade restrictions, propose beneficial trade policies, and deepen efforts in trade concessions so as to facilitate better access for exports.

Our panel empirical results in chapter 5 on the impact of public debt on economic growth, reveal a positive, statistically significant influence of fiscal policy on economic growth in the SADC region. Further to this empirical finding, our results show that fiscal policy is particularly growth-promoting when public debt is channeled towards investment in physical capital. These results underscore the need for SADC member countries to effectively utilise public debt by closing the infrastructure gap, as this is growth encouraging.

Our results for the interplay between fiscal policy and education suggests that education has a great potential to steer economic growth in SADC, but does not yield a meaningful effect. This may suggest the need to reconsider the quality of education because increased school enrolemnt does not appear to be effective, and has not culminated in educational qualities that are growth encouraging. Results in chapter 5, also show that while expansionary fiscal policy is conducive for growth up until a certain level, there is a certain public-debt-to-GDP threshold beyond which public debt severly retards economic growth. Given this empirical reality in the data, it is our considered view that SADC member countries should consider reliance on expansionary fiscal policy with caution, as over dependence on public debt beyond a certain level, resultantly hampers the growth rate of the economy.

Chapter 6 of our thesis - which presents our last set of empirical evidence – presents our empirical findings on the impact of fiscal policy, specifically focusing on budget deficits based on single-country analysis, on long run economic growth in South Africa, Madagascar and Lesotho. Further to these results, we also establish that budget deficit is more growth enhancing when directed towards investment in physical capital, in the case of Madagascar. Confirming our panel results in chapter 5, put together, the implications of these results are that SADC economies are best advised to intensify their efforts in government capital investment projects in technology, and infrastructure such as roads, and railway networks as these have been found to be growth enhancing. Additionally, our results establish the non-linear effects of public debt on economic growth in the case of Madagascar. This again, supports our panel empirical evidence of the need to rely on expansionary fiscal policy, for SADC economies, with great caution, as excessive dependence on budget deficit, beyond a certain point has adverse growth effects. For the South African economy, the revelation in the data that budget deficit slows down the growth rate of the economy, during the inflation targeting era, may be suggestive of the need to rebalance the positive, inflation regulatory role inflation targeting plays, as well as minimising its growth retarding effects.

7.3 Limitations of this Study and Scope for Future Research

Having conducted empirical evidence, we need to highlight the major impediments in this study and also suggest future lines of research.

The major drawback of this study has been data unavailability. The data on public debt-to-GDP ratio and budget deficits, our explanatory variables of interest, is not available over a continuous period from 1980 to 2015, for most of the countries in our study, which has resulted in an unbalanced panel. In fact, most of the countries have data on public debt-to-GDP ratio starting from the year 2000, at best, which is too recent for us to be able to calculate debt threshold. We hope future research, capitalising on rich sets of data, will fortuitously fill this gap. Unavailability of data, too, is the sole reason Zimbabwe was excluded from the analysis.

The thesis's findings in chapter 4 is a confirmation of the twin deficits hypothesis: the Keynesian notion that the current account moves in tandem with the fiscal account balance. It would be interesting if future research would analyse the international transmission mechanism of fiscal policy. This could be through the use of standard general equilibrium analysis to analyse the international transmission mechanism of fiscal policy, through for example, terms of trade, exchange rates, interest rates and investment. This is crucial as there are different channels by which the response by the private sector may amplify, or partly offset, the impact of fiscal shocks on the current account. These are some of the issues which have not been given sufficient attention in the literature, particularly for SADC member countries. Another important line of research with regards to the twin deficits in SADC is an analysis of causality between budget deficits and the current account deficits. There could be reverse causality between the current account and the fiscal balance, as movements in the budget deficits may be due to the current account behaviour. This is an issue we could not address in this thesis. Having noted, throughout this thesis, that the current account deficits for most SADC countries are well above the set SADC threshold, it will also be more beneficial if future research could formally analyse the sustainability of current account deficits in the context of SADC.

Chapter 5 of this thesis analyses the relationship between public debt and economic growth, by utilising a number of alternative panel estimation approaches. We conclude in chapter 5 that our empirical findings show that there is a positive relationship between public debt, and economic growth, in the 14 SADC countries used in our study. We also show in chapter 5 that fiscal policy has non-linear effects with regards to its effects on economic growth. Due to the scanty nature of our data, we could not establish the exact threshold beyond which public debt dampens economic growth. To this extent, it would be more befitting if further empirical work, capitalising on a comprehensive data set, is focused on analysing the threshold beyond which public debt has detrimental effects on economic growth. An equally appropriate aspect of our findings, for which further research is called for, is with regards to the role of education on economic growth. In this respect, we establish in chapter 5 that education has a great potential to stimulate economic growth, but resultantly has no meaningful growth enhancing role in the SADC region. It would be warranting if future research examines this empirical conundrum, and propose tangible solutions with the bid of making investment in human capital to be effectively growth supportive.

Chapter 6 of this thesis analyses the relationship between budget deficits and economic growth in South Africa, Madagascar, and Lesotho. Our empirical results in this chapter show that budget deficit is positively related to economic growth in the three countries, as well as alluding to the existence of non-linearities of budget deficits on economic growth in Madagascar. In the same spirit, with our suggestions in chapter 5, it would be more exciting if future research unveils the exact threshold beyond which expansionary fiscal policy in the case of Madagascar is growth corrosive. For the South African case, budget deficit has been found to negatively affect economic growth in the inflation-targeting era. It is also particularly deserving if further research unveils the specific nature of the interactions of budget deficit, and other macroeconomic variables, in the inflation targeting era that retards growth, with the aim of mitigating the negative growth effects of expansionary fiscal policy during the inflation targeting era.

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APPENDICES

Appendix A: Appendix to Chapter 4

Appendix A1: Common Correlated Mean Group Estimator (CCEMG)

CORRELATION MATRIX

	CA	BD	POP_G	EXCH	LGDP_CAP
CA	1.000000	0.286430	-0.022387	-0.043817	0.037112
BD	0.286430	1.000000	-0.063346	-0.144856	-0.098047
POP_G	-0.022387	-0.063346	1.000000	0.244409	0.149411
EXCH	-0.043817	-0.144856	0.244409	1.000000	0.408820
LGDP_CAP	0.037112	-0.098047	0.149411	0.408820	1.000000

DESCRIPTIVE STATISTICS

	CA	BD	POP_G	EXCH	LGDP_CAP
Mean	-5.848273	-1.351287	2.194262	159.1499	4.619906
Median	-5.692000	-1.249121	2.551454	7.564749	4.592186
Maximum	25.58000	60.96511	4.344559	2933.508	5.966155
Minimum	-44.73600	-50.00598	-2.628656	0.064640	3.477927
Std. Dev.	10.95647	8.184540	1.021788	454.4659	0.639078
Skewness	-0.441812	1.439704	-0.725405	3.684665	0.211949
Kurtosis	4.176736	22.19052	3.624666	16.50304	2.232471
Jarque-Bera	28.06127	4879.683	32.33175	3066.447	9.962231
Probability	0.000001	0.000000	0.000000	0.000000	0.006866
Sum	-1818.813	-420.2502	682.4156	49495.61	1436.791
Sum Sq. Dev.	37213.71	20765.87	323.6558	64027167	126.6106
Observations	311	311	311	311	311

PANEL UNIT ROOT TESTS

ADF-FISCHER CHI-SQUARE TEST

Current Account Balance (ca)

Null Hypothesis: Unit root (individual unit root process)

Series: CA

Date: 11/27/16 Time: 11:15

Sample: 1980 2015

Exogenous variables: Individual effects

User-specified lags: 1

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
ADF - Fisher Chi-square	53.1672	0.0028
ADF - Choi Z-stat	-2.59219	0.0048

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

Null Hypothesis: Unit root (individual unit root process)

Series: CA

Date: 11/27/16 Time: 11:16

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
ADF - Fisher Chi-square	33.3290	0.2238
ADF - Choi Z-stat	-0.49901	0.3089

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

Null Hypothesis: Unit root (individual unit root process)

Series: CA

Date: 11/27/16 Time: 11:18

Sample: 1980 2015

Exogenous variables: None

User-specified lags: 1

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
ADF - Fisher Chi-square	70.4442	0.0000
ADF - Choi Z-stat	-4.25465	0.0000

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

Budget Deficits (bd)

Null Hypothesis: Unit root (individual unit root process)

Series: BD

Date: 11/27/16 Time: 11:19

Sample: 1980 2015

Exogenous variables: Individual effects

User-specified lags: 1

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
ADF - Fisher Chi-square	62.0792	0.0002
ADF - Choi Z-stat	-1.10468	0.1346

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

Null Hypothesis: Unit root (individual unit root process)

Series: BD

Date: 11/27/16 Time: 11:20

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
ADF - Fisher Chi-square	58.1566	0.0007
ADF - Choi Z-stat	-2.04021	0.0207

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

Null Hypothesis: Unit root (individual unit root process)

Series: BD

Date: 01/09/17 Time: 07:55

Sample: 1980 2015

Exogenous variables: None

User-specified lags: 1

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
ADF - Fisher Chi-square	87.9345	0.0000
ADF - Choi Z-stat	-3.27793	0.0005

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

Exchange Rate

Null Hypothesis: Unit root (individual unit root process)

Series: EXCH

Date: 11/27/16 Time: 11:21

Sample: 1980 2015

Exogenous variables: Individual effects

User-specified lags: 1

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
ADF - Fisher Chi-square	13.3158	0.9914
ADF - Choi Z-stat	4.21938	1.0000

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

Intermediate ADF test results EXCH

Null Hypothesis: Unit root (individual unit root process)

Series: EXCH

Date: 11/27/16 Time: 11:21

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
ADF - Fisher Chi-square	37.3011	0.1124
ADF - Choi Z-stat	-1.25650	0.1045

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

Null Hypothesis: Unit root (individual unit root process)

Series: EXCH

Date: 11/27/16 Time: 11:22

Sample: 1980 2015

Exogenous variables: None

User-specified lags: 1

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
ADF - Fisher Chi-square	2.74137	1.0000
ADF - Choi Z-stat	5.59443	1.0000

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

Log of GDP per capita (lgdp_cap)

Null Hypothesis: Unit root (individual unit root process)

Series: LGDP_CAP

Date: 11/27/16 Time: 11:22

Sample: 1980 2015

Exogenous variables: Individual effects

User-specified lags: 1

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
ADF - Fisher Chi-square	13.1123	0.9924
ADF - Choi Z-stat	4.06090	1.0000

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

Null Hypothesis: Unit root (individual unit root process)

Series: LGDP_CAP

Date: 11/27/16 Time: 11:23

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
ADF - Fisher Chi-square	28.2671	0.4504
ADF - Choi Z-stat	-0.05860	0.4766

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

Null Hypothesis: Unit root (individual unit root process)

Series: LGDP_CAP

Date: 11/27/16 Time: 11:23

Sample: 1980 2015

Exogenous variables: None

User-specified lags: 1

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
ADF - Fisher Chi-square	3.07033	1.0000
ADF - Choi Z-stat	8.43596	1.0000

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

Population Growth Rate (pop_g)

Null Hypothesis: Unit root (individual unit root process)

Series: POP_G

Date: 11/27/16 Time: 11:24

Sample: 1980 2015

Exogenous variables: Individual effects

User-specified lags: 1

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
ADF - Fisher Chi-square	190.995	0.0000
ADF - Choi Z-stat	-10.5955	0.0000

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

Null Hypothesis: Unit root (individual unit root process)

Series: POP_G

Date: 11/27/16 Time: 11:24

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
ADF - Fisher Chi-square	489.124	0.0000
ADF - Choi Z-stat	-14.2539	0.0000

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

Null Hypothesis: Unit root (individual unit root process)
Series: POP_G
Date: 11/27/16 Time: 11:25
Sample: 1980 2015
Exogenous variables: None
User-specified lags: 1
Total number of observations: 283
Cross-sections included: 14

Method	Statistic	Prob.**
ADF - Fisher Chi-square	43.5261	0.0309
ADF - Choi Z-stat	-1.15085	0.1249

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

FIRST DIFFERENCE OF ADF-FISHER TEST

First Difference of Exchange Rate (D(exch))

Null Hypothesis: Unit root (individual unit root process)
Series: D(EXCH)
Date: 11/27/16 Time: 11:26
Sample: 1980 2015
Exogenous variables: Individual effects
User-specified lags: 1
Total number of observations: 269
Cross-sections included: 14

Method	Statistic	Prob.**
ADF - Fisher Chi-square	87.2826	0.0000
ADF - Choi Z-stat	-5.33592	0.0000

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

Null Hypothesis: Unit root (individual unit root process)
Series: D(EXCH)
Date: 11/27/16 Time: 11:26
Sample: 1980 2015
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Total number of observations: 269
Cross-sections included: 14

Method	Statistic	Prob.**
ADF - Fisher Chi-square	71.7218	0.0000
ADF - Choi Z-stat	-3.83860	0.0001

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

Null Hypothesis: Unit root (individual unit root process)
Series: D(EXCH)
Date: 11/27/16 Time: 11:26
Sample: 1980 2015
Exogenous variables: None
User-specified lags: 1
Total number of observations: 269
Cross-sections included: 14

Method	Statistic	Prob.**
ADF - Fisher Chi-square	113.011	0.0000
ADF - Choi Z-stat	-6.88894	0.0000

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

First Difference of Log of GDP per capita (D(lgdp_cap))

Null Hypothesis: Unit root (individual unit root process)

Series: D(LGDP_CAP)

Date: 11/27/16 Time: 11:27

Sample: 1980 2015

Exogenous variables: Individual effects

User-specified lags: 1

Total number of observations: 269

Cross-sections included: 14

Method	Statistic	Prob.**
ADF - Fisher Chi-square	84.7871	0.0000
ADF - Choi Z-stat	-5.04718	0.0000

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

Null Hypothesis: Unit root (individual unit root process)

Series: D(LGDP_CAP)

Date: 11/27/16 Time: 11:27

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 269

Cross-sections included: 14

Method	Statistic	Prob.**
ADF - Fisher Chi-square	68.4818	0.0000
ADF - Choi Z-stat	-3.94196	0.0000

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

Null Hypothesis: Unit root (individual unit root process)

Series: D(LGDP_CAP)

Date: 11/27/16 Time: 11:28

Sample: 1980 2015

Exogenous variables: None

User-specified lags: 1

Total number of observations: 269

Cross-sections included: 14

Method	Statistic	Prob.**
ADF - Fisher Chi-square	70.4247	0.0000
ADF - Choi Z-stat	-4.25618	0.0000

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

Intermediate ADF test results D(LGDP_CAP)

PP-FISCHER PANEL UNIT ROOT TEST

Current Account (ca)

Null Hypothesis: Unit root (individual unit root process)

Series: CA

Date: 11/27/16 Time: 11:29

Sample: 1980 2015

Exogenous variables: Individual effects

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 297

Cross-sections included: 14

Method	Statistic	Prob.**
PP - Fisher Chi-square	39.8858	0.0677
PP - Choi Z-stat	-1.49968	0.0668

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

Null Hypothesis: Unit root (individual unit root process)

Series: CA

Date: 11/27/16 Time: 11:30

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 297

Cross-sections included: 14

Method	Statistic	Prob.**
PP - Fisher Chi-square	26.3285	0.5550
PP - Choi Z-stat	0.32252	0.6265

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

Null Hypothesis: Unit root (individual unit root process)
Series: CA
Date: 11/27/16 Time: 11:30
Sample: 1980 2015
Exogenous variables: None
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 297
Cross-sections included: 14

Method	Statistic	Prob.**
PP - Fisher Chi-square	54.9747	0.0017
PP - Choi Z-stat	-3.28084	0.0005

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

Budget Deficits (bd)

Null Hypothesis: Unit root (individual unit root process)
Series: BD
Date: 11/27/16 Time: 11:31
Sample: 1980 2015
Exogenous variables: Individual effects
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 297
Cross-sections included: 14

Method	Statistic	Prob.**
PP - Fisher Chi-square	37.4146	0.1100
PP - Choi Z-stat	-1.17756	0.1195

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

Null Hypothesis: Unit root (individual unit root process)
Series: BD
Date: 11/27/16 Time: 11:31
Sample: 1980 2015
Exogenous variables: Individual effects, individual linear trends
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 297
Cross-sections included: 14

Method	Statistic	Prob.**
PP - Fisher Chi-square	43.4892	0.0312
PP - Choi Z-stat	-2.05187	0.0201

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

Null Hypothesis: Unit root (individual unit root process)
Series: BD
Date: 11/27/16 Time: 11:32
Sample: 1980 2015
Exogenous variables: None
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 297
Cross-sections included: 14

Method	Statistic	Prob.**
PP - Fisher Chi-square	69.6912	0.0000
PP - Choi Z-stat	-3.65796	0.0001

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

Exchange Rate (exch)

Null Hypothesis: Unit root (individual unit root process)

Series: EXCH

Date: 11/27/16 Time: 11:32

Sample: 1980 2015

Exogenous variables: Individual effects

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 297

Cross-sections included: 14

Method	Statistic	Prob.**
PP - Fisher Chi-square	10.9449	0.9984
PP - Choi Z-stat	6.31560	1.0000

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

Null Hypothesis: Unit root (individual unit root process)

Series: EXCH

Date: 11/27/16 Time: 11:33

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 297

Cross-sections included: 14

Method	Statistic	Prob.**
PP - Fisher Chi-square	19.1759	0.8926
PP - Choi Z-stat	2.27354	0.9885

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

Null Hypothesis: Unit root (individual unit root process)
Series: EXCH
Date: 11/27/16   Time: 11:33
Sample: 1980 2015
Exogenous variables: None
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 297
Cross-sections included: 14

Method	Statistic	Prob.**
PP - Fisher Chi-square	0.99403	1.0000
PP - Choi Z-stat	8.19671	1.0000

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

Log of per capita GDP (lgdp_cap)

Null Hypothesis: Unit root (individual unit root process)
Series: LGDP_CAP
Date: 11/27/16   Time: 11:34
Sample: 1980 2015
Exogenous variables: Individual effects
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 297
Cross-sections included: 14

Method	Statistic	Prob.**
PP - Fisher Chi-square	15.9578	0.9664
PP - Choi Z-stat	3.92670	1.0000

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

Null Hypothesis: Unit root (individual unit root process)

Series: LGDP_CAP

Date: 11/27/16   Time: 11:34

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear
trends

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 297

Cross-sections included: 14

Method	Statistic	Prob.**
PP - Fisher Chi-square	36.6195	0.1275
PP - Choi Z-stat	0.26092	0.6029

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

Null Hypothesis: Unit root (individual unit root process)

Series: LGDP_CAP

Date: 11/27/16   Time: 11:35

Sample: 1980 2015

Exogenous variables: None

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 297

Cross-sections included: 14

Method	Statistic	Prob.**
PP - Fisher Chi-square	5.13900	1.0000
PP - Choi Z-stat	12.1403	1.0000

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

Population Growth Rate (pop_g)

Null Hypothesis: Unit root (individual unit root process)

Series: POP_G

Date: 11/27/16 Time: 11:35

Sample: 1980 2015

Exogenous variables: Individual effects

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 297

Cross-sections included: 14

Method	Statistic	Prob.**
PP - Fisher Chi-square	74.8662	0.0000
PP - Choi Z-stat	-2.90559	0.0018

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

Null Hypothesis: Unit root (individual unit root process)

Series: POP_G

Date: 11/27/16 Time: 11:36

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 297

Cross-sections included: 14

Method	Statistic	Prob.**
PP - Fisher Chi-square	71.0313	0.0000
PP - Choi Z-stat	-2.32316	0.0101

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

assume asymptotic normality.

Null Hypothesis: Unit root (individual unit root process)

Series: POP_G

Date: 11/27/16 Time: 11:36

Sample: 1980 2015

Exogenous variables: None

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 297

Cross-sections included: 14

Method	Statistic	Prob.**
PP - Fisher Chi-square	53.4613	0.0026
PP - Choi Z-stat	-0.79937	0.2120

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

FIRST DIFFERENCE OF PP FISCHER Chi-square

Population growth d(pop_g)

Null Hypothesis: Unit root (individual unit root process)

Series: D(POP_G)

Date: 11/27/16 Time: 11:37

Sample: 1980 2015

Exogenous variables: Individual effects

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
PP - Fisher Chi-square	66.1791	0.0001
PP - Choi Z-stat	-4.02538	0.0000

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

assume asymptotic normality.

Null Hypothesis: Unit root (individual unit root process)

Series: D(POP_G)

Date: 11/27/16 Time: 11:37

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
PP - Fisher Chi-square	305.395	0.0000
PP - Choi Z-stat	-5.91703	0.0000

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

Null Hypothesis: Unit root (individual unit root process)

Series: D(POP_G)

Date: 11/27/16 Time: 11:38

Sample: 1980 2015

Exogenous variables: None

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
PP - Fisher Chi-square	355.009	0.0000
PP - Choi Z-stat	-10.5737	0.0000

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

First Difference of Exchange Rate (d(exch)

Null Hypothesis: Unit root (individual unit root process)

Series: D(EXCH)

Date: 11/27/16 Time: 11:44

Sample: 1980 2015

Exogenous variables: Individual effects

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
PP - Fisher Chi-square	99.4870	0.0000
PP - Choi Z-stat	-6.33122	0.0000

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

Null Hypothesis: Unit root (individual unit root process)

Series: D(EXCH)

Date: 11/27/16 Time: 11:44

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
PP - Fisher Chi-square	84.5922	0.0000
PP - Choi Z-stat	-5.13266	0.0000

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

Null Hypothesis: Unit root (individual unit root process)

Series: D(EXCH)

Date: 11/27/16 Time: 11:45

Sample: 1980 2015

Exogenous variables: None

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
PP - Fisher Chi-square	134.299	0.0000
PP - Choi Z-stat	-8.28037	0.0000

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

Log of per capita gdp (d(lgdp_cap)

Null Hypothesis: Unit root (individual unit root process)

Series: D(LGDP_CAP)

Date: 11/27/16 Time: 11:45

Sample: 1980 2015

Exogenous variables: Individual effects

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
PP - Fisher Chi-square	156.416	0.0000
PP - Choi Z-stat	-8.67522	0.0000

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

assume asymptotic normality.

Null Hypothesis: Unit root (individual unit root process)

Series: D(LGDP_CAP)

Date: 11/27/16 Time: 11:46

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
PP - Fisher Chi-square	147.247	0.0000
PP - Choi Z-stat	-7.89341	0.0000

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

Null Hypothesis: Unit root (individual unit root process)

Series: D(LGDP_CAP)

Date: 11/27/16 Time: 11:46

Sample: 1980 2015

Exogenous variables: None

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
PP - Fisher Chi-square	120.422	0.0000
PP - Choi Z-stat	-7.19000	0.0000

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

IM-PESARAN AND SHIN

Current Account (ca)

Null Hypothesis: Unit root (individual unit root process)

Series: CA

Date: 11/25/16 Time: 19:13

Sample: 1980 2015

Exogenous variables: Individual effects

User-specified lags: 1

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-2.59943	0.0047

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (individual unit root process)

Series: CA

Date: 11/25/16 Time: 19:14

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-0.48187	0.3150

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (individual unit root process)

Series: CA

Date: 11/25/16 Time: 19:15

Sample: 1980 2015

Exogenous variables: Individual effects

User-specified lags: 1

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-2.59943	0.0047

** Probabilities are computed assuming asympotic normality

Budget Deficits (bd)

Null Hypothesis: Unit root (individual unit root process)

Series: BD

Date: 11/25/16 Time: 19:15

Sample: 1980 2015

Exogenous variables: Individual effects

User-specified lags: 1

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-1.70093	0.0445

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (individual unit root process)

Series: BD

Date: 11/25/16 Time: 19:16

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-2.58118	0.0049

** Probabilities are computed assuming asympotic normality

Exchange Rate (exch)

Null Hypothesis: Unit root (individual unit root process)

Series: EXCH

Date: 11/25/16 Time: 19:16

Sample: 1980 2015

Exogenous variables: Individual effects

User-specified lags: 1

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	4.01017	1.0000

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (individual unit root process)

Series: EXCH

Date: 11/25/16 Time: 19:17

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-1.07522	0.1411

** Probabilities are computed assuming asympotic normality

Log of GDP per capita (lgdp_cap)

Null Hypothesis: Unit root (individual unit root process)

Series: LGDP_CAP

Date: 11/25/16 Time: 19:18

Sample: 1980 2015

Exogenous variables: Individual effects

User-specified lags: 1

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	4.11515	1.0000

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (individual unit root process)

Series: LGDP_CAP

Date: 11/25/16 Time: 19:18

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	0.00166	0.5007

** Probabilities are computed assuming asympotic normality

Intermediate ADF test results

Population Growth (pop_g)

Null Hypothesis: Unit root (individual unit root process)

Series: POP_G

Date: 11/25/16 Time: 19:19

Sample: 1980 2015

Exogenous variables: Individual effects

User-specified lags: 1

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-19.8675	0.0000

Null Hypothesis: Unit root (individual unit root process)

Series: POP_G

Date: 11/25/16 Time: 19:19

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-162.573	0.0000

BREITUNG PANEL UNIT ROOT TEST

Current Account (ca)

Null Hypothesis: Unit root (common unit root process)

Series: CA

Date: 11/25/16 Time: 19:20

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 269

Cross-sections included: 14

Method	Statistic	Prob.**
Breitung t-stat	-0.32925	0.3710

Budget Deficit (bd)

Null Hypothesis: Unit root (common unit root process)

Series: BD

Date: 11/25/16 Time: 19:21

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 269

Cross-sections included: 14

Method	Statistic	Prob.**
Breitung t-stat	0.56444	0.7138

Exchange Rate (exch)

Null Hypothesis: Unit root (common unit root process)

Series: EXCH

Date: 11/25/16 Time: 19:22

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 269

Cross-sections included: 14

Method	Statistic	Prob.**
Breitung t-stat	-0.76955	0.2208

Null Hypothesis: Unit root (common unit root process)

Series: LGDP_CAP

Date: 11/25/16 Time: 19:22

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 269

Cross-sections included: 14

Method	Statistic	Prob.**
Breitung t-stat	1.19598	0.8841

Population Growth (pop_g)

Null Hypothesis: Unit root (common unit root process)

Series: POP_G

Date: 11/25/16 Time: 19:23

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 269

Cross-sections included: 14

Method	Statistic	Prob.**
Breitung t-stat	-3.38863	0.0004

FIRST DIFFERENCE: BREITUNG

Budget Deficit (bd)

Null Hypothesis: Unit root (common unit root process)

Series: D(BD)

Date: 01/09/17 Time: 10:28

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 255

Cross-sections included: 14

Method	Statistic	Prob.**
Breitung t-stat	-3.39942	0.0003

** Probabilities are computed assuming asympotic normality

Current Account (ca)

Null Hypothesis: Unit root (common unit root process)

Series: D(CA)

Date: 01/09/17 Time: 10:31

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 255

Cross-sections included: 14

Method	Statistic	Prob.**
Breitung t-stat	-6.13164	0.0000

** Probabilities are computed assuming asympotic normality

First Difference of Exchange Rate d(exch)

Null Hypothesis: Unit root (common unit root process)

Series: D(EXCH)

Date: 01/09/17 Time: 10:36

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 255

Cross-sections included: 14

Method	Statistic	Prob.**
Breitung t-stat	0.40053	0.6556

** Probabilities are computed assuming asympotic normality

First Difference of Log of GDP per capita (d(lgdp_cap))

Null Hypothesis: Unit root (common unit root process)

Series: D(LGDP_CAP)

Date: 01/09/17 Time: 10:38

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 255

Cross-sections included: 14

Method	Statistic	Prob.**
Breitung t-stat	-3.41447	0.0003

** Probabilities are computed assuming asympotic normality

LEVIN, LIN & CHU

Current Account

Null Hypothesis: Unit root (common unit root process)

Series: CA

Date: 01/09/17 Time: 10:40

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-1.81513	0.0348

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)

Series: BD

Date: 01/09/17 Time: 10:43

Sample: 1980 2015

Exogenous variables: Individual effects

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-2.27250	0.0115

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)

Series: CA

Date: 01/09/17 Time: 10:45

Sample: 1980 2015

Exogenous variables: None

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-4.99193	0.0000

** Probabilities are computed assuming asympotic normality

Budget Deficits (bd)

Null Hypothesis: Unit root (common unit root process)

Series: BD

Date: 01/09/17 Time: 10:41

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-4.30186	0.0000

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)

Series: BD

Date: 01/09/17 Time: 10:43

Sample: 1980 2015

Exogenous variables: Individual effects

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-2.27250	0.0115

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)

Series: BD

Date: 01/09/17 Time: 10:48

Sample: 1980 2015

Exogenous variables: None

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-3.52885	0.0002

** Probabilities are computed assuming asympotic normality

Exchange Rate (exch)

Null Hypothesis: Unit root (common unit root process)

Series: EXCH

Date: 01/09/17 Time: 10:49

Sample: 1980 2015

Exogenous variables: Individual effects

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	2.52706	0.9942

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)
Series: EXCH
Date: 01/09/17   Time: 10:50
Sample: 1980 2015
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 283
Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-0.47362	0.3179

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)
Series: EXCH
Date: 01/09/17   Time: 10:51
Sample: 1980 2015
Exogenous variables: None
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 283
Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	4.05991	1.0000

** Probabilities are computed assuming asympotic normality

Log of GDP per capita (lgdp)

Null Hypothesis: Unit root (common unit root process)

Series: LGDP_CAP

Date: 01/09/17 Time: 10:52

Sample: 1980 2015

Exogenous variables: Individual effects

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	1.59308	0.9444

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)

Series: LGDP_CAP

Date: 01/09/17 Time: 10:53

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-1.60390	0.0544

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)

Series: LGDP_CAP

Date: 01/09/17 Time: 10:54

Sample: 1980 2015

Exogenous variables: None

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	7.52886	1.0000

** Probabilities are computed assuming asympotic normality

Population Growth Rate (pop_g)

Null Hypothesis: Unit root (common unit root process)

Series: POP_G

Date: 01/09/17 Time: 10:56

Sample: 1980 2015

Exogenous variables: Individual effects

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 283

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-16.1379	0.0000

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)
Series: POP_G
Date: 01/09/17   Time: 10:56
Sample: 1980 2015
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 283
Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-65.6342	0.0000

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)
Series: POP_G
Date: 01/09/17   Time: 10:57
Sample: 1980 2015
Exogenous variables: None
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 283
Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-1.71579	0.0431

** Probabilities are computed assuming asympotic normality

FIRST DIFFERENCE: LEVIN, LIN & CHU

Exchange Rate (exch)

Null Hypothesis: Unit root (common unit root process)

Series: D(EXCH)

Date: 11/25/16 Time: 19:24

Sample: 1980 2015

Exogenous variables: Individual effects

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 269

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-4.87791	0.0000

Null Hypothesis: Unit root (common unit root process)

Series: D(EXCH)

Date: 01/09/17 Time: 10:59

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 269

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-5.24166	0.0000

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)
Series: D(EXCH)
Date: 01/09/17   Time: 11:00
Sample: 1980 2015
Exogenous variables: None
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 269
Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-8.74857	0.0000

** Probabilities are computed assuming asympotic normality

Log of GDP per capita (d(lgdp_cap)

Null Hypothesis: Unit root (common unit root process)
Series: D(LGDP_CAP)
Date: 01/09/17   Time: 11:02
Sample: 1980 2015
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 269
Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-5.10028	0.0000

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)

Series: D(LGDP_CAP)

Date: 01/09/17 Time: 11:02

Sample: 1980 2015

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 269

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-5.29725	0.0000

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)

Series: D(LGDP_CAP)

Date: 01/09/17 Time: 11:03

Sample: 1980 2015

Exogenous variables: None

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 269

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-4.50346	0.0000

** Probabilities are computed assuming asympotic normality

COMMON CORRELATED MEAN GROUP

```
. xtmg ca bd exch lgdp_cap pop_g, cce trend


Pesaran (2006) Common Correlated Effects Mean Group estimator

All coefficients present represent averages across groups (fid)
Coefficient averages computed as unweighted means

Mean Group type estimation                    Number of obs      =       311
Group variable: fid                           Number of groups   =        14

                                              Obs per group: min =        13
                                                             avg =      22.2
                                                             max =        36

                                              Wald chi2(4)       =      9.37
                                              Prob > chi2        =    0.0525
```

ca	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
bd	.2762922	.1332103	2.07	0.038	.0152048	.5373796
exch	.6399077	.294347	2.17	0.030	.0629981	1.216817
lgdp_cap	104.4751	50.01472	2.09	0.037	6.44807	202.5022
pop_g	-10.65473	5.535287	-1.92	0.054	-21.50369	.194234
__000007_t	-2.107926	.7724076	-2.73	0.006	-3.621817	-.5940349
__00000M_ca	.8132987	.2554039	3.18	0.001	.3127163	1.313881
__00000L_bd	-.0958637	.2438776	-0.39	0.694	-.5738551	.3821277
__00000L_exch	.0298162	.017639	1.69	0.091	-.0047556	.0643879
__00000L_lgdp_cap	-2.880102	11.81906	-0.24	0.807	-26.04503	20.28482
__00000L_pop_g	.589803	3.038421	0.19	0.846	-5.365392	6.544998
_cons	-396.4719	223.9224	-1.77	0.077	-835.3518	42.40789

```
Root Mean Squared Error (sigma): 3.4111
——more——
```

COMMON CORRELATED FIXED EFFECTS

```
Fixed-effects (within) regression             Number of obs      -       311
Group variable: fid                           Number of groups   -        14

R-sq:  within  - 0.7281                       Obs per group: min -        13
       between - 0.0029                                      avg -      22.2
       overall - 0.0082                                      max -        36

                                              F(74,223)          -      8.07
corr(u_i, Xb)  - -0.9968                      Prob > F           -    0.0000
```

ca	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
bd	.4261831	.0850412	5.01	0.000	.258596	.5937703
exch	-.0028278	.0057662	-0.49	0.624	-.014191	.0085354
lgdp_cap	12.47437	9.368764	1.33	0.184	-5.988265	30.93701
pop_g	-.0887207	.7770628	-0.11	0.909	-1.620046	1.442605
caT	1.922359	.5205879	3.69	0.000	.8964573	2.94826

Appendix A2: System GMM Results

Descriptive Statistics

	CA	BD	POP_G	GCONS___	DEPRATIO	IM_G
Mean	-4.450674	1.353025	2.219572	19.09962	6.623731	6.424033
Median	-3.446217	-1.134499	2.486452	18.28558	5.850490	4.930200
Maximum	15.57860	32.10598	4.070264	42.85325	12.06692	26.97740
Minimum	-33.48683	-10.50869	0.201540	4.206194	4.682152	-18.65360
Std. Dev.	9.294896	9.590023	0.944936	8.233566	1.847853	7.725279
Skewness	-0.677086	2.181149	-0.308468	0.642447	1.641709	0.317548
Kurtosis	4.055511	6.863527	1.941877	3.075079	4.776518	4.403010
Jarque-Bera	9.089307	104.6992	4.625720	5.107815	42.97196	7.313004
Probability	0.010624	0.000000	0.098978	0.077777	0.000000	0.025823
Sum	-329.3499	100.1238	164.2483	1413.372	490.1561	475.3785
Sum Sq. Dev.	6306.841	6713.704	65.18201	4948.788	249.2628	4356.635
Observations	74	74	74	74	74	74

Correlation Matrix

	CA	BD	POP_G	GCONS___	DEPRATIO	IM_G
CA	1.000000	0.360144	0.003202	-0.062988	-0.298068	0.075286
BD	0.360144	1.000000	0.024041	0.205928	-0.238591	0.007231
POP_G	0.003202	0.024041	1.000000	-0.389452	-0.696070	-0.033139
GCONS___	-0.062988	0.205928	-0.389452	1.000000	0.450670	-0.124590
DEPRATIO	-0.298068	-0.238591	-0.696070	0.450670	1.000000	0.024389
IM_G	0.075286	0.007231	-0.033139	-0.124590	0.024389	1.000000

ORDINARY LEAST SQUARES (OLS)

```
. reg ca bd pop_g gcons im_g yg
```

Source	SS	df	MS
Model	1178.70494	5	235.740987
Residual	5128.13612	68	75.4137665
Total	6306.84106	73	86.395083

Number of obs =	74
F(5, 68) =	3.13
Prob > F =	0.0134
R-squared =	0.1869
Adj R-squared =	0.1271
Root MSE =	8.6841

ca	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
bd	.44799	.116411	3.85	0.000	.2156954	.6802845
pop_g	-.044884	1.245634	-0.04	0.971	-2.530508	2.44074
gcons	-.1311312	.1437626	-0.91	0.365	-.4180051	.1557426
im_g	.234089	.1722339	1.36	0.179	-.1095983	.5777763
yg	-.684443	.4280885	-1.60	0.114	-1.53868	.1697942
_cons	-.8959624	4.741145	-0.19	0.851	-10.35677	8.564845

Ommited Variables Test

Ramsey RESET test using powers of the fitted values of ca

Ho: model has no omitted variables

F(3, 65) = 0.16

Prob > F = 0.9236

Heteroscedasticity Test

```
. hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of ca

         chi2(1)      =     2.67
         Prob > chi2  =   0.1020

.
```

Fixed Effects Without Country Dummies

```
. xtset fid year
       panel variable:  fid (unbalanced)
        time variable:  year, 1980 to 1986
                delta:  1 unit

. xtreg ca bd yg depratio im_g pop_g

Random-effects GLS regression                   Number of obs      =        74
Group variable: fid                             Number of groups   =        14

R-sq:  within  = 0.0405                         Obs per group: min =         3
       between = 0.5168                                        avg =       5.3
       overall = 0.2525                                        max =         7

                                                Wald chi2(5)       =     12.61
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0274
```

ca	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
bd	.3309046	.1618341	2.04	0.041	.0137155	.6480936
yg	-.40056	.4459631	-0.90	0.369	-1.274632	.4735115
depratio	-1.758585	.9122653	-1.93	0.054	-3.546592	.0294218
im_g	.1685302	.1631683	1.03	0.302	-.1512737	.4883342
pop_g	-2.112234	1.70327	-1.24	0.215	-5.450583	1.226114
_cons	12.10939	8.879242	1.36	0.173	-5.293603	29.51238
sigma_u	3.7839423					
sigma_e	7.7577789					
rho	.19218737	(fraction of variance due to u_i)				

Test of Time Dummies

```
. testparm i.year

 ( 1)  1981.year = 0
 ( 2)  1982.year = 0
 ( 3)  1983.year = 0
 ( 4)  1984.year = 0
 ( 5)  1985.year = 0
 ( 6)  1986.year = 0

       F(  6,    49) =    0.96
            Prob > F =    0.4652
```

Test for country dummies

testparm i.fid

(1) 2.fid = 0

(2) 3.fid = 0

(3) 4.fid = 0

(4) 5.fid = 0

(5) 6.fid = 0

(6) 7.fid = 0

(7) 8.fid = 0

(8) 9.fid = 0

(9) 10.fid = 0

(10) 11.fid = 0

(11) 12.fid = 0

(12) 13.fid = 0

(13) 14.fid = 0

F(13, 55) = 2.32

Prob > F = 0.0156

POOLED OLS

```
. reg ca bd pop_g gcons im_g yg

      Source |       SS       df       MS              Number of obs =      74
-------------+------------------------------           F(  5,    68) =    3.13
       Model |  1178.70494     5  235.740987           Prob > F      =  0.0134
    Residual |  5128.13612    68  75.4137665           R-squared     =  0.1869
-------------+------------------------------           Adj R-squared =  0.1271
       Total |  6306.84106    73   86.395083           Root MSE      =  8.6841

------------------------------------------------------------------------------
          ca |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          bd |     .44799    .116411     3.85   0.000     .2156954    .6802845
       pop_g |   -.044884   1.245634    -0.04   0.971    -2.530508     2.44074
       gcons |  -.1311312   .1437626    -0.91   0.365    -.4180051    .1557426
        im_g |    .234089   .1722339     1.36   0.179    -.1095983    .5777763
          yg |   -.684443   .4280885    -1.60   0.114     -1.53868    .1697942
       _cons |  -.8959624   4.741145    -0.19   0.851    -10.35677    8.564845
------------------------------------------------------------------------------
```

SYSTEM GMM RESULTS

```
. xtdpdsys ca, lags(1) endog(bd im_g yg pop_g gcons) vce(robust) artests(2)

System dynamic panel-data estimation        Number of obs         =        60
Group variable: fid                         Number of groups      =        14
Time variable: year
                                            Obs per group:    min =         2
                                                              avg =  4.285714
                                                              max =         6

Number of instruments =     67              Wald chi2(6)          =     40.35
                                            Prob > chi2           =    0.0000
One-step results
```

ca	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
ca						
L1.	.1814231	.0725418	2.50	0.012	.0392437	.3236025
bd	.5166038	.1708242	3.02	0.002	.1817945	.8514131
im_g	.239905	.1338754	1.79	0.073	-.0224859	.5022959
yg	-.7599265	.321384	-2.36	0.018	-1.389828	-.1300255
pop_g	1.89688	1.205109	1.57	0.115	-.4650909	4.25885
gcons	.1635412	.1488406	1.10	0.272	-.128181	.4552635
_cons	-8.899168	3.196228	-2.78	0.005	-15.16366	-2.634677

```
Instruments for differenced equation
        GMM-type: L(2/.).ca L(2/.).bd L(2/.).im_g L(2/.).yg L(2/.).pop_g
                  L(2/.).gcons
Instruments for level equation
        GMM-type: LD.ca LD.bd LD.im_g LD.yg LD.pop_g LD.gcons
        Standard: _cons

.
```

Autocorrelation Test

```
. estat abond

Arellano-Bond test for zero autocorrelation in first-differenced errors
```

Order	z	Prob > z
1	-2.1883	0.0286
2	-1.1142	0.2652

```
  H0: no autocorrelation
```

Sargan Test

```
. estat sargan
Sargan test of overidentifying restrictions
        H0: overidentifying restrictions are valid

        chi2(60)     =  66.39888
        Prob > chi2  =    0.2660

.
```

Appendix B: Appendix to Chapter 5

Appendix B1: Panel Time Series Evidence

Descriptive Statistics

	LGDP	GDEBT	INV	LSEC	POPG	LCONS
Mean	4.623238	54.95256	25.12530	5.352931	2.108316	12.66295
Median	4.667114	40.17000	23.96900	5.256240	2.235254	10.57465
Maximum	5.966155	202.0520	69.03400	6.685023	3.555303	39.58374
Minimum	3.466944	6.228000	4.561000	3.802457	-2.628656	1.657859
Std. Dev.	0.624898	42.78586	11.45798	0.712098	0.998947	7.808588
Skewness	0.118743	1.210860	1.237416	-0.247464	-0.801341	2.305294
Kurtosis	2.344352	3.727977	5.596704	2.858677	3.797036	7.355740
Jarque-Bera	5.450325	71.67370	144.2251	2.969381	35.90985	450.9110
Probability	0.065536	0.000000	0.000000	0.226572	0.000000	0.000000
Sum	1243.651	14782.24	6758.705	1439.938	567.1370	3406.333
Sum Sq. Dev.	104.6533	490608.7	35184.49	135.8985	267.4359	16341.04
Observations	269	269	269	269	269	269

Correlation Matrix

	LGDP	GDEBT	INV	LSEC	POPG	LCONS
LGDP	1					
GDEBT	0.18403	1				
INV	-0.44439	-0.07585	1			
LSEC	0.268772	-0.29821	-0.35537	1		
POPG	0.205525	-0.02765	-0.25209	0.530657	1	
LCONS	-0.44291	0.045659	0.476907	-0.10603	-0.31077	1

PANEL UNIT ROOT TESTS

LEVIN, LIN & CHU (LLC)

Log of GDP per capita (lgdp)

Null Hypothesis: Unit root (common unit root process)

Series: LGDP

Date: 11/16/16   Time: 08:55

Sample: 1980 2007

Exogenous variables: Individual effects

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 241

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-0.95131	0.1707

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)

Series: LGDP

Date: 11/16/16   Time: 08:56

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 241

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-0.32239	0.3736

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)
Series: LGDP
Date: 11/16/16 Time: 08:56
Sample: 1980 2007
Exogenous variables: None
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 241
Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	7.45505	1.0000

** Probabilities are computed assuming asympotic normality

Intermediate results on LGDP

Government Debt (gdebt)

Null Hypothesis: Unit root (common unit root process)
Series: GDEBT
Date: 11/16/16 Time: 08:58
Sample: 1980 2007
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 241
Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-1.71131	0.0435

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)

Series: GDEBT

Date: 11/16/16   Time: 08:59

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 241

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-0.38036	0.3518

** Probabilities are computed assuming asympotic normality

Intermediate results on GDEBT

Null Hypothesis: Unit root (common unit root process)

Series: GDEBT

Date: 11/16/16   Time: 08:59

Sample: 1980 2007

Exogenous variables: None

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 241

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-1.47359	0.0703

** Probabilities are computed assuming asympotic normality

Investment Ratio (inv)

Null Hypothesis: Unit root (common unit root process)

Series: INV

Date: 11/16/16 Time: 09:00

Sample: 1980 2007

Exogenous variables: Individual effects

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 241

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-1.43029	0.0763

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)

Series: INV

Date: 11/16/16 Time: 09:01

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 241

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	0.15594	0.5620

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)
Series: INV
Date: 11/16/16 Time: 09:01
Sample: 1980 2007
Exogenous variables: None
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 241
Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	0.15927	0.5633

** Probabilities are computed assuming asympotic normality

Log of secondary school enrolment ratio (educ)

Null Hypothesis: Unit root (common unit root process)
Series: educ
Date: 11/16/16 Time: 09:02
Sample: 1980 2007
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 241
Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-3.37004	0.0004

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)

Series: educ

Date: 11/16/16   Time: 09:02

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 241

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-10.1387	0.0000

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)

Series: educ

Date: 11/16/16   Time: 09:03

Sample: 1980 2007

Exogenous variables: None

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 241

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	5.47945	1.0000

** Probabilities are computed assuming asympotic normality

Population Growth rate (pop_g)

Null Hypothesis: Unit root (common unit root process)

Series: POPG

Date: 11/16/16 Time: 09:03

Sample: 1980 2007

Exogenous variables: Individual effects

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 241

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-13.1791	0.0000

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)

Series: POPG

Date: 11/16/16 Time: 09:04

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 241

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-60.3865	0.0000

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)

Series: POPG

Date: 11/16/16   Time: 09:04

Sample: 1980 2007

Exogenous variables: None

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 241

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-3.00409	0.0013

** Probabilities are computed assuming asympotic normality

Log of Government Consumption (lgcons)

Null Hypothesis: Unit root (common unit root process)

Series: LCONS

Date: 11/16/16   Time: 09:05

Sample: 1980 2007

Exogenous variables: Individual effects

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 241

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-2.32450	0.0100

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)

Series: LCONS

Date: 11/16/16 Time: 09:05

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 241

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-0.41956	0.3374

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)

Series: LCONS

Date: 11/16/16 Time: 09:06

Sample: 1980 2007

Exogenous variables: None

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 241

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	7.41645	1.0000

** Probabilities are computed assuming asympotic normality

FIRST DIFFERENCE LLC

First Difference of GDP per capita (D(lgdp))

Null Hypothesis: Unit root (common unit root process)

Series: D(LGDP)

Date: 11/16/16 Time: 09:07

Sample: 1980 2007

Exogenous variables: Individual effects

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 227

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-4.37091	0.0000

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)

Series: D(LGDP)

Date: 11/16/16 Time: 09:07

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 227

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-4.35288	0.0000

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)

Series: D(LGDP)

Date: 11/16/16   Time: 09:08

Sample: 1980 2007

Exogenous variables: None

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 227

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-3.87141	0.0001

** Probabilities are computed assuming asympotic normality

Public Debt (gdebt)

Null Hypothesis: Unit root (common unit root process)

Series: D(GDEBT)

Date: 11/16/16   Time: 09:08

Sample: 1980 2007

Exogenous variables: Individual effects

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 227

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-4.58403	0.0000

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)
Series: D(GDEBT)
Date: 11/16/16 Time: 09:09
Sample: 1980 2007
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 227
Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-3.62929	0.0001

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)
Series: D(GDEBT)
Date: 11/16/16 Time: 09:09
Sample: 1980 2007
Exogenous variables: None
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 227
Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-9.37521	0.0000

** Probabilities are computed assuming asympotic normality

Investment Ratio (inv)

Null Hypothesis: Unit root (common unit root process)

Series: D(INV)

Date: 11/16/16 Time: 09:10

Sample: 1980 2007

Exogenous variables: Individual effects

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 227

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-2.95262	0.0016

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)

Series: D(INV)

Date: 11/16/16 Time: 09:12

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 227

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-1.23683	0.1081

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)

Series: D(INV)

Date: 11/16/16 Time: 09:12

Sample: 1980 2007

Exogenous variables: None

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 227

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-10.6776	0.0000

** Probabilities are computed assuming asympotic normality

Log of Secondary School Enrolment Ratio (educ)

Null Hypothesis: Unit root (common unit root process)

Series: D(educ)

Date: 11/16/16 Time: 09:13

Sample: 1980 2007

Exogenous variables: Individual effects

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 227

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-7.74818	0.0000

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)
Series: D(LSEC)
Date: 11/16/16 Time: 09:14
Sample: 1980 2007
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 227
Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-0.96038	0.1684

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)
Series: D(LSEC)
Date: 11/16/16 Time: 09:14
Sample: 1980 2007
Exogenous variables: None
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 227
Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-7.43426	0.0000

** Probabilities are computed assuming asympotic normality

Population Growth Rate (popg)

Null Hypothesis: Unit root (common unit root process)

Series: D(POPG)

Date: 11/16/16 Time: 09:15

Sample: 1980 2007

Exogenous variables: Individual effects

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 227

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-228.548	0.0000

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)

Series: D(POPG)

Date: 11/16/16 Time: 09:15

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 227

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-1455.76	0.0000

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)

Series: D(POPG)

Date: 11/16/16   Time: 09:16

Sample: 1980 2007

Exogenous variables: None

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 227

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-10.5654	0.0000

** Probabilities are computed assuming asympotic normality

Log of Governement Consumption (lcons)

Null Hypothesis: Unit root (common unit root process)

Series: D(LCONS)

Date: 11/16/16   Time: 09:16

Sample: 1980 2007

Exogenous variables: Individual effects

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 227

Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-5.09211	0.0000

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)
Series: D(LCONS)
Date: 11/16/16 Time: 09:17
Sample: 1980 2007
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 227
Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-6.19351	0.0000

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (common unit root process)
Series: D(LCONS)
Date: 11/16/16 Time: 09:17
Sample: 1980 2007
Exogenous variables: None
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 227
Cross-sections included: 14

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-4.66388	0.0000

** Probabilities are computed assuming asympotic normality

IM, PESARAN & SHIN (IPS)

Log of GDP (lgdp)

Null Hypothesis: Unit root (individual unit root process)

Series: LGDP

Date: 11/16/16 Time: 09:18

Sample: 1980 2007

Exogenous variables: Individual effects

User-specified lags: 1

Total number of observations: 241

Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	3.20795	0.9993

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (individual unit root process)

Series: LGDP

Date: 11/16/16 Time: 09:19

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 241

Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	1.22427	0.8896

** Probabilities are computed assuming asympotic normality

Public Debt (gdebt)

Null Hypothesis: Unit root (individual unit root process)

Series: GDEBT

Date: 11/16/16 Time: 09:20

Sample: 1980 2007

Exogenous variables: Individual effects

User-specified lags: 1

Total number of observations: 241

Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-0.55602	0.2891

** Probabilities are computed assuming asympotic normality

Intermediate ADF test results

Null Hypothesis: Unit root (individual unit root process)

Series: GDEBT

Date: 11/16/16 Time: 09:20

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 241

Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	2.01677	0.9781

** Probabilities are computed assuming asympotic normality

Investment ratio (inv)

Null Hypothesis: Unit root (individual unit root process)

Series: INV

Date: 11/16/16 Time: 09:21

Sample: 1980 2007

Exogenous variables: Individual effects

User-specified lags: 1

Total number of observations: 241

Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-1.39916	0.0809

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (individual unit root process)

Series: INV

Date: 11/16/16 Time: 09:21

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 241

Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	0.17452	0.5693

** Probabilities are computed assuming asympotic normality

Log of School Enrolment Ratio (educ)

Null Hypothesis: Unit root (individual unit root process)

Series: educ

Date: 11/16/16 Time: 09:22

Sample: 1980 2007

Exogenous variables: Individual effects

User-specified lags: 1

Total number of observations: 241

Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-0.25354	0.3999

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (individual unit root process)

Series: LSEC

Date: 11/16/16 Time: 09:22

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 241

Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-2.56397	0.0052

** Probabilities are computed assuming asympotic normality

Population Growth Rate (popg)

Null Hypothesis: Unit root (individual unit root process)
Series: POPG
Date: 11/16/16 Time: 09:23
Sample: 1980 2007
Exogenous variables: Individual effects
User-specified lags: 1
Total number of observations: 241
Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-12.3309	0.0000

** Probabilities are computed assuming asympotic normality

Intermediate ADF test results

Null Hypothesis: Unit root (individual unit root process)
Series: POPG
Date: 11/16/16 Time: 09:23
Sample: 1980 2007
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Total number of observations: 241
Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-125.122	0.0000

** Probabilities are computed assuming asympotic normality

Log of Governement Consumption (lcons)

Null Hypothesis: Unit root (individual unit root process)
Series: LCONS
Date: 11/16/16 Time: 09:25
Sample: 1980 2007
Exogenous variables: Individual effects
User-specified lags: 1
Total number of observations: 241
Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	1.93154	0.9733

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (individual unit root process)
Series: LCONS
Date: 11/16/16 Time: 09:25
Sample: 1980 2007
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Total number of observations: 241
Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	1.78868	0.9632

** Probabilities are computed assuming asympotic normality

FIRST DIFFERENCE IPS

Log of GDP (lgdp)

Null Hypothesis: Unit root (individual unit root process)
Series: D(LGDP)
Date: 11/16/16   Time: 09:26
Sample: 1980 2007
Exogenous variables: Individual effects
User-specified lags: 1
Total number of observations: 227
Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-4.64551	0.0000

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (individual unit root process)
Series: D(LGDP)
Date: 11/16/16   Time: 09:27
Sample: 1980 2007
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Total number of observations: 227
Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-3.35075	0.0004

** Probabilities are computed assuming asympotic normality

Public Debt (gdebt)

Null Hypothesis: Unit root (individual unit root process)
Series: D(GDEBT)
Date: 11/16/16 Time: 09:28
Sample: 1980 2007
Exogenous variables: Individual effects
User-specified lags: 1
Total number of observations: 227
Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-4.16874	0.0000

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (individual unit root process)
Series: D(GDEBT)
Date: 11/16/16 Time: 09:28
Sample: 1980 2007
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Total number of observations: 227
Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-3.89414	0.0000

** Probabilities are computed assuming asympotic normality

First Difference of Ivestment Ratio (D (inv)

Null Hypothesis: Unit root (individual unit root process)

Series: D(INV)

Date: 11/16/16 Time: 09:28

Sample: 1980 2007

Exogenous variables: Individual effects

User-specified lags: 1

Total number of observations: 227

Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-5.64666	0.0000

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (individual unit root process)

Series: D(INV)

Date: 11/16/16 Time: 09:29

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 227

Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-3.20878	0.0007

** Probabilities are computed assuming asympotic normality

Intermediate ADF test results

First Difference of Secondary School Enrolment (D(educ)

Null Hypothesis: Unit root (individual unit root process)

Series: D(educ)

Date: 11/16/16 Time: 09:30

Sample: 1980 2007

Exogenous variables: Individual effects

User-specified lags: 1

Total number of observations: 227

Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-5.56172	0.0000

** Probabilities are computed assuming asympotic normality

Intermediate ADF test results

Null Hypothesis: Unit root (individual unit root process)

Series: D(Leduc)

Date: 11/16/16 Time: 09:30

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 227

Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-3.97785	0.0000

** Probabilities are computed assuming asympotic normality

First Difference of Population Growth (d(pop_g)

Null Hypothesis: Unit root (individual unit root process)

Series: D(POPG)

Date: 11/16/16 Time: 09:31

Sample: 1980 2007

Exogenous variables: Individual effects

User-specified lags: 1

Total number of observations: 227

Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-211.929	0.0000

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (individual unit root process)

Series: D(POPG)

Date: 11/16/16 Time: 09:31

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 227

Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-1253.84	0.0000

** Probabilities are computed assuming asympotic normality

First Difference of Government Consumption D(lcons)

Null Hypothesis: Unit root (individual unit root process)

Series: D(LCONS)

Date: 11/16/16 Time: 09:32

Sample: 1980 2007

Exogenous variables: Individual effects

User-specified lags: 1

Total number of observations: 227

Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-4.91196	0.0000

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Unit root (individual unit root process)

Series: D(LCONS)

Date: 11/16/16 Time: 09:33

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 227

Cross-sections included: 14

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-4.11612	0.0000

** Probabilities are computed assuming asympotic normality

HADRI

Null Hypothesis: Stationarity

Series: LGDP

Date: 11/16/16 Time: 09:34

Sample: 1980 2007

Exogenous variables: Individual effects

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 269

Cross-sections included: 14

Method	Statistic	Prob.**
Hadri Z-stat	10.7486	0.0000
Heteroscedastic Consistent Z-stat	10.3190	0.0000

* Note: High autocorrelation leads to severe size distortion in Hadri test,
  leading to over-rejection of the null.

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Stationarity

Series: LGDP

Date: 11/16/16 Time: 09:35

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 269

Cross-sections included: 14

Method	Statistic	Prob.**
Hadri Z-stat	5.90444	0.0000
Heteroscedastic Consistent Z-stat	5.80888	0.0000

* Note: High autocorrelation leads to severe size distortion in Hadri test,
  leading to over-rejection of the null.

** Probabilities are computed assuming asympotic normality

Governement Debt (gdebt)

Null Hypothesis: Stationarity
Series: GDEBT
Date: 11/16/16 Time: 09:35
Sample: 1980 2007
Exogenous variables: Individual effects
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 269
Cross-sections included: 14

Method	Statistic	Prob.**
Hadri Z-stat	6.53129	0.0000
Heteroscedastic Consistent Z-stat	4.10179	0.0000

* Note: High autocorrelation leads to severe size distortion in Hadri test,
leading to over-rejection of the null.
** Probabilities are computed assuming asympotic normality

Null Hypothesis: Stationarity
Series: GDEBT
Date: 11/16/16 Time: 09:36
Sample: 1980 2007
Exogenous variables: Individual effects, individual linear trends
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 269
Cross-sections included: 14

Method	Statistic	Prob.**
Hadri Z-stat	8.74019	0.0000
Heteroscedastic Consistent Z-stat	7.13654	0.0000

* Note: High autocorrelation leads to severe size distortion in Hadri test,
leading to over-rejection of the null.
** Probabilities are computed assuming asympotic normality

Investment Ratio (inv)

Null Hypothesis: Stationarity

Series: INV

Date: 11/16/16 Time: 09:36

Sample: 1980 2007

Exogenous variables: Individual effects

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 269

Cross-sections included: 14

Method	Statistic	Prob.**
Hadri Z-stat	5.66235	0.0000
Heteroscedastic Consistent Z-stat	4.25314	0.0000

* Note: High autocorrelation leads to severe size distortion in Hadri test,
leading to over-rejection of the null.

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Stationarity

Series: INV

Date: 11/16/16 Time: 09:37

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 269

Cross-sections included: 14

Method	Statistic	Prob.**
Hadri Z-stat	4.54536	0.0000
Heteroscedastic Consistent Z-stat	4.79355	0.0000

* Note: High autocorrelation leads to severe size distortion in Hadri test,
leading to over-rejection of the null.

** Probabilities are computed assuming asympotic normality

Secondary School Enrolment Ratio (educ)

Null Hypothesis: Stationarity

Series: educ

Date: 11/16/16   Time: 09:37

Sample: 1980 2007

Exogenous variables: Individual effects

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 269

Cross-sections included: 14

Method	Statistic	Prob.**
Hadri Z-stat	10.3857	0.0000
Heteroscedastic Consistent Z-stat	9.79499	0.0000

* Note: High autocorrelation leads to severe size distortion in Hadri test,
leading to over-rejection of the null.

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Stationarity

Series: educ

Date: 11/16/16   Time: 09:38

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 269

Cross-sections included: 14

Method	Statistic	Prob.**
Hadri Z-stat	8.61224	0.0000
Heteroscedastic Consistent Z-stat	7.14689	0.0000

* Note: High autocorrelation leads to severe size distortion in Hadri test,

leading to over-rejection of the null.

** Probabilities are computed assuming asympotic normality

Population Growth Rate (pop_g)

Null Hypothesis: Stationarity
Series: POPG
Date: 11/16/16 Time: 09:38
Sample: 1980 2007
Exogenous variables: Individual effects
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 269
Cross-sections included: 14

Method	Statistic	Prob.**
Hadri Z-stat	2.64901	0.0040
Heteroscedastic Consistent Z-stat	4.43405	0.0000

* Note: High autocorrelation leads to severe size distortion in Hadri test,
leading to over-rejection of the null.
** Probabilities are computed assuming asympotic normality

Null Hypothesis: Stationarity
Series: POPG
Date: 11/16/16 Time: 09:39
Sample: 1980 2007
Exogenous variables: Individual effects, individual linear trends
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 269
Cross-sections included: 14

Method	Statistic	Prob.**
Hadri Z-stat	5.26701	0.0000
Heteroscedastic Consistent Z-stat	6.18022	0.0000

* Note: High autocorrelation leads to severe size distortion in Hadri test,
leading to over-rejection of the null.
** Probabilities are computed assuming asympotic normality

Intermediate results on POPG

Log of Government Consumption (lcons)

Null Hypothesis: Stationarity

Series: LCONS

Date: 11/16/16 Time: 09:39

Sample: 1980 2007

Exogenous variables: Individual effects

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 269

Cross-sections included: 14

Method	Statistic	Prob.**
Hadri Z-stat	9.43299	0.0000
Heteroscedastic Consistent Z-stat	10.7000	0.0000

* Note: High autocorrelation leads to severe size distortion in Hadri test,
  leading to over-rejection of the null.

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Stationarity

Series: LCONS

Date: 11/16/16 Time: 09:40

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 269

Cross-sections included: 14

Method	Statistic	Prob.**
Hadri Z-stat	9.07633	0.0000
Heteroscedastic Consistent Z-stat	6.93580	0.0000

* Note: High autocorrelation leads to severe size distortion in Hadri test,
  leading to over-rejection of the null.

** Probabilities are computed assuming asympotic normality

HADRI FIRST DIFFERENCE

First Difference of Log of GDP per capita (D(lgdp)

Null Hypothesis: Stationarity

Series: D(LGDP)

Date: 11/16/16 Time: 09:41

Sample: 1980 2007

Exogenous variables: Individual effects

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 255

Cross-sections included: 14

Method	Statistic	Prob.**
Hadri Z-stat	1.86376	0.0312
Heteroscedastic Consistent Z-stat	4.19068	0.0000

* Note: High autocorrelation leads to severe size distortion in Hadri test,
  leading to over-rejection of the null.

** Probabilities are computed assuming asympotic normality

Null Hypothesis: Stationarity

Series: D(LGDP)

Date: 11/16/16 Time: 09:41

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 255

Cross-sections included: 14

Method	Statistic	Prob.**
Hadri Z-stat	4.45524	0.0000
Heteroscedastic Consistent Z-stat	13.7538	0.0000

* Note: High autocorrelation leads to severe size distortion in Hadri test,
  leading to over-rejection of the null.

** Probabilities are computed assuming asympotic normality

Intermediate results on D(LGDP)

First Difference of Public Debt (D(gdebt)

Null Hypothesis: Stationarity

Series: D(GDEBT)

Date: 11/16/16 Time: 09:44

Sample: 1980 2007

Exogenous variables: Individual effects

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 255

Cross-sections included: 14

Method	Statistic	Prob.**
Hadri Z-stat	3.73660	0.0001
Heteroscedastic Consistent Z-stat	3.57554	0.0002

* Note: High autocorrelation leads to severe size distortion in Hadri test,
leading to over-rejection of the null.

** Probabilities are computed assuming asympotic normality

Intermediate results on D(GDEBT)

Null Hypothesis: Stationarity

Series: D(GDEBT)

Date: 11/16/16 Time: 09:45

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

Newey-West automatic bandwidth selection and Bartlett kernel

Total number of observations: 255

Cross-sections included: 14

Method	Statistic	Prob.**
Hadri Z-stat	10.3057	0.0000
Heteroscedastic Consistent Z-stat	9.08431	0.0000

* Note: High autocorrelation leads to severe size distortion in Hadri test,
leading to over-rejection of the null.

** Probabilities are computed assuming asympotic normality

BREITUNG

Log of GDP per capita (lgdp)

Null Hypothesis: Unit root (common unit root process)

Series: LGDP

Date: 11/16/16 Time: 09:46

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 227

Cross-sections included: 14

Method	Statistic	Prob.**
Breitung t-stat	1.88951	0.9706

** Probabilities are computed assuming asympotic normality

Intermediate regression results on LGDP

Public Debt (gdebt)

Null Hypothesis: Unit root (common unit root process)

Series: GDEBT

Date: 11/16/16 Time: 09:47

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 227

Cross-sections included: 14

Method	Statistic	Prob.**
Breitung t-stat	2.45003	0.9929

** Probabilities are computed assuming asympotic normality

Intermediate regression results on GDEBT

Investment Ratio (inv)

Null Hypothesis: Unit root (common unit root process)

Series: INV

Date: 11/16/16 Time: 09:48

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 227

Cross-sections included: 14

Method	Statistic	Prob.**
Breitung t-stat	-2.43936	0.0074

** Probabilities are computed assuming asympotic normality

Secondary School Enrolment Ratio (educ)

Null Hypothesis: Unit root (common unit root process)

Series: educ

Date: 11/16/16 Time: 09:48

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 227

Cross-sections included: 14

Method	Statistic	Prob.**
Breitung t-stat	3.57592	0.9998

** Probabilities are computed assuming asympotic normality

Population Growth (pop_g)

Null Hypothesis: Unit root (common unit root process)

Series: POPG

Date: 11/16/16 Time: 09:52

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 227

Cross-sections included: 14

Method	Statistic	Prob.**
Breitung t-stat	0.85004	0.8023

** Probabilities are computed assuming asympotic normality

Intermediate regression results on POPG

Log of Government Consumption (lcons)

Null Hypothesis: Unit root (common unit root process)

Series: LCONS

Date: 11/16/16 Time: 09:53

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 227

Cross-sections included: 14

Method	Statistic	Prob.**
Breitung t-stat	2.19566	0.9859

** Probabilities are computed assuming asympotic normality

BREITUNG FIRST DIFFERENCE

First Difference of per Capita GDP (D(lgdp)

Null Hypothesis: Unit root (common unit root process)

Series: D(LGDP)

Date: 11/16/16 Time: 09:54

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 213

Cross-sections included: 14

Method	Statistic	Prob.**
Breitung t-stat	-2.68152	0.0037

** Probabilities are computed assuming asympotic normality

Intermediate regression results on D(LGDP)

First Difference of Public Debt (GDEBT)

Null Hypothesis: Unit root (common unit root process)

Series: D(GDEBT)

Date: 11/16/16 Time: 09:55

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 213

Cross-sections included: 14

Method	Statistic	Prob.**
Breitung t-stat	-4.32899	0.0000

** Probabilities are computed assuming asympotic normality

First Difference of Investment (D(inv))

Null Hypothesis: Unit root (common unit root process)

Series: D(INV)

Date: 11/16/16 Time: 09:56

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 213

Cross-sections included: 14

Method	Statistic	Prob.**
Breitung t-stat	-3.84917	0.0001

** Probabilities are computed assuming asympotic normality

Intermediate regression results on D(INV)

First Difference of Secondary School Enrolment Ratio (D(educ)

Null Hypothesis: Unit root (common unit root process)

Series: D(educ)

Date: 11/16/16 Time: 09:57

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 213

Cross-sections included: 14

Method	Statistic	Prob.**
Breitung t-stat	-2.18820	0.0143

** Probabilities are computed assuming asympotic normality

First Difference of Population Growth (D(pop_g))

Null Hypothesis: Unit root (common unit root process)

Series: D(POPG)

Date: 11/16/16 Time: 09:58

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 213

Cross-sections included: 14

Method	Statistic	Prob.**
Breitung t-stat	-3.58370	0.0002

** Probabilities are computed assuming asympotic normality

First Difference of Log of GDP per capita (D(lgdp))

Null Hypothesis: Unit root (common unit root process)

Series: D(LCONS)

Date: 11/16/16 Time: 09:59

Sample: 1980 2007

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 213

Cross-sections included: 14

Method	Statistic	Prob.**
Breitung t-stat	-0.57973	0.2810

** Probabilities are computed assuming asympotic normality

COINTEGRATION TESTS

Pedroni Residual Cointegration Test

Series: LGDP GDEBT INV LCONS LSEC POPG

Date: 11/16/16 Time: 11:14

Sample: 1980 2007

Included observations: 269

Cross-sections included: 14

Null Hypothesis: No cointegration

Trend assumption: Deterministic intercept and trend

User-specified lag length: 1

Newey-West automatic bandwidth selection and Bartlett kernel

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

			Weighted	
	Statistic	Prob.	Statistic	Prob.
Panel v-Statistic	2.323361	0.0101	-0.597207	0.7248
Panel rho-Statistic	3.237415	0.9994	3.985324	1.0000
Panel PP-Statistic	-0.238800	0.4056	-3.245838	0.0006
Panel ADF-Statistic	-0.850136	0.1976	-3.678443	0.0001

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

	Statistic	Prob.
Group rho-Statistic	5.018126	1.0000
Group PP-Statistic	-6.209254	0.0000
Group ADF-Statistic	-2.156256	0.0155

POOLED OLS

Dependent Variable: LGDP
Method: Panel Least Squares
Date: 11/16/16 Time: 10:06
Sample: 1980 2007
Periods included: 28
Cross-sections included: 14
Total panel (unbalanced) observations: 269

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDEBT	0.004100	0.000798	5.139504	0.0000
LCONS	-0.030611	0.004833	-6.333259	0.0000
LSEC	0.277396	0.059745	4.643036	0.0000
POPG	-0.070594	0.039299	-1.796330	0.0736
INV	-0.008551	0.003408	-2.508792	0.0127
C	3.664326	0.335666	10.91659	0.0000

R-squared	0.352521	Mean dependent var	4.623238
Adjusted R-squared	0.340211	S.D. dependent var	0.624898
S.E. of regression	0.507588	Akaike info criterion	1.503759
Sum squared resid	67.76079	Schwarz criterion	1.583938
Log likelihood	-196.2556	Hannan-Quinn criter.	1.535959
F-statistic	28.63815	Durbin-Watson stat	0.037559
Prob(F-statistic)	0.000000		

PANEL FULLY MODIFIED LEAST SQUARES (FMOLS)

FMOLS===POOLED

Dependent Variable: LGDP

Method: Panel Fully Modified Least Squares (FMOLS)

Date: 11/16/16   Time: 10:30

Sample (adjusted): 1981 2007

Periods included: 27

Cross-sections included: 14

Total panel (unbalanced) observations: 255

Panel method: Pooled estimation

Cointegrating equation deterministics: C

Additional regressor deterministics: @TREND

Coefficient covariance computed using default method

Long-run covariance estimates (Bartlett kernel, Newey-West fixed bandwidth)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDEBT	-0.000217	0.000225	-0.964628	0.3357
INV	0.000374	0.000735	0.509218	0.6111
LSEC	0.148677	0.041466	3.585516	0.0004
POPG	-0.006919	0.011188	-0.618404	0.5369
LCONS	0.031611	0.005920	5.339785	0.0000

R-squared	0.991874	Mean dependent var	4.626845
Adjusted R-squared	0.991254	S.D. dependent var	0.623984
S.E. of regression	0.058354	Sum squared resid	0.803638
Long-run variance	0.006320		

FMOLS===WEIGHTED

Dependent Variable: LGDP

Method: Panel Fully Modified Least Squares (FMOLS)

Date: 11/16/16 Time: 10:29

Sample (adjusted): 1981 2007

Periods included: 27

Cross-sections included: 14

Total panel (unbalanced) observations: 255

Panel method: Weighted estimation

Cointegrating equation deterministics: C

Additional regressor deterministics: @TREND

Long-run covariance estimates (Bartlett kernel, Newey-West fixed bandwidth)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDEBT	0.120948	0.035511	3.405912	0.0008
INV	0.125842	0.045411	2.771168	0.0060
LSEC	0.244041	0.013668	17.85493	0.0000
POPG	-0.059102	0.018577	-3.181516	0.0017
LCONS	0.018016	0.011382	1.582802	0.1148

R-squared	-25.781892	Mean dependent var	4.626845
Adjusted R-squared	-27.824578	S.D. dependent var	0.623984
S.E. of regression	3.350078	Sum squared resid	2648.633
Long-run variance	0.001314		

FMOLS---GROUPED

Dependent Variable: LGDP
Method: Panel Fully Modified Least Squares (FMOLS)
Date: 11/16/16 Time: 10:32
Sample (adjusted): 1981 2007
Periods included: 27
Cross-sections included: 14
Total panel (unbalanced) observations: 255
Panel method: Grouped estimation
Cointegrating equation deterministics: C
Additional regressor deterministics: @TREND
Long-run covariance estimates (Bartlett kernel, Newey-West fixed
bandwidth)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDEBT	-0.000578	9.26E-05	-6.242025	0.0000
INV	0.000591	0.000238	2.480881	0.0138
LSEC	0.099736	0.033331	2.992261	0.0031
POPG	-0.001425	0.007891	-0.180633	0.8568
LCONS	0.141840	0.007836	18.10081	0.0000

R-squared	-3.966206	Mean dependent var	4.626845
Adjusted R-squared	-4.344984	S.D. dependent var	0.623984
S.E. of regression	1.442602	Sum squared resid	491.1399
Long-run variance	0.000130		

DOLS----POOLED

Dependent Variable: LGDP
Method: Panel Dynamic Least Squares (DOLS)
Date: 11/16/16 Time: 10:33
Sample (adjusted): 1982 2006
Periods included: 25
Cross-sections included: 3
Total panel (unbalanced) observations: 71
Panel method: Grouped estimation
Cointegrating equation deterministics: C
Fixed leads and lags specification (lead=1, lag=1)
Individual HAC standard errors & covariances (Bartlett kernel, Newey-West fixed bandwidth)
Warning: one more more cross-sections have been dropped due to estimation errors

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDEBT	0.000997	0.000654	1.524559	0.1447
INV	0.000909	0.001710	0.531522	0.6016
LSEC	0.671479	0.204363	3.285722	0.0041
POPG	0.706857	0.164531	4.296193	0.0004
LCONS	0.162043	0.058829	2.754495	0.0130

R-squared	-23.355670	Mean dependent var	4.619549
Adjusted R-squared	-93.716495	S.D. dependent var	0.794334
S.E. of regression	7.730652	Sum squared resid	1075.734
Long-run variance	6.09E-06		

DOLS----WEIGHTED

Dependent Variable: LGDP
Method: Panel Dynamic Least Squares (DOLS)
Date: 11/16/16 Time: 10:36
Sample (adjusted): 1982 2006
Periods included: 25
Cross-sections included: 5
Total panel (unbalanced) observations: 111
Panel method: Weighted estimation
Cointegrating equation deterministics: C @TREND
Fixed leads and lags specification (lead=1, lag=1)
Long-run variance weights (Bartlett kernel, Newey-West fixed bandwidth)
Warning: one more more cross-sections have been dropped due to
estimation errors

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDEBT	5.04E-05	8.37E-05	0.602723	0.5531
INV	0.002305	0.000270	8.528105	0.0000
LSEC	0.081709	0.082670	0.988369	0.3342
POPG	0.001617	0.008566	0.188762	0.8521
LCONS	-0.004572	0.001105	-4.137675	0.0005

R-squared	0.999960	Mean dependent var	4.515164
Adjusted R-squared	0.999789	S.D. dependent var	0.652316
S.E. of regression	0.009476	Sum squared resid	0.001886
Long-run variance	1.26E-05		

DOLS---GROUPED

Dependent Variable: LGDP
Method: Panel Dynamic Least Squares (DOLS)
Date: 11/16/16 Time: 10:35
Sample (adjusted): 1982 2006
Periods included: 25
Cross-sections included: 3
Total panel (unbalanced) observations: 71
Panel method: Grouped estimation
Cointegrating equation deterministics: C @TREND
Fixed leads and lags specification (lead=1, lag=1)
Individual HAC standard errors & covariances (Prewhitening with lags = 1,
Bartlett kernel, Newey-West fixed bandwidth)
Warning: one more more cross-sections have been dropped due to
estimation errors

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDEBT	0.001080	0.000136	7.944897	0.0000
INV	0.002181	0.001157	1.884114	0.0791
LSEC	0.623408	0.138097	4.514295	0.0004
POPG	0.738812	0.038278	19.30116	0.0000
LCONS	0.235105	0.000474	495.6635	0.0000

R-squared	-92.896764	Mean dependent var	4.619549
Adjusted R-squared	-437.184898	S.D. dependent var	0.794334
S.E. of regression	16.62769	Sum squared resid	4147.203
Long-run variance	6.71E-06		

DOLS DEBT-INVESTMENT INTERACTION

Dependent Variable: LGDP
Method: Panel Dynamic Least Squares (DOLS)
Date: 01/29/17 Time: 13:46
Sample (adjusted): 1982 2007
Periods included: 26
Cross-sections included: 5
Total panel (unbalanced) observations: 116
Panel method: Grouped estimation
Cointegrating equation deterministics: C @TREND
Fixed leads and lags specification (lead=0, lag=1)
Long-run variances (Bartlett kernel, Newey-West fixed bandwidth) used for
individual coefficient covariances
Warning: one more more cross-sections have been dropped due to
estimation errors

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDEBT	-0.004972	0.001908	-2.605970	0.0128
EDUC	0.835756	0.179312	4.660907	0.0000
POPG	0.399508	0.095101	4.200893	0.0001
GDEBT*INV	0.000350	0.000102	3.434900	0.0014
INV	-0.007885	0.001797	-4.387451	0.0001
LCONS	0.093916	0.052067	1.803759	0.0788

R-squared	-372.737014	Mean dependent var	4.519964
Adjusted R-squared	-1073.493914	S.D. dependent var	0.649160
S.E. of regression	21.27913	Sum squared resid	18112.05
Long-run variance	1.34E-05		

DEBT-EDUCATION INTERACTION

Dependent Variable: LGDP
Method: Panel Dynamic Least Squares (DOLS)
Date: 01/29/17 Time: 13:55
Sample (adjusted): 1982 2007
Periods included: 26
Cross-sections included: 5
Total panel (unbalanced) observations: 116
Panel method: Grouped estimation
Cointegrating equation deterministics: C @TREND
Fixed leads and lags specification (lead=0, lag=1)
Long-run variances (Bartlett kernel, Newey-West fixed bandwidth) used for
individual coefficient covariances
Warning: one more more cross-sections have been dropped due to
estimation errors

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDEBT	-0.082555	0.093450	-0.883410	0.3823
GDEBT*EDUC	0.016510	0.018931	0.872131	0.3883
EDUC	-0.687028	0.348111	-1.973590	0.0554
POPG	0.225020	0.064455	3.491100	0.0012
INV	0.000409	0.000498	0.821339	0.4163
LCONS	0.228944	0.047637	4.806011	0.0000

R-squared	-543.201774	Mean dependent var	4.519964
Adjusted R-squared	-1563.580100	S.D. dependent var	0.649160
S.E. of regression	25.67738	Sum squared resid	26373.12
Long-run variance	3.05E-05		

DEBT NON-LINEARITY

Dependent Variable: LGDP
Method: Panel Dynamic Least Squares (DOLS)
Date: 01/29/17 Time: 13:54
Sample (adjusted): 1982 2007
Periods included: 26
Cross-sections included: 5
Total panel (unbalanced) observations: 116
Panel method: Grouped estimation
Cointegrating equation deterministics: C @TREND
Fixed leads and lags specification (lead=0, lag=1)
Long-run variances (Bartlett kernel, Newey-West fixed bandwidth) used for
individual coefficient covariances
Warning: one more more cross-sections have been dropped due to
estimation errors

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDEBT	0.004683	0.001376	3.403419	0.0015
GDEBT^2	-0.000112	3.93E-05	-2.845601	0.0070
EDUC	-0.296432	0.176244	-1.681942	0.1004
POPG	0.278100	0.097422	2.854591	0.0068
INV	-0.000217	0.000543	-0.400122	0.6912
LCONS	0.156301	0.080854	1.933123	0.0603

R-squared	-343.370386	Mean dependent var	4.519964
Adjusted R-squared	-989.064861	S.D. dependent var	0.649160
S.E. of regression	20.42602	Sum squared resid	16688.88
Long-run variance	3.01E-05		

CORRELEROGRAMS====Q-STATISTICS

Date: 11/16/16 Time: 10:46
Sample: 1980 2007
Included observations: 71

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	0.955	0.955	67.566	0.000
		2	0.916	0.043	130.63	0.000
		3	0.873	-0.062	188.77	0.000
		4	0.833	0.004	242.47	0.000
		5	0.789	-0.067	291.31	0.000
		6	0.746	-0.008	335.71	0.000
		7	0.706	0.003	376.02	0.000
		8	0.666	-0.015	412.49	0.000
		9	0.621	-0.078	444.75	0.000
		10	0.580	0.010	473.38	0.000
		11	0.540	-0.015	498.58	0.000
		12	0.498	-0.053	520.34	0.000

*Probabilities may not be valid for this equation specification.

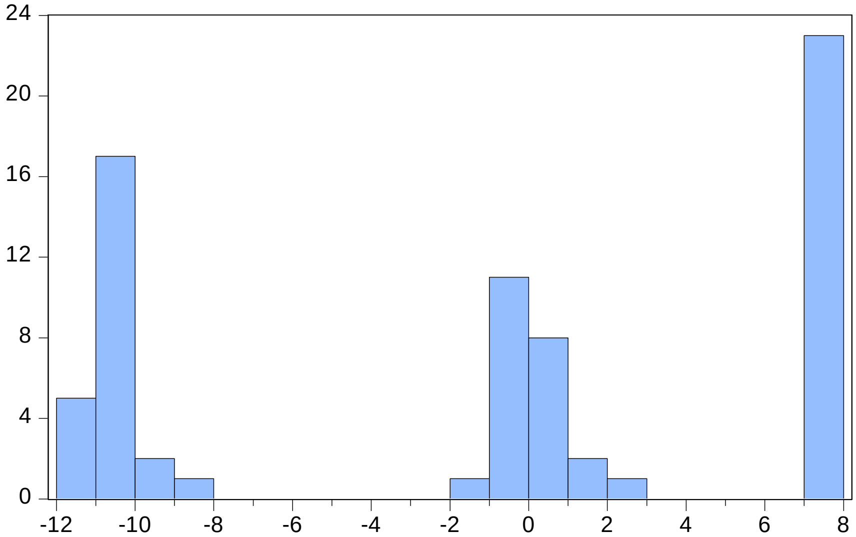
CORRELOGRAM SQUARED RESIDUALS

Date: 11/16/16 Time: 10:46
Sample: 1980 2007
Included observations: 71

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	0.955	0.955	67.566	0.000
		2	0.916	0.043	130.63	0.000
		3	0.873	-0.062	188.77	0.000
		4	0.833	0.004	242.47	0.000
		5	0.789	-0.067	291.31	0.000
		6	0.746	-0.008	335.71	0.000
		7	0.706	0.003	376.02	0.000
		8	0.666	-0.015	412.49	0.000
		9	0.621	-0.078	444.75	0.000
		10	0.580	0.010	473.38	0.000
		11	0.540	-0.015	498.58	0.000
		12	0.498	-0.053	520.34	0.000

*Probabilities may not be valid for this equation specification.

NORMALITY TESTS



Series: Residuals	
Sample 1980 2007	
Observations 71	
Mean	-1.186873
Median	-0.025532
Maximum	7.745554
Minimum	-11.52721
Std. Dev.	7.603747
Skewness	-0.160185
Kurtosis	1.454806
Jarque-Bera	7.367024
Probability	0.025135

Appendix B2: System GMM-Five Year Initial Values Empirical Evidence

Summary Statistics

	Y_IT_T_5	Y_5	URBAN_5	DEPR_5	GDEBT_5	INFL_5	SAV_5
Mean	0.050499	4.632175	3.313507	81.21433	61.16510	149.8111	18.79560
Median	0.051761	4.652514	3.542774	85.84952	44.95050	85.75550	17.17400
Maximum	0.245519	5.868957	5.882685	103.8196	163.2260	2296.740	50.41100
Minimum	-0.086668	3.511501	-0.273375	41.98861	8.909000	0.183000	-2.051000
Std. Dev.	0.051701	0.629456	1.633090	17.92198	45.84400	334.1563	11.09367
Skewness	0.436566	0.107985	-0.479070	-0.768003	0.849107	5.768426	0.634237
Kurtosis	6.323584	2.268501	2.526134	2.415983	2.426305	37.16542	3.287055
Jarque-Bera	23.61714	1.163466	2.285167	5.400787	6.426113	2600.749	3.382850
Probability	0.000007	0.558929	0.318994	0.067179	0.040233	0.000000	0.184257
Sum	2.423930	222.3444	159.0483	3898.288	2935.925	7190.934	902.1890
Sum Sq. Dev.	0.125632	18.62212	125.3482	15096.27	98778.61	5248042.	5784.271
Observations	48	48	48	48	48	48	48

Correlation Matrix

	Y_IT_T_5	Y_5	URBAN_5	DEPR_5	GDEBT_5	INFL_5	SAV_5
Y_IT_T_5	1.000000	-0.258105	-0.068329	-0.047424	-0.318939	0.154588	-0.008771
Y_5	-0.258105	1.000000	0.080217	-0.123896	0.262439	0.162512	-0.261476
URBAN_5	-0.068329	0.080217	1.000000	0.636717	0.118739	-0.009912	0.043417
DEPR_5	-0.047424	-0.123896	0.636717	1.000000	0.046748	0.011142	-0.141139
GDEBT_5	-0.318939	0.262439	0.118739	0.046748	1.000000	-0.116088	-0.270323
INFL_5	0.154588	0.162512	-0.009912	0.011142	-0.116088	1.000000	-0.102142
SAV_5	-0.008771	-0.261476	0.043417	-0.141139	-0.270323	-0.102142	1.000000

POOLED OLS RESULTS

```
. regress y_it_t5 y5 gdebt_5 infl5 depr5 urban5 sav5
```

Source	SS	df	MS
Model	.023472447	6	.003912075
Residual	.102159568	41	.002491697
Total	.125632015	47	.002673022

Number of obs =	48
F(6, 41) =	1.57
Prob > F =	0.1805
R-squared =	0.1868
Adj R-squared =	0.0678
Root MSE =	.04992

y_it_t5	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
y5	-.0230775	.0130461	-1.77	0.084	-.0494246	.0032697
gdebt_5	-.0003119	.0001729	-1.80	0.079	-.000661	.0000373
infl5	.0000238	.0000225	1.06	0.297	-.0000217	.0000693
depr5	-.0004462	.0005679	-0.79	0.437	-.0015931	.0007007
urban5	.0029856	.0061501	0.49	0.630	-.0094349	.015406
sav5	-.0007793	.0007362	-1.06	0.296	-.002266	.0007075
_cons	.2138991	.0819306	2.61	0.013	.0484369	.3793612

HETEROSCEDASTICITY TEST

```
. hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of y_it_t5

         chi2(1)      =     0.76
         Prob > chi2  =   0.3844
```

FIXED EFFECTS RESULTS

```
. xtreg y_it_t5 y5 gdebt_5 infl5 depr5 urban5 sav5 i.year,fe

Fixed-effects (within) regression               Number of obs      =        48
Group variable: fid                             Number of groups   =        14

R-sq:  within  = 0.5868                         Obs per group: min =         3
       between = 0.1096                                        avg =       3.4
       overall = 0.1027                                        max =         5

                                                F(10,24)           =      3.41
corr(u_i, Xb)  = -0.9890                        Prob > F           =    0.0067

------------------------------------------------------------------------------
     y_it_t5 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          y5 |  -.4529547   .1335553    -3.39   0.002    -.7285992   -.1773102
     gdebt_5 |  -.0008501   .0003625    -2.35   0.028    -.0015982    -.000102
       infl5 |   7.75e-07   .0000361     0.02   0.983    -.0000737    .0000753
       depr5 |   -.001076   .0017827    -0.60   0.552    -.0047553    .0026032
      urban5 |   .0046669   .0084471     0.55   0.586    -.0127669    .0221008
        sav5 |  -.0005421   .0007924    -0.68   0.500    -.0021775    .0010934
             |
        year |
       1992  |   .0506749   .0161947     3.13   0.005     .0172507    .0840991
       1993  |   .0612422    .028269     2.17   0.040     .0028979    .1195865
       1994  |   .0677108   .0410611     1.65   0.112    -.0170352    .1524567
       1995  |   -.034351   .0617009    -0.56   0.583    -.1616955    .0929934
             |
       _cons |   2.243679    .650048     3.45   0.002     .9020461    3.585312
-------------+----------------------------------------------------------------
     sigma_u |  .28519767
     sigma_e |  .03553141
         rho |  .98471576   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(13, 24) =     3.68              Prob > F = 0.0028

. estimates store fixed
```

RANDOM EFFECTS RESULTS

```
. xtreg y_it_t5 y5 gdebt_5 infl5 depr5 urban5 sav5, re

Random-effects GLS regression                   Number of obs      =        48
Group variable: fid                             Number of groups   =        14

R-sq:  within  = 0.2750                         Obs per group: min =         3
       between = 0.0508                                        avg =       3.4
       overall = 0.1801                                        max =         5

                                                Wald chi2(6)       =     11.52
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0735

------------------------------------------------------------------------------
     y_it_t5 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          y5 |  -.0226252     .018594    -1.22   0.224    -.0590688    .0138184
     gdebt_5 |  -.0003544    .0002014    -1.76   0.078    -.0007491    .0000404
       infl5 |   .0000352    .0000242     1.46   0.146    -.0000122    .0000825
       depr5 |  -.0003169    .0006818    -0.46   0.642    -.0016533    .0010194
      urban5 |   .0003815     .006769     0.06   0.955    -.0128855    .0136486
        sav5 |  -.0006718    .0006885    -0.98   0.329    -.0020212    .0006776
       _cons |   .2106293    .1078311     1.95   0.051    -.0007158    .4219745
-------------+----------------------------------------------------------------
     sigma_u |  .03393464
     sigma_e |  .04079125
         rho |  .40900923   (fraction of variance due to u_i)
------------------------------------------------------------------------------

. estimates store random
```

HAUSMAN TEST RESULTS

```
. hausman fixed random

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     fixed        random       Difference          S.E.
-------------+----------------------------------------------------------------
          y5 |   -.4529547    -.0226252       -.4303295         .1322546
     gdebt_5 |   -.0008501    -.0003544       -.0004957         .0003014
       infl5 |    7.75e-07     .0000352       -.0000344         .0000268
       depr5 |    -.001076    -.0003169       -.0007591         .0016471
      urban5 |    .0046669     .0003815        .0042854          .005053
        sav5 |   -.0005421    -.0006718        .0001297         .0003923
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       14.08
                Prob>chi2 =      0.0288
                (V_b-V_B is not positive definite)
```

TEST FOR TIME DUMMIES

```
. testparm i.year

 ( 1)  1992.year = 0
 ( 2)  1993.year = 0
 ( 3)  1994.year = 0
 ( 4)  1995.year = 0

           chi2(  4) =   12.90
         Prob > chi2 =    0.0118
```

POOLABILITY TEST

```
. testparm i.fid

 ( 1)  2.fid = 0
 ( 2)  3.fid = 0
 ( 3)  4.fid = 0
 ( 4)  5.fid = 0
 ( 5)  6.fid = 0
 ( 6)  7.fid = 0
 ( 7)  8.fid = 0
 ( 8)  9.fid = 0
 ( 9)  10.fid = 0
 (10)  11.fid = 0
 (11)  12.fid = 0
 (12)  13.fid = 0
 (13)  14.fid = 0

           chi2( 13) =   47.86
         Prob > chi2 =    0.0000

.
```

CROSS SECTIONAL DEPENDENCE

```
. xtcsd, pesaran abs


Pesaran's test of cross sectional independence =    -0.885, Pr = 0.3760

Average absolute value of the off-diagonal elements =     0.605

.
```

SYSTEM GMM RESULTS

```
. xtdpdsys y_it_t5, lags(1) endog(y5 gdebt_5 sav5 infl5 urban5 depr5 inv5 ) vce(robust) artests(2)

System dynamic panel-data estimation        Number of obs        =        34
Group variable: fid                         Number of groups     =        14
Time variable: year
                                            Obs per group:    min =         2
                                                              avg =  2.428571
                                                              max =         4

Number of instruments =     29              Wald chi2(8)         =     72.44
                                            Prob > chi2          =    0.0000
One-step results
```

y_it_t5	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
y_it_t5						
L1.	.0028526	.169645	0.02	0.987	-.3296455	.3353507
y5	-.0516896	.0235984	-2.19	0.028	-.0979416	-.0054375
gdebt_5	.0003369	.0001271	2.65	0.008	.0000877	.000586
sav5	-.0008174	.001436	-0.57	0.569	-.003632	.0019972
infl5	.0000509	.0000107	4.75	0.000	.0000299	.000072
urban5	.006422	.0086934	0.74	0.460	-.0106167	.0234608
depr5	-.0007608	.0004611	-1.65	0.099	-.0016645	.0001429
inv5	.002184	.0017365	1.26	0.209	-.0012196	.0055875
_cons	.2741336	.0803841	3.41	0.001	.1165838	.4316835

```
Instruments for differenced equation
        GMM-type: L(2/.).y_it_t5 L(2/.).y5 L(2/.).gdebt_5 L(2/.).sav5
```

TEST OF AUTOCORRELATION

```
. estat abond

Arellano-Bond test for zero autocorrelation in first-differenced errors
```

Order	z	Prob > z
1	-2.0282	0.0425
2	-1.0166	0.3093

```
H0: no autocorrelation

.
```

SARGAN TEST

```
. estat sargan
Sargan test of overidentifying restrictions
        H0: overidentifying restrictions are valid

        chi2(19)     =  8.126406
        Prob > chi2  =    0.9854

.
```

Appendix B3: System GMM- Five Year Averages Empirical Evidence

Summary Statistics

	Y	Y_T_5	TRADE	GDEBT	EXCH	LCONS	DEFLATOR
Mean	0.446472	4.561334	97.82397	55.59738	273.3559	9.907295	23.09025
Median	0.055425	4.531059	89.62349	42.51567	30.98668	10.08396	8.701107
Maximum	4.482428	5.868957	196.8374	182.9648	2310.878	12.92331	550.9366
Minimum	-0.067195	3.450289	36.94819	9.177800	3.003838	2.264192	1.039023
Std. Dev.	1.265542	0.639826	45.01739	43.11356	525.7294	2.021181	75.84837
Skewness	2.840520	0.166356	0.668109	1.120577	2.367940	-1.969470	6.425551
Kurtosis	9.085444	2.320648	2.337227	3.351245	7.846602	8.220826	44.50158
Jarque-Bera	158.8282	1.311330	5.098373	11.79325	105.2290	98.01979	4325.594
Probability	0.000000	0.519097	0.078145	0.002749	0.000000	0.000000	0.000000
Sum	24.55597	250.8733	5380.318	3057.856	15034.57	544.9012	1269.964
Sum Sq. Dev.	86.48621	22.10635	109434.5	100374.1	14925134	220.5993	310660.6
Observations	55	55	55	55	55	55	55

Correlation Matrix

	Y	Y_T_5	TRADE	GDEBT	EXCH	LCONS	DEFLATOR
Y	1.000000	-0.091010	0.236177	-0.306912	-0.169682	-0.112224	-0.057094
Y_T_5	-0.091010	1.000000	-0.396807	0.194527	0.628321	0.384263	0.072009
TRADE	0.236177	-0.396807	1.000000	-0.015180	-0.339124	-0.456957	-0.163867
GDEBT	-0.306912	0.194527	-0.015180	1.000000	0.018462	-0.003637	0.310564
EXCH	-0.169682	0.628321	-0.339124	0.018462	1.000000	0.467553	-0.010876
LCONS	-0.112224	0.384263	-0.456957	-0.003637	0.467553	1.000000	-0.071598
DEFLATOR	-0.057094	0.072009	-0.163867	0.310564	-0.010876	-0.071598	1.000000

POOLED OLS RESULTS

```
. reg y y_t5 gdebt deflator trade exch lcons
```

Source	SS	df	MS
Model	15.9485816	6	2.65809693
Residual	70.5376317	48	1.46953399
Total	86.4862133	54	1.60159654

Number of obs	= 55
F(6, 48)	= 1.81
Prob > F	= 0.1173
R-squared	= 0.1844
Adj R-squared	= 0.0825
Root MSE	= 1.2122

y	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
y_t5	.3968619	.3532304	1.12	0.267	-.3133555	1.107079
gdebt	-.0107004	.0041472	-2.58	0.013	-.0190389	-.002362
deflator	.0014395	.0023563	0.61	0.544	-.0032982	.0061773
trade	.0075725	.0043926	1.72	0.091	-.0012595	.0164045
exch	-.0005177	.0004278	-1.21	0.232	-.0013779	.0003426
lcons	.024519	.100248	0.24	0.808	-.1770431	.2260811
_cons	-1.644255	1.967578	-0.84	0.407	-5.600336	2.311826

.

HETEROSCEDASTICITY TEST

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of y

         chi2(1)      =    27.19
         Prob > chi2  =   0.0000
```

.

FIXED EFFECTS RESULTS

```
Fixed-effects (within) regression               Number of obs      =        55
Group variable: fid                             Number of groups   =        14

R-sq:  within  = 0.3213                         Obs per group: min =         3
       between = 0.0032                                        avg =       3.9
       overall = 0.0024                                        max =         6

                                                F(6,35)            =      2.76
corr(u_i, Xb)  = -0.1550                        Prob > F           =    0.0264
```

y	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
y_t5	-.3888575	.1409172	-2.76	0.009	-.6749345	-.1027804
gdebt	-.0005011	.0002588	-1.94	0.061	-.0010264	.0000242
deflator	.0000401	.0000966	0.42	0.681	-.000156	.0002362
trade	-.0001275	.0002119	-0.60	0.551	-.0005577	.0003028
exch	-.000061	.0000366	-1.67	0.104	-.0001352	.0000133
lcons	.0897677	.0316517	2.84	0.008	.0255114	.154024
_cons	1.386895	.4024209	3.45	0.001	.5699374	2.203853
sigma_u	1.1813173					
sigma_e	.03662697					
rho	.9990396	(fraction of variance due to u_i)				

F test that all u_i=0:   F(13, 35) = 4041.91   Prob > F = 0.0000

PESARAN CROSS SECTIONAL DEPENDENCE

```
. xtcsd, pesaran abs


Pesaran's test of cross sectional independence =    -0.624, Pr = 0.5327

Average absolute value of the off-diagonal elements =     0.683
```

FGLS REGRESSION

```
. xtgls y y_t5 gdebt deflator trade exch lcons

Cross-sectional time-series FGLS regression

Coefficients:  generalized least squares
Panels:        homoskedastic
Correlation:   no autocorrelation

Estimated covariances      =         1          Number of obs      =        55
Estimated autocorrelations =         0          Number of groups   =        14
Estimated coefficients     =         7          Obs per group: min =         3
                                                               avg =  3.928571
                                                               max =         6
                                                Wald chi2(6)       =     12.44
Log likelihood             = -84.88398          Prob > chi2        =    0.0529

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        y_t5 |   .3968619   .3299874     1.20   0.229    -.2499016    1.043625
       gdebt |  -.0107004   .0038743    -2.76   0.006    -.0182939   -.003107
    deflator |   .0014395   .0022013     0.65   0.513     -.002875     .005754
       trade |   .0075725   .0041036     1.85   0.065    -.0004704    .0156154
        exch |  -.0005177   .0003997    -1.30   0.195     -.001301    .0002657
       lcons |    .024519   .0936516     0.26   0.793    -.1590347    .2080727
       _cons |  -1.644255   1.838109    -0.89   0.371    -5.246883    1.958372
------------------------------------------------------------------------------

.
```

DIFFERENCE GMM REGRESSION

```
. xtabond y, lags(1) endog(y_t5 gdebt trade exch  lcons deflator) vce(robust) artes

Arellano-Bond dynamic panel-data estimation  Number of obs         =        27
Group variable: fid                          Number of groups      =        14
Time variable: year
                                             Obs per group:    min =         1
                                                               avg =  1.928571
                                                               max =         4

Number of instruments =     28               Wald chi2(7)          =     51.58
                                             Prob > chi2           =    0.0000
One-step results
                                    (Std. Err. adjusted for clustering on fid)
------------------------------------------------------------------------------
             |               Robust
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           y |
         L1. |   -.043236   .2648608    -0.16   0.870    -.5623537    .4758817
             |
        y_t5 |   -.305924     .25403    -1.20   0.228    -.8038136    .1919656
       gdebt |  -.0010733   .0004407    -2.44   0.015    -.0019371   -.0002096
       trade |  -.0004314   .0001436    -3.00   0.003    -.0007128     -.00015
        exch |  -.0001008   .0000626    -1.61   0.108    -.0002236     .000022
       lcons |   .0787242    .048758     1.61   0.106    -.0168396    .1742881
    deflator |   1.10e-06   .0017416     0.00   0.999    -.0034123    .0034145
       _cons |   1.236885   .7291328     1.70   0.090    -.1921888    2.665959
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).y L(2/.).y_t5 L(2/.).gdebt L(2/.).trade L(2/.).exch
                  L(2/.).lcons L(2/.).deflator
Instruments for level equation
        Standard: _cons

.
```

AUTOCORRELATION TEST

```
. estat abond

Arellano-Bond test for zero autocorrelation in first-differenced errors
```

Order	z	Prob > z
1	-.52083	0.6025
2	.47662	0.6336

```
H0: no autocorrelation
```

SARGAN TEST

```
. estat sargan
Sargan test of overidentifying restrictions
        H0: overidentifying restrictions are valid

        chi2(20)     =  23.38378
        Prob > chi2  =    0.2703

.
```

SYSTEM GMM

```
. xtdpdsys y, lags(1) endog(y_t5  gdebt  lcons  trade exch  deflator) vce(robust)

System dynamic panel-data estimation        Number of obs        =        41
Group variable: fid                         Number of groups     =        14
Time variable: year
                                            Obs per group:    min =         2
                                                              avg =  2.928571
                                                              max =         5

Number of instruments =     48              Wald chi2(7)         = 407681.03
                                            Prob > chi2          =    0.0000
One-step results
------------------------------------------------------------------------------
             |               Robust
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           y |
         L1. |   .9980554   .0045796   217.94   0.000     .9890796    1.007031
             |
        y_t5 |    .022264   .0194116     1.15   0.251    -.0157821    .0603102
       gdebt |  -.0008313   .0001893    -4.39   0.000    -.0012023   -.0004604
       lcons |   .0230755    .007711     2.99   0.003     .0079623    .0381887
       trade |   .0005171   .0001155     4.48   0.000     .0002907    .0007435
        exch |  -.0000409   .0000226    -1.81   0.070    -.0000851    3.31e-06
    deflator |   .0033204   .0025027     1.33   0.185    -.0015848    .0082256
       _cons |  -.3510956   .1169843    -3.00   0.003    -.5803806   -.1218106
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).y L(2/.).y_t5 L(2/.).gdebt L(2/.).lcons
                  L(2/.).trade L(2/.).exch L(2/.).deflator
Instruments for level equation
        GMM-type: LD.y LD.y_t5 LD.gdebt LD.lcons LD.trade LD.exch
                  LD.deflator
        Standard: _cons

.
```

AUTOCORRELATION TEST

```
. estat abond

Arellano-Bond test for zero autocorrelation in first-differenced errors
```

Order	z	Prob > z
1	-1.3154	0.1884
2	1.3704	0.1706

```
H0: no autocorrelation

.
```

SARGAN TEST

```
. estat sargan
Sargan test of overidentifying restrictions
        H0: overidentifying restrictions are valid

        chi2(40)     =  24.10522
        Prob > chi2  =    0.9779

.
```

Appendix B4: System GMMThree-Year Average Empirical Results

Summary of statistics

	Y_IT_Y_T_3	Y_3	INFL_3	GDEBT_3	DEPR_3	SAV_3	URBAN_3
Mean	0.032026	4.622512	170.6772	57.94731	80.07881	20.02432	4.745783
Median	0.036670	4.660077	97.94950	40.60950	84.22269	20.16750	3.480337
Maximum	0.204631	5.903212	2710.240	172.5610	102.6092	51.04500	25.74673
Minimum	-0.050214	3.466944	2.707000	7.652000	41.06104	0.487000	-0.239398
Std. Dev.	0.037054	0.636278	357.4589	45.68555	17.81531	10.98652	5.391440
Skewness	1.102107	0.095130	5.857737	0.949446	-0.718909	0.357462	2.652796
Kurtosis	8.695622	2.290352	40.02715	2.643772	2.335791	2.666096	9.548898
Jarque-Bera	105.6796	1.529430	4273.410	10.57596	7.107396	1.764055	201.2725
Probability	0.000000	0.465467	0.000000	0.005052	0.028619	0.413943	0.000000
Sum	2.177771	314.3308	11606.05	3940.417	5445.359	1361.654	322.7132
Sum Sq. Dev.	0.091991	27.12490	8561052.	139840.3	21264.82	8087.145	1947.531
Observations	68	68	68	68	68	68	68

Correlation Matrix

	Y_IT_Y_T_3	Y_3	INFL_3	GDEBT_3	DEPR_3	SAV_3	URBAN_3
Y_IT_Y_T_3	1.000000	-0.208980	0.096759	-0.134811	-0.004524	0.126123	-0.049678
Y_3	-0.208980	1.000000	0.189859	0.224157	-0.124667	-0.441574	-0.164815
INFL_3	0.096759	0.189859	1.000000	-0.054812	0.045548	-0.278674	-0.088359
GDEBT_3	-0.134811	0.224157	-0.054812	1.000000	-0.030446	-0.342368	-0.229026
DEPR_3	-0.004524	-0.124667	0.045548	-0.030446	1.000000	-0.179170	0.152341
SAV_3	0.126123	-0.441574	-0.278674	-0.342368	-0.179170	1.000000	0.134726
URBAN_3	-0.049678	-0.164815	-0.088359	-0.229026	0.152341	0.134726	1.000000

POOLED OLS

```
regress y_it_y_t3 y_3 gdebt_3 infl_3 sav_3 depr_3 urban_3

      Source |       SS       df       MS              Number of obs =      68
-------------+------------------------------           F(  6,    61) =    0.89
       Model |  .007399788     6  .001233298           Prob > F      =  0.5084
    Residual |  .084591345    61  .001386743           R-squared     =  0.0804
-------------+------------------------------           Adj R-squared = -0.0100
       Total |  .091991132    67  .001373002           Root MSE      =  .03724

------------------------------------------------------------------------------
   y_it_y_t3 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         y_3 |  -.0122791   .0082583    -1.49   0.142    -.0287927    .0042344
     gdebt_3 |  -.0000683   .0001104    -0.62   0.538    -.0002891    .0001524
      infl_3 |   .0000144   .0000135     1.07   0.291    -.0000127    .0000415
       sav_3 |   .0001792   .0005167     0.35   0.730    -.0008539    .0012124
      depr_3 |  -.0000323   .0002706    -0.12   0.905    -.0005735    .0005088
     urban_3 |  -.0006613   .0008857    -0.75   0.458    -.0024324    .0011098
       _cons |   .0924191   .0540691     1.71   0.092    -.0156987    .2005369
------------------------------------------------------------------------------
```

HETEROSCEDASTICITY TEST

```
. hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of y_it_y_t3

         chi2(1)      =     6.32
         Prob > chi2  =   0.0120
```

GENERALISED LEAST SQUARES REGRESSION

```
. xtgls y_it_y_t3 y_3 gdebt_3 infl_3 sav_3 depr_3 urban_3 i.fid i.year

Cross-sectional time-series FGLS regression

Coefficients:  generalized least squares
Panels:        homoskedastic
Correlation:   no autocorrelation

Estimated covariances      =         1          Number of obs      =        68
Estimated autocorrelations =         0          Number of groups   =        14
Estimated coefficients     =        26          Obs per group: min =         4
                                                               avg =  4.857143
                                                               max =         7
                                                Wald chi2(25)      =     85.38
Log likelihood             =  155.7583          Prob > chi2        =    0.0000

------------------------------------------------------------------------------
   y_it_y_t3 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         y_3 |  -.2738732    .066799    -4.10   0.000    -.4047969   -.1429495
     gdebt_3 |   .0000355   .0001726     0.21   0.837    -.0003029    .0003738
      infl_3 |   .0000239   .0000157     1.52   0.129    -6.92e-06    .0000547
       sav_3 |  -.0004726   .0005313    -0.89   0.374    -.0015139    .0005687
      depr_3 |  -.0004853   .0011908    -0.41   0.684    -.0028192    .0018486
     urban_3 |  -.0008192   .0026574    -0.31   0.758    -.0060276    .0043892
             |
         fid |
          2  |  -.3969036   .1192593    -3.33   0.001    -.6306476   -.1631595
          3  |  -.2625235   .0784641    -3.35   0.001    -.4163104   -.1087367
          4  |   .1645969   .0304308     5.41   0.000     .1049536    .2242403
          5  |  -.2980031   .1115681    -2.67   0.008    -.5166725   -.0793336
          6  |  -.1680313   .0662394    -2.54   0.011    -.2978581   -.0382046
          7  |  -.3135064    .099021    -3.17   0.002     -.507584   -.1194288
          8  |  -.1586937   .0500682    -3.17   0.002    -.2568256   -.0605618
          9  |  -.0248435    .071882    -0.35   0.730    -.1657296    .1160427
         10  |  -.1173634   .0412729    -2.84   0.004    -.1982568     -.03647
         11  |  -.4682466   .1318212    -3.55   0.000    -.7266113   -.2098818
         12  |  -.1883511   .0773309    -2.44   0.015    -.3399169   -.0367854
         13  |  -.1249757   .0603321    -2.07   0.038    -.2432244    -.006727
         14  |  -.2267835   .0888495    -2.55   0.011    -.4009252   -.0526417
             |
        year |
       1992  |   .0346761   .0103775     3.34   0.001     .0143365    .0550157
       1993  |   .0328787   .0133092     2.47   0.013     .0067931    .0589644
       1994  |   .0408791   .0166032     2.46   0.014     .0083375    .0734207
       1995  |   .0579581   .0241246     2.40   0.016     .0106747    .1052415
       1996  |   .0715538   .0319271     2.24   0.025     .0089779    .1341297
       1997  |   .0638464   .0365681     1.75   0.081    -.0078258    .1355187
             |
       _cons |   1.504102   .3882092     3.87   0.000     .7432259    2.264978
------------------------------------------------------------------------------

.
```

TIME DUMMIES

```
. testparm i.year

 ( 1)  1992.year = 0
 ( 2)  1993.year = 0
 ( 3)  1994.year = 0
 ( 4)  1995.year = 0
 ( 5)  1996.year = 0
 ( 6)  1997.year = 0

           chi2(  6) =   11.92
         Prob > chi2 =    0.0637
```

POOLABILITY/COUNTRY DUMMIES

```
. testparm i.fid

 ( 1)  2.fid = 0
 ( 2)  3.fid = 0
 ( 3)  4.fid = 0
 ( 4)  5.fid = 0
 ( 5)  6.fid = 0
 ( 6)  7.fid = 0
 ( 7)  8.fid = 0
 ( 8)  9.fid = 0
 ( 9)  10.fid = 0
 (10)  11.fid = 0
 (11)  12.fid = 0
 (12)  13.fid = 0
 (13)  14.fid = 0

           chi2( 13) =   64.11
         Prob > chi2 =    0.0000
```

CROSS SECTIONAL DEPENDENCE

```
. xtcsd, pesaran abs


Pesaran's test of cross sectional independence =    -0.789, Pr = 0.4301

Average absolute value of the off-diagonal elements =     0.443
```

SYSTEM GMMREGRESSION

```
. xtdpdsys y_it_y_t3, lags(1) endog(y_3 gdebt_3 infl_3 sav_3 urban_3 depr_3) vce(robust) arte

System dynamic panel-data estimation         Number of obs         =        54
Group variable: fid                          Number of groups      =        14
Time variable: year
                                             Obs per group:    min =         3
                                                               avg =  3.857143
                                                               max =         6

Number of instruments =     60               Wald chi2(7)          =    315.24
                                             Prob > chi2           =    0.0000
One-step results
```

y_it_y_t3	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
y_it_y_t3						
L1.	-.1933324	.0930527	-2.08	0.038	-.3757123	-.0109524
y_3	-.0445382	.0143419	-3.11	0.002	-.0726479	-.0164286
gdebt_3	.0000191	.0001616	0.12	0.906	-.0002975	.0003358
infl_3	.0000165	7.15e-06	2.30	0.021	2.45e-06	.0000305
sav_3	-.0004787	.0007687	-0.62	0.533	-.0019854	.0010279
urban_3	-.0002053	.0005174	-0.40	0.692	-.0012193	.0008088
depr_3	.0000635	.0004831	0.13	0.895	-.0008833	.0010104
_cons	.2491339	.1092702	2.28	0.023	.0349683	.4632995

```
Instruments for differenced equation
        GMM-type: L(2/.).y_it_y_t3 L(2/.).y_3 L(2/.).gdebt_3 L(2/.).infl_3
                  L(2/.).sav_3 L(2/.).urban_3 L(2/.).depr_3
Instruments for level equation
        GMM-type: LD.y_it_y_t3 LD.y_3 LD.gdebt_3 LD.infl_3 LD.sav_3
                  LD.urban_3 LD.depr_3
        Standard: _cons
```

AUTOCORRELATION TEST

```
. estat abond

Arellano-Bond test for zero autocorrelation in first-differenced errors
```

Order	z	Prob > z
1	-1.8214	0.0686
2	1.6034	0.1089

H0: no autocorrelation

SARGAN TEST

Sargan

```
. estat sargan
Sargan test of overidentifying restrictions
        H0: overidentifying restrictions are valid

        chi2(52)      =  39.00887
        Prob > chi2   =    0.9085
```

Appendix B5: System GMM Five Year Comfirmatory Specifications Results

SYSTEM GMMCONFIRMATORY SPECIFICATIONS

OPTION ONE

```
. xtdpdsys y, lags(1) endog(y_t5 gdebt exch aid lcons inv infl) vce(robust) artests(2)

System dynamic panel-data estimation         Number of obs         =        41
Group variable: fid                          Number of groups      =        14
Time variable: year
                                             Obs per group:    min =         2
                                                               avg =  2.928571
                                                               max =         5

Number of instruments =     49               Wald chi2(8)          = 280856.87
                                             Prob > chi2           =    0.0000
One-step results
------------------------------------------------------------------------------
             |               Robust
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           y |
         L1. |   1.008553   .0052322   192.76   0.000     .9982986    1.018808
             |
        y_t5 |   .0112272   .0293512     0.38   0.702    -.0463002    .0687545
       gdebt |  -.0004142   .0001764    -2.35   0.019      -.00076   -.0000684
        exch |  -.0000416   .0000204    -2.04   0.041    -.0000815   -1.67e-06
         aid |  -.0007765   .0019431    -0.40   0.689     -.004585    .0030319
       lcons |   .0248865   .0042102     5.91   0.000     .0166347    .0331383
         inv |   .0016612   .0008784     1.89   0.059    -.0000604    .0033828
        infl |   7.83e-06   .0000123     0.64   0.525    -.0000163     .000032
       _cons |  -.3021405   .1267073    -2.38   0.017    -.5504822   -.0537987
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).y L(2/.).y_t5 L(2/.).gdebt L(2/.).exch L(2/.).aid
                  L(2/.).lcons L(2/.).inv L(2/.).infl
Instruments for level equation
        GMM-type: LD.y LD.y_t5 LD.gdebt LD.exch LD.aid LD.lcons LD.inv
                  LD.infl
        Standard: _cons

.
```

AUTOCORRELATION TEST

```
. estat abond

Arellano-Bond test for zero autocorrelation in first-differenced errors
```

Order	z	Prob > z
1	-1.3645	0.1724
2	1.3587	0.1742

```
   H0: no autocorrelation
```

SARGAN TEST

```
. estat sargan
Sargan test of overidentifying restrictions
        H0: overidentifying restrictions are valid

        chi2(40)     =  22.72866
        Prob > chi2  =    0.9872

.
```

OPTION TWO

```
System dynamic panel-data estimation         Number of obs         =        41
Group variable: fid                          Number of groups      =        14
Time variable: year
                                             Obs per group:    min =         2
                                                               avg =  2.928571
                                                               max =         5

Number of instruments =     49               Wald chi2(8)          = 745513.60
                                             Prob > chi2           =    0.0000
One-step results
```

y	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
y						
L1.	.9909909	.0075278	131.64	0.000	.9762367	1.005745
y_t5	-.0069201	.0257258	-0.27	0.788	-.0573417	.0435014
gdebt	-.0010461	.0002991	-3.50	0.000	-.0016324	-.0004598
exch	-.0000153	.0000253	-0.60	0.545	-.000065	.0000343
sav	-.0010534	.0008989	-1.17	0.241	-.0028151	.0007084
lcons	.0218963	.0071484	3.06	0.002	.0078858	.0359068
infl_c	.006327	.002769	2.28	0.022	.0008999	.011754
laid	-.066472	.0247665	-2.68	0.007	-.1150135	-.0179304
_cons	.410809	.2479135	1.66	0.098	-.0750926	.8967106

```
Instruments for differenced equation
        GMM-type: L(2/.).y L(2/.).y_t5 L(2/.).gdebt L(2/.).exch L(2/.).sav
                  L(2/.).lcons L(2/.).infl_c L(2/.).laid
Instruments for level equation
        GMM-type: LD.y LD.y_t5 LD.gdebt LD.exch LD.sav LD.lcons LD.infl_c
                  LD.laid
        Standard: _cons

.
```

AUTOCORRELATION TEST

```
. estat abond

Arellano-Bond test for zero autocorrelation in first-differenced errors
```

Order	z	Prob > z
1	-1.4757	0.1400
2	1.1787	0.2385

```
   H0: no autocorrelation

.
```

SARGAN TEST

```
. estat sargan
Sargan test of overidentifying restrictions
        H0: overidentifying restrictions are valid

        chi2(40)      =    24.237
        Prob > chi2   =    0.9767
```

Appendix C: Appendix to Chapter 6

Appendix C1: Appendix for South Africa

DESCRIPTIVE STATISTICS

	LNY	BD	GFC	PGRHF
Mean	4.669101	-2.937139	19.15505	81.32079
Median	4.658616	-2.939501	18.73340	88.14645
Maximum	4.746228	0.984117	27.49630	101.6629
Minimum	4.606321	-8.853817	15.15028	47.88861
Std. Dev.	0.044245	2.478165	3.422282	19.84083
Skewness	0.431625	-0.467693	1.073127	-0.475741
Kurtosis	1.939829	2.981904	3.343477	1.660714
Jarque-Bera	2.570098	1.203504	6.496032	3.711129
Probability	0.276637	0.547851	0.038851	0.156365
Sum	154.0803	-96.92560	632.1166	2683.586
Sum Sq. Dev.	0.062643	196.5216	374.7844	12597.07
Observations	33	33	33	33

CORRELATION MATRIX

Covariance Analysis: Ordinary

Date: 01/08/17 Time: 20:21

Sample: 1981 2013

Included observations: 33

Covariance Correlation	LNY	BD	GFC	PGRHF
LNY	0.001898			
	1.000000			
BD	0.031629	5.955200		
	0.297482	1.000000		
GFC	0.063493	3.518727	11.35710	
	0.432425	0.427862	1.000000	
PGRHF	0.306140	-1.445494	-36.34222	381.7294
	0.359635	-0.030317	-0.551950	1.000000

BREAKPOINT UNIT ROOT TEST

LOG OF PER CAPITA GDP (LNY)

Null Hypothesis: LNY has a unit root

Trend Specification: Trend and intercept

Break Specification: Intercept only

Break Type: Innovational outlier

Break Date: 2001

Break Selection: Minimize Dickey-Fuller t-statistic

Lag Length: 1 (Automatic - based on Schwarz information criterion, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.668111	0.9704
Test critical values:	1% level	-5.347598	
	5% level	-4.859812	
	10% level	-4.607324	

*Vogelsang (1993) asymptotic one-sided p-values.

FIRST DIFFERENCE OF PER CAPITA GDP (LNY)

Null Hypothesis: D(LNY) has a unit root

Trend Specification: Trend and intercept

Break Specification: Intercept only

Break Type: Innovational outlier

Break Date: 2007

Break Selection: Minimize Dickey-Fuller t-statistic

Lag Length: 0 (Automatic - based on Schwarz information criterion, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.843977	0.0524
Test critical values:	1% level	-5.347598	
	5% level	-4.859812	
	10% level	-4.607324	

*Vogelsang (1993) asymptotic one-sided p-values.

BUDGET DEFICITS (BD)

Null Hypothesis: BD has a unit root

Trend Specification: Trend and intercept

Break Specification: Intercept only

Break Type: Innovational outlier

Break Date: 1997

Break Selection: Minimize Dickey-Fuller t-statistic

Lag Length: 0 (Automatic - based on Schwarz information criterion, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.448008	0.7240
Test critical values:	1% level	-5.347598	
	5% level	-4.859812	
	10% level	-4.607324	

*Vogelsang (1993) asymptotic one-sided p-values.

Null Hypothesis: GFC has a unit root

Trend Specification: Trend and intercept

Break Specification: Intercept only

Break Type: Innovational outlier

Break Date: 2005

Break Selection: Minimize Dickey-Fuller t-statistic

Lag Length: 1 (Automatic - based on Schwarz information criterion, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.027113	0.3553
Test critical values:	1% level	-5.347598	
	5% level	-4.859812	
	10% level	-4.607324	

*Vogelsang (1993) asymptotic one-sided p-values.

FIRST DIFFERENCE OF GROSS FIXED CAPITAL FORMATION (GFC)

Null Hypothesis: D(GFC) has a unit root

Trend Specification: Trend and intercept

Break Specification: Intercept only

Break Type: Innovational outlier

Break Date: 2008

Break Selection: Minimize Dickey-Fuller t-statistic

Lag Length: 3 (Automatic - based on Schwarz information criterion, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.368147	< 0.01
Test critical values:	1% level	-5.347598	
	5% level	-4.859812	
	10% level	-4.607324	

*Vogelsang (1993) asymptotic one-sided p-values.

PRIMARY GROSS ENROLMENT RATIO (PGRHF)

Null Hypothesis: PGRHF has a unit root

Trend Specification: Trend and intercept

Break Specification: Intercept only

Break Type: Innovational outlier

Break Date: 1996

Break Selection: Minimize Dickey-Fuller t-statistic

Lag Length: 6 (Automatic - based on Schwarz information criterion, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.651517	< 0.01
Test critical values:	1% level	-5.347598	
	5% level	-4.859812	
	10% level	-4.607324	

*Vogelsang (1993) asymptotic one-sided p-values.

RESULTS OF BREAKPOINT UNIT ROOT TESTS

TEST OF STRUCTURAL BREAKS

Multiple breakpoint tests

Bai-Perron tests of L+1 vs. L sequentially determined breaks

Date: 01/28/17   Time: 13:32

Sample: 1981 2013

Included observations: 33

Breaking variables: C

Non-breaking variables: BD GFC CPI PGRHF

Break test options: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Sequential F-statistic determined breaks:			2
Break Test	F-statistic	Scaled F-statistic	Critical Value**
0 vs. 1 *	24.39950	24.39950	8.58
1 vs. 2 *	10.51427	10.51427	10.13
2 vs. 3	4.996247	4.996247	11.14

* Significant at the 0.05 level.

** Bai-Perron (Econometric Journal, 2003) critical values.

Break dates:

	Sequential	Repartition
1	2002	1994
2	1994	2002

DYNAMIC ORDINARY LEAST SQUARES (DOLS) ESTIMATION RESULTS

Dependent Variable: LNY

Method: Dynamic Least Squares (DOLS)

Date: 01/28/17 Time: 13:40

Sample (adjusted): 1983 2012

Included observations: 30 after adjustments

Cointegrating equation deterministics: C B2002

Fixed leads and lags specification (lead=1, lag=1)

Long-run variance estimate (Bartlett kernel, Newey-West automatic

bandwidth = 8.4846, NW automatic lag length = 3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BD	0.007250	0.001427	5.081840	0.0003
GFC	0.002457	0.001347	1.824519	0.0931
CPI	0.002208	0.000261	8.452951	0.0000
PGRHF	-0.002423	0.000361	-6.717841	0.0000
C	4.729389	0.047545	99.47254	0.0000
B2002	0.026757	0.005819	4.598579	0.0006

R-squared	0.993273	Mean dependent var	4.665188
Adjusted R-squared	0.983744	S.D. dependent var	0.043685
S.E. of regression	0.005570	Sum squared resid	0.000372
Long-run variance	1.30E-05		

FULLY MODIFIED ORDINARY LEAST SQUARES (FMOLS)

Dependent Variable: LNY

Method: Fully Modified Least Squares (FMOLS)

Date: 01/28/17   Time: 13:35

Sample (adjusted): 1982 2013

Included observations: 32 after adjustments

Cointegrating equation deterministics: C B2002

Long-run covariance estimate (Bartlett kernel, Newey-West fixed bandwidth
= 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BD	0.006186	0.000907	6.819644	0.0000
GFC	0.001793	0.000903	1.985345	0.0577
CPI	0.001885	0.000196	9.616528	0.0000
PGRHF	-0.002087	0.000287	-7.272125	0.0000
C	4.725209	0.034251	137.9564	0.0000
B2002	0.034298	0.006170	5.558397	0.0000

R-squared	0.970098	Mean dependent var	4.668271
Adjusted R-squared	0.964347	S.D. dependent var	0.044691
S.E. of regression	0.008438	Sum squared resid	0.001851
Long-run variance	6.20E-05		

CANONICAL COINTEGRATION REGRESSION

Dependent Variable: LNY

Method: Canonical Cointegrating Regression (CCR)

Date: 01/28/17 Time: 13:36

Sample (adjusted): 1982 2013

Included observations: 32 after adjustments

Cointegrating equation deterministics: C B2002

Long-run covariance estimate (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BD	0.006474	0.001080	5.996255	0.0000
GFC	0.001609	0.000958	1.680421	0.1049
CPI	0.001877	0.000223	8.402731	0.0000
PGRHF	-0.002093	0.000309	-6.780607	0.0000
C	4.730444	0.036625	129.1605	0.0000
B2002	0.033859	0.006687	5.063564	0.0000

R-squared	0.969022	Mean dependent var	4.668271
Adjusted R-squared	0.963065	S.D. dependent var	0.044691
S.E. of regression	0.008589	Sum squared resid	0.001918
Long-run variance	6.20E-05		

COINTEGRATION TEST

HANSEN INSTABILITY

Cointegration Test - Hansen Parameter Instability

Date: 01/28/17 Time: 13:40

Equation: UNTITLED

Series: LNY BD GFC CPI PGRHF

Null hypothesis: Series are cointegrated

Cointegrating equation deterministics: C B2002

Lc statistic	Stochastic Trends (m)	Deterministic Trends (k)	Excluded Trends (p2)	Prob.*
0.250853	4	0	0	> 0.2

*Hansen (1992b) Lc(m2=4, k=0) p-values, where m2=m-p2 is the number of stochastic trends in the asymptotic distribution

Warning: number of trends and p-values do not account for user-specified deterministic regressors

ENGLE-GRANGER COINTEGRATION TEST

Cointegration Test - Engle-Granger

Date: 01/28/17 Time: 13:41

Equation: UNTITLED

Specification: LNY BD GFC CPI PGRHF C B2002

Cointegrating equation deterministics: C B2002

Null hypothesis: Series are not cointegrated

Automatic lag specification (lag=0 based on Schwarz Info Criterion, maxlag=6)

	Value	Prob.*
Engle-Granger tau-statistic	-4.848029	0.0517
Engle-Granger z-statistic	-27.05014	0.0528

*MacKinnon (1996) p-values.

Warning: p-values do not account for user-specified deterministic regressors.

PHILLIPS OULIARIS

Cointegration Test - Phillips-Ouliaris

Date: 01/28/17 Time: 13:41

Equation: UNTITLED

Specification: LNY BD GFC CPI PGRHF C B2002

Cointegrating equation deterministics: C B2002

Null hypothesis: Series are not cointegrated

Long-run variance estimate (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

No d.f. adjustment for variances

	Value	Prob.*
Phillips-Ouliaris tau-statistic	-4.907493	0.0464
Phillips-Ouliaris z-statistic	-25.93567	0.0718

*MacKinnon (1996) p-values.

Warning: p-values do not account for user-specified deterministic regressors.

D94-BUDGET DEFICIT INTERACTION DUMMY

Dependent Variable: LNY
Method: Dynamic Least Squares (DOLS)
Date: 01/28/17 Time: 13:43
Sample (adjusted): 1983 2012
Included observations: 30 after adjustments
Cointegrating equation deterministics: C
Fixed leads and lags specification (lead=1, lag=1)
Long-run variance estimate (Bartlett kernel, Newey-West automatic
bandwidth = 12.9005, NW automatic lag length = 3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BD	0.007041	0.001004	7.010698	0.0009
GFC	0.010182	0.000997	10.20922	0.0002
CPI	-0.000646	0.000291	-2.219645	0.0772
PGRHF	0.001542	0.000387	3.989994	0.0104
D94*BD	0.009828	0.000867	11.33565	0.0001
B2002*BD	-0.026085	0.002484	-10.49895	0.0001
C	4.333196	0.043200	100.3047	0.0000

R-squared	0.997703	Mean dependent var	4.665188
Adjusted R-squared	0.986680	S.D. dependent var	0.043685
S.E. of regression	0.005042	Sum squared resid	0.000127
Long-run variance	1.39E-06		

NON-LINEARITY TESTS

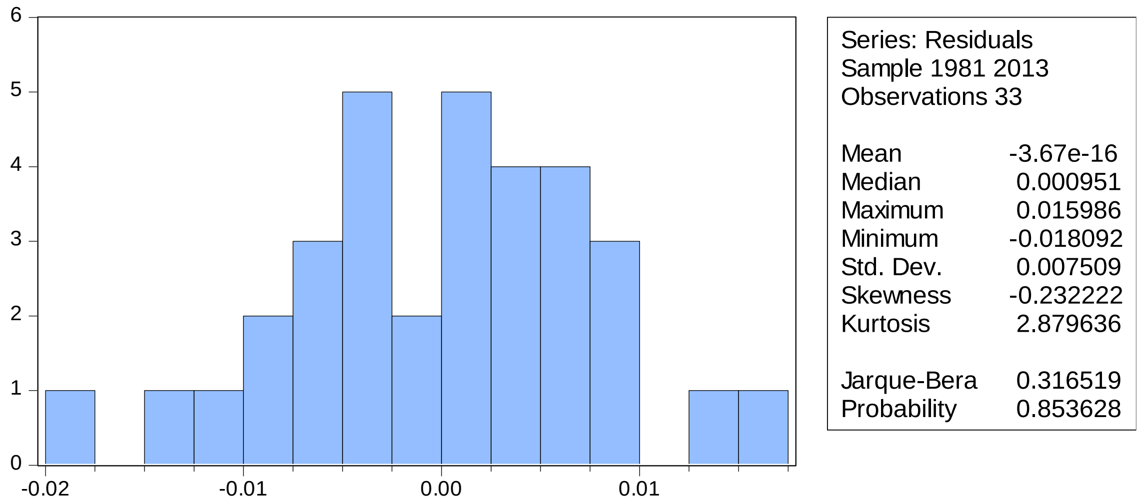
Dependent Variable: LNY
Method: Dynamic Least Squares (DOLS)
Date: 01/28/17 Time: 13:45
Sample (adjusted): 1983 2012
Included observations: 30 after adjustments
Cointegrating equation deterministics: C
Fixed leads and lags specification (lead=1, lag=1)
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BD	0.010644	0.004338	2.453479	0.0365
GFC	0.000666	0.003559	0.187212	0.8556
CPI	0.002712	0.000857	3.163423	0.0115
PGRHF	-0.002911	0.001106	-2.633050	0.0272
BD^2	0.000142	0.000466	0.305434	0.7670
C	4.804966	0.126112	38.10075	0.0000

R-squared	0.989794	Mean dependent var	4.665188
Adjusted R-squared	0.967113	S.D. dependent var	0.043685
S.E. of regression	0.007922	Sum squared resid	0.000565

POST ESTIMATION DIAGNOSTIC CHECKS

JAQUE-BERA NORMALITY TEST



RAMSEY-RESET MODEL SPECIFICATION TEST

Ramsey RESET Test

Equation: UNTITLED

Specification: LNY BD GFC CPI PGRHF C B2002 D94

Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	0.835531	25	0.4113
F-statistic	0.698113	(1, 25)	0.4113
Likelihood ratio	0.908877	1	0.3404

F-test summary:

SERIAL CORRELATION LM TEST

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.443076	Prob. F(2,24)	0.2560
Obs*R-squared	3.542457	Prob. Chi-Square(2)	0.1701

HETEROSCEDASTICITY TEST

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.240656	Prob. F(6,26)	0.3183
Obs*R-squared	7.345123	Prob. Chi-Square(6)	0.2901
Scaled explained SS	4.285106	Prob. Chi-Square(6)	0.6382

MODEL STABILITY TEST

Appendix C2: Appendix for Magascar

BREAKPOINT UNIT ROOT TESTS

LOG OF GDP PER CAPITA

Null Hypothesis: LNY has a unit root

Trend Specification: Trend and intercept

Break Specification: Intercept only

Break Type: Innovational outlier

Break Date: 2005

Break Selection: Minimize Dickey-Fuller t-statistic

Lag Length: 0 (Automatic - based on Schwarz information criterion, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.975018	0.3878
Test critical values:	1% level	-5.347598	
	5% level	-4.859812	
	10% level	-4.607324	

*Vogelsang (1993) asymptotic one-sided p-values.

FIRST DIFFERENCE OF PER CAPITA GDP (LYN)

Null Hypothesis: D(LNY) has a unit root

Trend Specification: Trend and intercept

Break Specification: Intercept only

Break Type: Innovational outlier

Break Date: 2002

Break Selection: Minimize Dickey-Fuller t-statistic

Lag Length: 0 (Automatic - based on Schwarz information criterion, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.014138	< 0.01
Test critical values:	1% level	-5.347598	
	5% level	-4.859812	
	10% level	-4.607324	

*Vogelsang (1993) asymptotic one-sided p-values.

BUDGET DEFICIT (BD)

Null Hypothesis: BD has a unit root

Trend Specification: Trend and intercept

Break Specification: Intercept only

Break Type: Innovational outlier

Break Date: 2012

Break Selection: Minimize Dickey-Fuller t-statistic

Lag Length: 0 (Automatic - based on Schwarz information criterion, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.984232	< 0.01
Test critical values:	1% level	-5.347598	
	5% level	-4.859812	
	10% level	-4.607324	

*Vogelsang (1993) asymptotic one-sided p-values.

GROSS FIXED CAPITAL FORMATION (GFC)

Null Hypothesis: GFC has a unit root

Trend Specification: Trend and intercept

Break Specification: Intercept only

Break Type: Innovational outlier

Break Date: 2005

Break Selection: Minimize Dickey-Fuller t-statistic

Lag Length: 5 (Automatic - based on Schwarz information criterion, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.553103	0.1150
Test critical values:	1% level	-5.347598	
	5% level	-4.859812	
	10% level	-4.607324	

*Vogelsang (1993) asymptotic one-sided p-values.

FIRST DIFFERENCE OF GROSS FIXED CAPITAL FORMATION (DGFC)

Null Hypothesis: D(GFC) has a unit root

Trend Specification: Trend and intercept

Break Specification: Intercept only

Break Type: Innovational outlier

Break Date: 2008

Break Selection: Minimize Dickey-Fuller t-statistic

Lag Length: 1 (Automatic - based on Schwarz information criterion, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.648319	< 0.01
Test critical values:	1% level	-5.347598	
	5% level	-4.859812	
	10% level	-4.607324	

*Vogelsang (1993) asymptotic one-sided p-values.

PRIMARY GROSS ENROLMENT RATIO (PGR)

Null Hypothesis: PGR has a unit root

Trend Specification: Trend and intercept

Break Specification: Intercept only

Break Type: Innovational outlier

Break Date: 2002

Break Selection: Minimize Dickey-Fuller t-statistic

Lag Length: 1 (Automatic - based on Schwarz information criterion, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.561019	< 0.01
Test critical values:	1% level	-5.347598	
	5% level	-4.859812	
	10% level	-4.607324	

*Vogelsang (1993) asymptotic one-sided p-values.

DESCRIPTIVE STATISTICS

	LNY	BD	GFC	PGR
Mean	5.536070	-3.722844	16.01501	116.3044
Median	5.518763	-2.808505	14.78140	112.0591
Maximum	5.626216	-0.124243	40.31782	149.9517
Minimum	5.464065	-13.67243	7.918092	83.80518
Std. Dev.	0.040115	3.421047	7.552984	22.86405
Skewness	0.607101	-1.205469	1.640226	0.138881
Kurtosis	2.255649	4.230458	5.378700	1.383646
Jarque-Bera	2.958002	10.68469	23.94521	3.922556
Probability	0.227865	0.004785	0.000006	0.140678
Sum	193.7625	-130.2995	560.5254	4070.654
Sum Sq. Dev.	0.054713	397.9212	1939.617	17774.00
Observations	35	35	35	35

CORRELATION MATRIX

Covariance Analysis: Ordinary

Date: 01/08/17 Time: 16:44

Sample: 1981 2015

Included observations: 35

Covariance Correlation	LNY	BD	GFC	PGR
LNY	0.001563			
	1.000000			
BD	0.090815	11.36918		
	0.681206	1.000000		
GFC	-0.095278	-8.497722	55.41764	
	-0.323709	-0.338543	1.000000	
PGR	-0.090268	-38.59774	91.27311	507.8285
	-0.101312	-0.507971	0.544077	1.000000

MULTIPLE BREAKPOINT TESTS

Multiple breakpoint tests

Bai-Perron tests of L+1 vs. L sequentially determined breaks

Date: 01/27/17 Time: 17:13

Sample: 1981 2015

Included observations: 35

Breaking variables: C

Non-breaking variables: GFC BD PGER

Break test options: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Sequential F-statistic determined breaks: 4

Break Test	F-statistic	Scaled F-statistic	Critical Value**
0 vs. 1 *	54.21346	54.21346	8.58
1 vs. 2 *	87.56153	87.56153	10.13
2 vs. 3 *	18.94914	18.94914	11.14
3 vs. 4 *	16.14593	16.14593	11.83
4 vs. 5	1.116518	1.116518	12.25

* Significant at the 0.05 level.

** Bai-Perron (Econometric Journal, 2003) critical values.

Break dates:

	Sequential	Repartition
1	1991	1991
2	2002	1996
3	1996	2002
4	2009	2009

DYNAMIC ORDINARY LEAST SQUARES (DOLS)

Dependent Variable: LNY
Method: Dynamic Least Squares (DOLS)
Date: 01/27/17 Time: 17:39
Sample (adjusted): 1983 2014
Included observations: 32 after adjustments
Cointegrating equation deterministics: C B1991 B1996 B2002
Fixed leads and lags specification (lead=1, lag=1)
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GFC	0.001265	0.000333	3.802819	0.0016
BD	0.002775	0.001299	2.135730	0.0485
PGER	0.001377	0.000189	7.268243	0.0000
C	5.429998	0.018046	300.8962	0.0000
B1991	-0.034944	0.005038	-6.935550	0.0000
B1996	-0.019533	0.006598	-2.960527	0.0092
B2002	-0.074171	0.009503	-7.804696	0.0000

R-squared	0.991865	Mean dependent var	5.532098
Adjusted R-squared	0.984238	S.D. dependent var	0.035915
S.E. of regression	0.004509	Sum squared resid	0.000325

Dependent Variable: LNY

Method: Dynamic Least Squares (DOLS)

Date: 01/27/17 Time: 17:43

Sample (adjusted): 1983 2014

Included observations: 32 after adjustments

Cointegrating equation deterministics: C B1991 B1996 B2002 B2009

Fixed leads and lags specification (lead=1, lag=1)

White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GFC	0.001494	0.000506	2.951516	0.0099
BD	0.001537	0.002439	0.629954	0.5382
PGER	0.001320	0.000225	5.872827	0.0000
C	5.432376	0.019660	276.3173	0.0000
B1991	-0.038868	0.007839	-4.958453	0.0002
B1996	-0.018815	0.006668	-2.821668	0.0129
B2002	-0.073020	0.009608	-7.599838	0.0000
B2009	-0.008998	0.012822	-0.701731	0.4936

R-squared	0.992197	Mean dependent var	5.532098
Adjusted R-squared	0.983873	S.D. dependent var	0.035915
S.E. of regression	0.004561	Sum squared resid	0.000312

FULLY MODIFIED LEAST SQUARES (FMOLS)

Dependent Variable: LNY

Method: Fully Modified Least Squares (FMOLS)

Date: 01/27/17 Time: 17:45

Sample (adjusted): 1982 2015

Included observations: 34 after adjustments

Cointegrating equation deterministics: C B1991 B1996 B2002 B2009

Long-run covariance estimate (Bartlett kernel, Andrews bandwidth = 0.8695)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GFC	0.001363	0.000187	7.299447	0.0000
BD	0.000370	0.000457	0.808845	0.4259
PGER	0.001021	9.50E-05	10.75042	0.0000
C	5.463693	0.010113	540.2513	0.0000
B1991	-0.044041	0.003428	-12.84640	0.0000
B1996	-0.017311	0.003144	-5.506595	0.0000
B2002	-0.057877	0.004540	-12.74901	0.0000
B2009	-0.012840	0.003632	-3.535295	0.0016

R-squared	0.985562	Mean dependent var	5.533419
Adjusted R-squared	0.981675	S.D. dependent var	0.037476
S.E. of regression	0.005073	Sum squared resid	0.000669
Long-run variance	2.49E-05		

CANONICAL COINTEGRATION REGRESSION (CCR)

Dependent Variable: LNY
Method: Canonical Cointegrating Regression (CCR)
Date: 01/27/17 Time: 17:48
Sample (adjusted): 1982 2015
Included observations: 34 after adjustments
Cointegrating equation deterministics: C B1991 B1996 B2002 B2009
Long-run covariance estimate (Bartlett kernel, Andrews bandwidth = 0.8695)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GFC	0.001368	0.000194	7.035806	0.0000
BD	0.000430	0.000521	0.824673	0.4171
PGER	0.001033	8.78E-05	11.76536	0.0000
C	5.462762	0.009716	562.2329	0.0000
B1991	-0.044236	0.003669	-12.05626	0.0000
B1996	-0.017247	0.003133	-5.504855	0.0000
B2002	-0.058061	0.004481	-12.95729	0.0000
B2009	-0.012977	0.003407	-3.808734	0.0008

R-squared	0.985430	Mean dependent var	5.533419
Adjusted R-squared	0.981508	S.D. dependent var	0.037476
S.E. of regression	0.005096	Sum squared resid	0.000675
Long-run variance	2.49E-05		

COINTEGRATION TEST

HANSEN PARAMETER INSTABILITY COINTEGRATION TEST

Cointegration Test - Hansen Parameter Instability

Date: 01/27/17 Time: 17:49

Equation: UNTITLED

Series: LNY GFC BD PGER

Null hypothesis: Series are cointegrated

Cointegrating equation deterministics: C B1991 B1996 B2002

Lc statistic	Stochastic Trends (m)	Deterministic Trends (k)	Excluded Trends (p2)	Prob.*
0.145664	3	0	0	> 0.2

*Hansen (1992b) Lc(m2=3, k=0) p-values, where m2=m-p2 is the number of stochastic trends in the asymptotic distribution

Warning: number of trends and p-values do not account for user-specified deterministic regressors

ENGLE-GRANGER COINTEGRATION TEST

Cointegration Test - Engle-Granger

Date: 01/27/17 Time: 17:50

Equation: UNTITLED

Specification: LNY GFC BD PGER C B1991 B1996 B2002

Cointegrating equation deterministics: C B1991 B1996 B2002

Null hypothesis: Series are not cointegrated

Automatic lag specification (lag=0 based on Schwarz Info Criterion, maxlag=6)

	Value	Prob.*
Engle-Granger tau-statistic	-5.125673	0.0120
Engle-Granger z-statistic	-29.09563	0.0135

*MacKinnon (1996) p-values.

Warning: p-values do not account for user-specified deterministic regressors.

PHILLIPS OULIARIS COINTEGRATION TEST

Cointegration Test - Phillips-Ouliaris

Date: 01/27/17 Time: 17:50

Equation: UNTITLED

Specification: LNY GFC BD PGER C B1991 B1996 B2002

Cointegrating equation deterministics: C B1991 B1996 B2002

Null hypothesis: Series are not cointegrated

Long-run variance estimate (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

No d.f. adjustment for variances

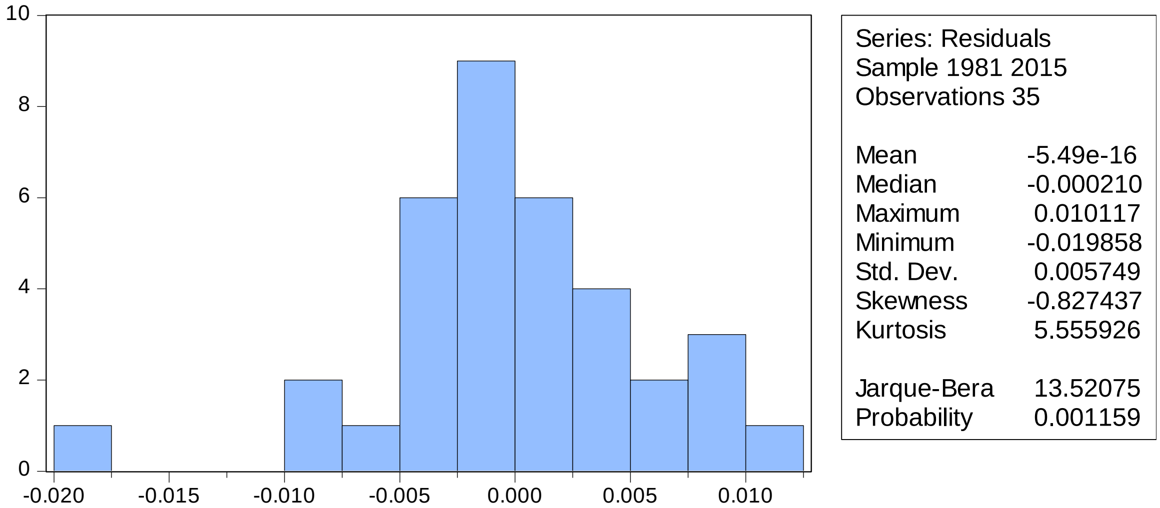
	Value	Prob.*
Phillips-Ouliaris tau-statistic	-5.188371	0.0105
Phillips-Ouliaris z-statistic	-27.16890	0.0249

*MacKinnon (1996) p-values.

Warning: p-values do not account for user-specified deterministic regressors.

POST ESTIMATION DIAGNOSTIC CHECKS

NORMALITY TEST



SERIAL CORRELATION TEST

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.491127	Prob. F(2,26)	0.6175
Obs*R-squared	1.274130	Prob. Chi-Square(2)	0.5288

RAMSEY RESET TEST

Ramsey RESET Test

Equation: UNTITLED

Specification: LNY GFC BD PGER C B1991 B1996 B2002 B2009

Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	0.465823	26	0.6452
F-statistic	0.216991	(1, 26)	0.6452
Likelihood ratio	0.290891	1	0.5897

MODEL SPECIFICATION TEST

Ramsey RESET Test

Equation: UNTITLED

Specification: Y GFC BD PGR D(GFC(1)) D(GFC) D(GFC(-1)) D(BD(1))

D(BD) D(BD(-1)) D(PGR(1)) D(PGR) D(PGR(-1)) C

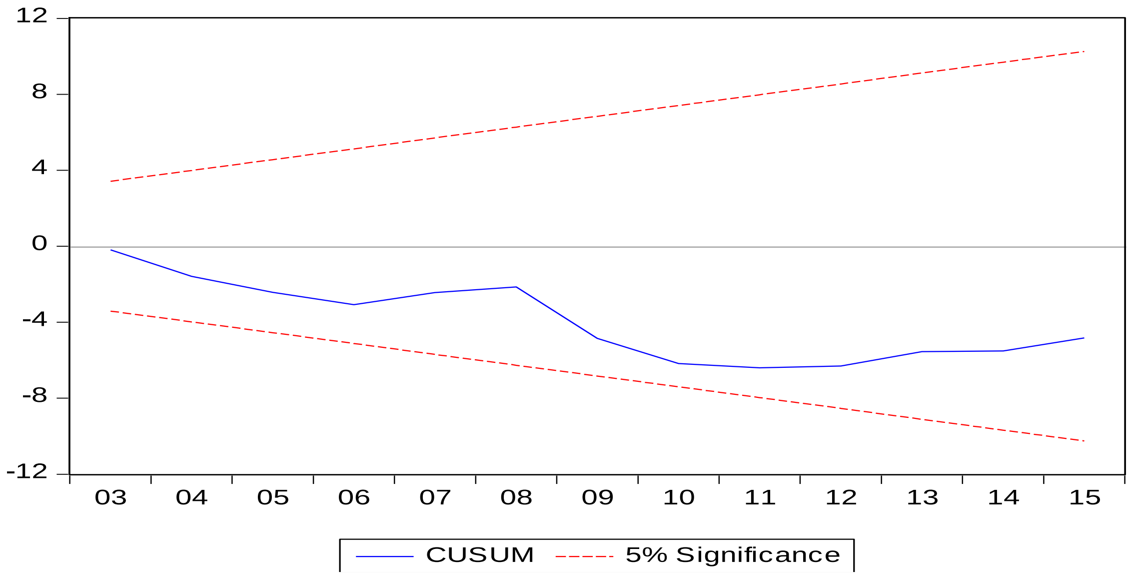
Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	0.494363	18	0.6270
F-statistic	0.244395	(1, 18)	0.6270
Likelihood ratio	0.431556	1	0.5112

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	3.393566	Prob. F(7,27)	0.0099
Obs*R-squared	16.38113	Prob. Chi-Square(7)	0.0219
Scaled explained SS	10.05489	Prob. Chi-Square(7)	0.1855

CUSUM TEST



REDUNTANT TEST

Redundant Variables Test

Null hypothesis: BD*GFC are jointly insignificant

Equation: UNTITLED

Specification: LNY GFC BD PGER BD*GFC C B1991 B1996 B2002 B2009

Redundant Variables: BD*GFC

	Value	df	Probability
t-statistic	2.117140	26	0.0440
F-statistic	4.482284	(1, 26)	0.0440
Likelihood ratio	5.566719	1	0.0183

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	0.000103	1	0.000103
Restricted SSR	0.000703	27	2.60E-05
Unrestricted SSR	0.000600	26	2.31E-05

LR test summary:

	Value	df
Restricted LogL	139.6020	27
Unrestricted LogL	142.3854	26

NON-LINEARITY TEST

Dependent Variable: LNY
Method: Dynamic Least Squares (DOLS)
Date: 01/27/17 Time: 18:27
Sample (adjusted): 1983 2014
Included observations: 32 after adjustments
Cointegrating equation deterministics: C B1991 B1996 B2002 B2009
Fixed leads and lags specification (lead=1, lag=1)
Long-run variance estimate (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GFC	0.002152	0.000273	7.886089	0.0000
BD	0.008459	0.001241	6.813869	0.0000
PGER	0.000994	9.44E-05	10.52261	0.0000
BD^2	0.000593	0.000140	4.227788	0.0014
C	5.461642	0.008385	651.3750	0.0000
B1991	-0.035612	0.003026	-11.76667	0.0000
B1996	-0.010415	0.002283	-4.560943	0.0008
B2002	-0.057228	0.004373	-13.08556	0.0000
B2009	-0.035296	0.007369	-4.789980	0.0006

R-squared	0.997923	Mean dependent var	5.532098
Adjusted R-squared	0.994147	S.D. dependent var	0.035915
S.E. of regression	0.002748	Sum squared resid	8.30E-05
Long-run variance	3.05E-06		

BD-GFC INTERACTION DUMMY

Dependent Variable: LNY
Method: Dynamic Least Squares (DOLS)

Date: 01/27/17 Time: 18:26
Sample (adjusted): 1983 2014
Included observations: 32 after adjustments
Cointegrating equation deterministics: C B1991 B1996 B2002 B2009
Fixed leads and lags specification (lead=1, lag=1)
Long-run variance estimate (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GFC	0.002110	0.001428	1.477370	0.1676
BD	-0.000712	0.005519	-0.128925	0.8997
PGER	0.001329	0.000266	4.986187	0.0004
BD*GFC	0.000194	0.000385	0.502762	0.6250
C	5.424628	0.032317	167.8588	0.0000
B1991	-0.039123	0.008054	-4.857636	0.0005
B1996	-0.018101	0.004726	-3.830028	0.0028
B2002	-0.070008	0.011162	-6.272101	0.0001
B2009	-0.006625	0.012180	-0.543965	0.5973

R-squared	0.992976	Mean dependent var	5.532098
Adjusted R-squared	0.980204	S.D. dependent var	0.035915
S.E. of regression	0.005053	Sum squared resid	0.000281
Long-run variance	2.05E-05		

Appendix C3: Appendix for Lesotho

DESCRIPTIVE STATISTICS

	LNY	BD	CPI	GFC	PGER
Mean	3.580651	0.781607	60.86443	42.89244	111.3115
Median	3.561009	0.745871	61.17866	37.30492	110.3310
Maximum	3.800489	16.23467	116.9270	74.82057	120.8341
Minimum	3.419808	-17.51078	15.95540	21.11719	105.0041
Std. Dev.	0.109854	7.047429	28.11845	16.93202	4.413184
Skewness	0.473416	-0.212881	0.203550	0.528765	0.662258
Kurtosis	2.149870	3.845175	2.246400	1.957548	2.480745
Jarque-Bera	2.091485	1.156808	0.947622	2.848223	2.614293
Probability	0.351431	0.560793	0.622625	0.240722	0.270591
Sum	111.0002	24.22981	1886.797	1329.666	3450.656
Sum Sq. Dev.	0.362035	1489.988	23719.42	8600.798	584.2858
Observations	31	31	31	31	31

CORRELATION MATRIX

Covariance Analysis: Ordinary

Date: 01/08/17   Time: 17:30

Sample: 1983 2013

Included observations: 31

Covariance Correlation	LNY	BD	CPI	GFC	PGER
LNY	0.011679				
	1.000000				
BD	-0.028181	48.06412			
	-0.037615	1.000000			
CPI	2.792221	-0.677158	765.1425		
	0.934080	-0.003531	1.000000		
GFC	-0.965350	-8.279117	-126.1670	277.4451	
	-0.536292	-0.071694	-0.273833	1.000000	
PGER	0.128832	8.007848	18.69957	-23.06171	18.84793
	0.274599	0.266056	0.155714	-0.318912	1.000000

BREAK POINT UNIT ROOT TESTS

LOG OF GDP PER CAPITA

Null Hypothesis: LNY has a unit root

Trend Specification: Trend and intercept

Break Specification: Intercept only

Break Type: Innovational outlier

Break Date: 2007

Break Selection: Minimize Dickey-Fuller t-statistic

Lag Length: 0 (Automatic - based on Schwarz information criterion, maxlag=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.075196	> 0.99
Test critical values:	1% level	-5.347598	
	5% level	-4.859812	
	10% level	-4.607324	

*Vogelsang (1993) asymptotic one-sided p-values.

FIRST DIFFERENCE OF GDP PER CAPITA (LNY)

Null Hypothesis: D(LNY) has a unit root

Trend Specification: Trend and intercept

Break Specification: Intercept only

Break Type: Innovational outlier

Break Date: 2005

Break Selection: Minimize Dickey-Fuller t-statistic

Lag Length: 0 (Automatic - based on Schwarz information criterion, maxlag=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.600366	< 0.01
Test critical values:	1% level	-5.347598	
	5% level	-4.859812	
	10% level	-4.607324	

*Vogelsang (1993) asymptotic one-sided p-values.

BUDGET DEFICITS (BD)

Null Hypothesis: BD has a unit root

Trend Specification: Trend and intercept

Break Specification: Intercept only

Break Type: Innovational outlier

Break Date: 2005

Break Selection: Minimize Dickey-Fuller t-statistic

Lag Length: 4 (Automatic - based on Schwarz information criterion, maxlag=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.070731	0.0268
Test critical values:	1% level	-5.347598	
	5% level	-4.859812	
	10% level	-4.607324	

*Vogelsang (1993) asymptotic one-sided p-values.

GROSS FIXED CAPITAL FORMATION

Null Hypothesis: GFC has a unit root

Trend Specification: Trend and intercept

Break Specification: Intercept only

Break Type: Innovational outlier

Break Date: 1999

Break Selection: Minimize Dickey-Fuller t-statistic

Lag Length: 7 (Automatic - based on Schwarz information criterion, maxlag=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.075557	< 0.01
Test critical values:	1% level	-5.347598	
	5% level	-4.859812	
	10% level	-4.607324	

*Vogelsang (1993) asymptotic one-sided p-values.

PRIMARY GROSS ENROLMENT RATIO (PGER)

Null Hypothesis: PGER has a unit root

Trend Specification: Trend and intercept

Break Specification: Intercept only

Break Type: Innovational outlier

Break Date: 1999

Break Selection: Minimize Dickey-Fuller t-statistic

Lag Length: 0 (Automatic - based on Schwarz information criterion, maxlag=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.944289	0.4063
Test critical values:	1% level	-5.347598	
	5% level	-4.859812	
	10% level	-4.607324	

*Vogelsang (1993) asymptotic one-sided p-values.

FIRST DIFFERENCE OF PRIMARY ENROLMENT RATIO (DPGER)

Null Hypothesis: D(PGER) has a unit root

Trend Specification: Trend and intercept

Break Specification: Intercept only

Break Type: Innovational outlier

Break Date: 2000

Break Selection: Minimize Dickey-Fuller t-statistic

Lag Length: 0 (Automatic - based on Schwarz information criterion, maxlag=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.248205	< 0.01
Test critical values:	1% level	-5.347598	
	5% level	-4.859812	
	10% level	-4.607324	

*Vogelsang (1993) asymptotic one-sided p-values.

ORDINATY LEAST SQUARES (OLS)

Dependent Variable: LNY
Method: Least Squares
Date: 01/08/17 Time: 17:47
Sample: 1983 2013
Included observations: 31

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BD	-0.001157	0.000594	-1.946595	0.0625
GFC	-0.001867	0.000259	-7.216821	0.0000
PGER	0.001771	0.001001	1.768903	0.0886
CPI	0.003297	0.000150	22.03084	0.0000
C	3.263881	0.114827	28.42433	0.0000

R-squared	0.964979	Mean dependent var	3.580651
Adjusted R-squared	0.959591	S.D. dependent var	0.109854
S.E. of regression	0.022083	Akaike info criterion	-4.641344
Sum squared resid	0.012679	Schwarz criterion	-4.410056
Log likelihood	76.94083	Hannan-Quinn criter.	-4.565950
F-statistic	179.1016	Durbin-Watson stat	1.180801
Prob(F-statistic)	0.000000		

MULTIPLE BREAKPOINT TESTS

Multiple breakpoint tests

Bai-Perron tests of L+1 vs. L sequentially determined breaks

Date: 01/27/17 Time: 21:19

Sample: 1983 2013

Included observations: 31

Breaking variables: C

Non-breaking variables: BD CPI GFC PGER

Break test options: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Sequential F-statistic determined breaks: 2

Break Test	F-statistic	Scaled F-statistic	Critical Value**
0 vs. 1 *	26.62632	26.62632	8.58
1 vs. 2 *	11.32419	11.32419	10.13
2 vs. 3	5.650645	5.650645	11.14

* Significant at the 0.05 level.

** Bai-Perron (Econometric Journal, 2003) critical values.

Break dates:

	Sequential	Repartition
1	1999	1999
2	2010	2010

DYNAMIC ORDINARY LEAST SQUARES (DOLS)

Dependent Variable: LNY
Method: Dynamic Least Squares (DOLS)
Date: 01/28/17   Time: 12:13
Sample (adjusted): 1985 2012
Included observations: 28 after adjustments
Cointegrating equation deterministics: C B1999 B2010
Fixed leads and lags specification (lead=1, lag=1)
Long-run variance estimate (Bartlett kernel, Newey-West automatic
bandwidth = 7.2648, NW automatic lag length = 3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BD	0.001525	0.000403	3.783982	0.0023
GFC	0.000356	0.000125	2.857153	0.0135
SGER	0.008890	0.000475	18.72843	0.0000
C	3.243821	0.010935	296.6454	0.0000
B1999	0.045162	0.007838	5.762014	0.0001
B2010	0.046445	0.010633	4.367953	0.0008

R-squared	0.997337	Mean dependent var	3.583344
Adjusted R-squared	0.994470	S.D. dependent var	0.099921
S.E. of regression	0.007431	Sum squared resid	0.000718
Long-run variance	2.53E-05		

FULLY MODIFIED LEAST SQUARES TEST

Dependent Variable: LNY

Method: Fully Modified Least Squares (FMOLS)

Date: 01/28/17 Time: 12:15

Sample (adjusted): 1984 2013

Included observations: 30 after adjustments

Cointegrating equation deterministics: C B1999

Long-run covariance estimate (Bartlett kernel, Newey-West automatic bandwidth = 10.6125, NW automatic lag length = 3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BD	0.000512	0.000147	3.478561	0.0019
GFC	0.000199	9.17E-05	2.165433	0.0401
SGER	0.009842	0.000175	56.28023	0.0000
C	3.222364	0.007002	460.2256	0.0000
B1999	0.031555	0.004113	7.671939	0.0000

R-squared	0.990328	Mean dependent var	3.586013
Adjusted R-squared	0.988781	S.D. dependent var	0.107527
S.E. of regression	0.011389	Sum squared resid	0.003243
Long-run variance	3.14E-05		

CANONICAL COINTEGRATION REGRESSION

Dependent Variable: LNY

Method: Canonical Cointegrating Regression (CCR)

Date: 01/28/17 Time: 12:15

Sample (adjusted): 1984 2013

Included observations: 30 after adjustments

Cointegrating equation deterministics: C B1999

Long-run covariance estimate (Bartlett kernel, Newey-West automatic bandwidth = 10.6125, NW automatic lag length = 3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BD	0.000514	0.000200	2.567741	0.0166
GFC	0.000201	8.88E-05	2.268695	0.0322
SGER	0.009862	0.000203	48.52111	0.0000
C	3.221658	0.005837	551.8959	0.0000
B1999	0.031317	0.004931	6.351265	0.0000

R-squared	0.990316	Mean dependent var	3.586013
Adjusted R-squared	0.988767	S.D. dependent var	0.107527
S.E. of regression	0.011397	Sum squared resid	0.003247
Long-run variance	3.14E-05		

COINTEGRATION TEST

HANSEN INSTABILITY COINTEGRATION TEST

Cointegration Test - Hansen Parameter Instability

Date: 01/28/17 Time: 12:16

Equation: UNTITLED

Series: LNY BD GFC SGER

Null hypothesis: Series are cointegrated

Cointegrating equation deterministics: C B1999 B2010

Lc statistic	Stochastic Trends (m)	Deterministic Trends (k)	Excluded Trends (p2)	Prob.*
0.113039	3	0	0	> 0.2

*Hansen (1992b) Lc(m2=3, k=0) p-values, where m2=m-p2 is the number of stochastic trends in the asymptotic distribution

Warning: number of trends and p-values do not account for user-specified deterministic regressors

ENGLE-GRANGER COINTEGRATION TEST

Cointegration Test - Engle-Granger

Date: 01/28/17 Time: 12:16

Equation: UNTITLED

Specification: LNY BD GFC SGER C B1999 B2010

Cointegrating equation deterministics: C B1999 B2010

Null hypothesis: Series are not cointegrated

Automatic lag specification (lag=3 based on Schwarz Info Criterion, maxlag=5)

	Value	Prob.*
Engle-Granger tau-statistic	-4.684618	0.0376
Engle-Granger z-statistic	60.39533	1.0000

*MacKinnon (1996) p-values.

Warning: p-values do not account for user-specified deterministic regressors.

PHILLIPS OULIARIS

Cointegration Test - Phillips-Ouliaris

Date: 01/28/17 Time: 12:16

Equation: UNTITLED

Specification: LNY BD GFC SGER C B1999 B2010

Cointegrating equation deterministics: C B1999 B2010

Null hypothesis: Series are not cointegrated

Long-run variance estimate (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

No d.f. adjustment for variances

	Value	Prob.*
Phillips-Ouliaris tau-statistic	-4.606013	0.0397
Phillips-Ouliaris z-statistic	-21.84056	0.0900

*MacKinnon (1996) p-values.

Warning: p-values do not account for user-specified deterministic regressors.

NON-LINEARITY TESTS

Dependent Variable: LNY
Method: Dynamic Least Squares (DOLS)
Date: 01/28/17 Time: 12:22
Sample (adjusted): 1985 2012
Included observations: 28 after adjustments
Cointegrating equation deterministics: C B1999 B2010
Fixed leads and lags specification (lead=1, lag=1)
Long-run variance estimate (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BD	0.002008	0.000877	2.289980	0.0478
GFC	0.000315	0.000148	2.137061	0.0613
SGER	0.009393	0.000640	14.67549	0.0000
BD^2	-6.35E-05	6.04E-05	-1.050966	0.3207
C	3.236037	0.015202	212.8713	0.0000
B1999	0.043656	0.010721	4.071902	0.0028
B2010	0.050025	0.016497	3.032374	0.0142

R-squared	0.997800	Mean dependent var	3.583344
Adjusted R-squared	0.993401	S.D. dependent var	0.099921
S.E. of regression	0.008117	Sum squared resid	0.000593
Long-run variance	3.23E-05		

BD-GFC INTERACTION DUMMY

Dependent Variable: LNY

Method: Dynamic Least Squares (DOLS)

Date: 01/28/17 Time: 12:28

Sample (adjusted): 1985 2012

Included observations: 28 after adjustments

Cointegrating equation deterministics: C B1999 B2010

Fixed leads and lags specification (lead=1, lag=1)

Long-run variance estimate (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BD	0.000304	0.001691	0.179550	0.8615
GFC	0.000290	0.000244	1.188956	0.2649
SGER	0.008661	0.000756	11.46073	0.0000
BD*GFC	4.35E-05	4.61E-05	0.945090	0.3693
C	3.253421	0.012048	270.0453	0.0000
B1999	0.054851	0.014251	3.848844	0.0039
B2010	0.042178	0.012817	3.290757	0.0094

R-squared	0.998105	Mean dependent var	3.583344
Adjusted R-squared	0.994314	S.D. dependent var	0.099921
S.E. of regression	0.007535	Sum squared resid	0.000511
Long-run variance	2.27E-05		

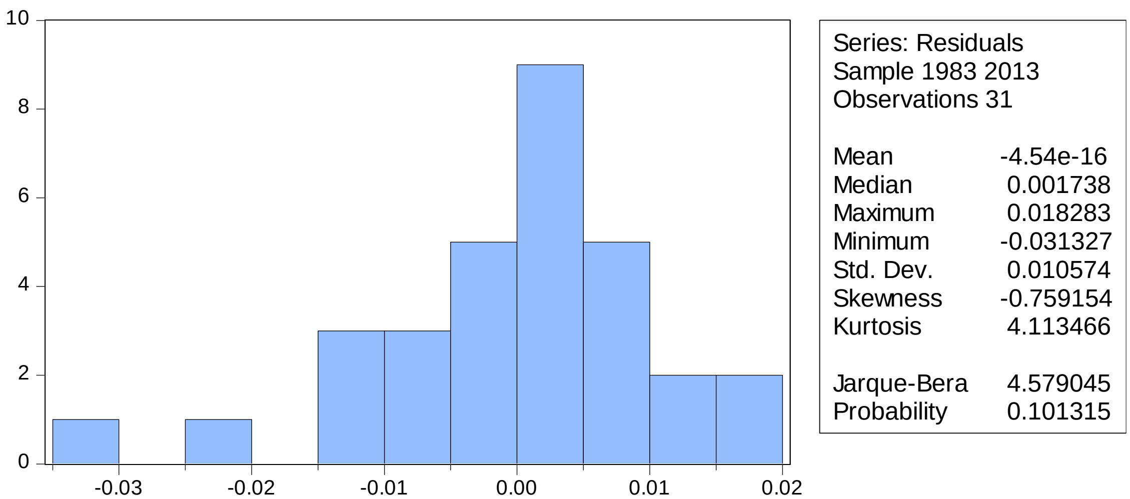
POST ESTIMATION TESTS

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.727280	Prob. F(2,23)	0.4940
Obs*R-squared	1.843884	Prob. Chi-Square(2)	0.3977

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.347242	Prob. F(5,25)	0.2774
Obs*R-squared	6.579946	Prob. Chi-Square(5)	0.2538
Scaled explained SS	6.661823	Prob. Chi-Square(5)	0.2470

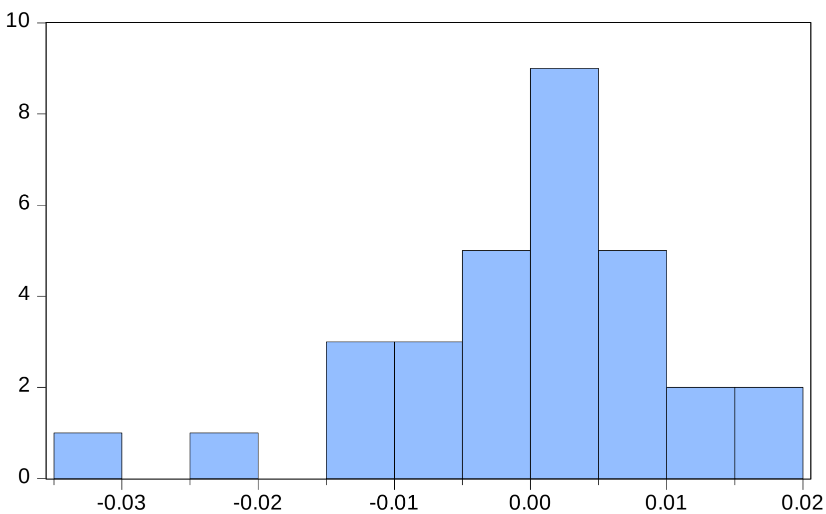


Ramsey RESET Test
Equation: UNTITLED
Specification: LNY BD GFC SGER C B1999 B2010
Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	0.941994	24	0.3556
F-statistic	0.887353	(1, 24)	0.3556
Likelihood ratio	1.125484	1	0.2887

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	0.000120	1	0.000120
Restricted SSR	0.003354	25	0.000134
Unrestricted SSR	0.003235	24	0.000135



Series: Residuals
Sample 1983 2013
Observations 31

Mean	-4.54e-16
Median	0.001738
Maximum	0.018283
Minimum	-0.031327
Std. Dev.	0.010574
Skewness	-0.759154
Kurtosis	4.113466
Jarque-Bera	4.579045
Probability	0.101315