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FISCAL POLICY AND ECONOMIC GROWTH NEXUS IN SADC COUNTRIES: A SPATIAL ECONOMETRIC APPROACH

BY

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DECLARATION

I hereby declare that this dissertation titled: "**Fiscal Policy and Economic Growth Nexus in SADC Countries: A Spatial Econometric Approach**" is my work, and sources that have been used are acknowledged by means of complete references. The work submitted is the result of my research and is original.

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APPROVAL

This dissertation has been examined and approved as meeting the requirements for the partial fulfillment of the Master of Arts (Economics) degree.

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DEDICATION

I dedicate this study to the Tseladikae family, especially my mother and sister, with Devotion and Affection.

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ABBREVIATIONS

AfDB: African Development Bank

ARDL: Autoregressive Distributed Lag

CCR: Canonical Cointegrating Regression

DOLS: Dynamic Ordinary Least Squares

ECM: Error Correction Model

FE: Fixed Effects

FMOLS: Fully Modified Ordinary Least Squares

GMM: General Methods of Moments

GSA: Global Spatial Autocorrelation

IMF: International Monetary Fund

LISA: Local Indicators of Spatial Autocorrelation

OECD: Organisation for Economic Co-operation and Development

OLS: Ordinary Least Squares

RE: Random Effects

SADC: Southern African Development Community

SAR: Spatial Autoregressive

SDM: Spatial Durbin Model

SEM: Spatial Error Model

S-GMM: System Generalized Methods of Moments

VAR: Vector Autoregressive

VECM: Vector Error Correction Model

WDI: World Development Indicators

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ABSTRACT

This study pursued an empirical investigation on the nexus between fiscal policy and economic growth in SADC countries with special reference to spatial analysis. Econometric approach employed in the study is based on the data spanning from 2000-2017 considering twelve countries in the SADC region. The study uses both the traditional and spatial econometric approaches to map channels through which fiscal variables affect economic growth considering individual countries and the region as a whole. The empirical evidence from the country-level analysis is mixed but substantial across economies. The Toda and Yamamoto causality followed for individual countries supports the adoption of different hypotheses to address fiscal variables. However, the panel causality test proposed by Dumitrescu and Hurlin (2012) suggested the use of the tax-spend hypothesis. The investigation of spillover effects through the spatial modelling suggested that tax revenue in the region negatively affected other contiguous countries due to spatial interaction. The recommendations were that the countries should adopt tax harmonization policies and that tax revenues and government spending decisions should be reconciled. Boosting economic growth for the region remains vital since it influences the evolution of debt levels.

Key Words: *Fiscal policy*, *tax revenues, government expenditures, public debt, economic growth, causality, spillover effects*

CHAPTER 1

INTRODUCTION

Understanding the trends of government revenues, expenditures and public debt is an integral part of the budgetary process and its impact on the economic growth for every economy. For instance, excessive and unsustainable budget deficits are believed to contribute to poor economic performance in Africa (Wolde-Rufael, 2008). The discrepancy between government revenues and expenditures has a negative effect on saving and investment decisions due to high real interest rates, high unemployment and slow capital formation (Darrat, 1998). Furthermore, financing persistent fiscal deficits aggravates the public debt problem, which negatively impacts economic growth.

The budget process phenomenon has gained a lot of attention from researchers and policymakers in developing and developed countries, intending to establish the relationship between government expenditures and tax revenues. The empirical findings from such investigations have theoretical and policy relevance (Narayan & Narayan, 2006).

Economists offer policy recommendations based on the application of tax-spend (Friedman, 1978; Buchanan & Wagner, 1978), spend-tax (Barro, 1974; Peacock & Wiseman, 1979), fiscal synchronization (Musgrave, 1966; Richard, 1981), and institutional separation hypotheses (Ram, 1988; Baghestani & McNown, 1994) to address the problem of slow economic growth. Similarly, the spending cut and no tax increase are sound fiscal adjustments to reduce deficits and debt-to-GDP ratio (Alesina & Ardagna, 2010).

Several studies have tested these theories through econometric procedures to determine causality (Darrat, 1998; Narayan & Narayan, 2006; Hamdi & Sbia, 2013; Mupimpila et al., 2015), the relationship between these variables remains unclear as there is no consensus. However, in some cases, the results are contradictory (Mupimpila et al., 2015). Some studies found mixed results on the impact of fiscal policy variables on economic growth (Barro, 1990; Barro & Sala-i-Martin, 1992; Connolly & Li, 2016; Quashigah et al., 2016). Engen and Skinner (1992) pointed out that fiscal policy stifles dynamic economic growth due to the distortionary effects of taxation and inefficient expenditures.

The relevance of spatial dependence has been pointed out in the Tobler`s Law which states that "Everything is related to everything else, but near things are more related than distant things" (Tobler, 1970 p. 236). This highlights the propensity for neighbouring countries to influence each other due to the behaviour of fiscal variables and hence regions cannot be treated in isolation. Fiscal policy decisions in one country are affected by changes in other countries (Case et al., 1993). Fiscal spatial spillovers exist due to fiscal shocks in one country which in turn impacts fiscal policies in other countries, especially when they share a border (Kopczewska et al., 2016). Furthermore, growth rates appear to depend on the growth rates of other neighbouring countries (Ertur & Koch, 2007).

The Southern African Development Community (SADC) is one of the regional communities that experiences persistently escalating government spending coupled with limited tax handles[1] and sluggish economic growth rates (African Development Bank [AfDB], 2018). This breeds sustained fiscal deficits that negatively affect growth. This study seeks to explore the causal relationship between fiscal policy variables in the SADC region then apply spatial econometric modelling techniques to further explore the size and significance of fiscal policy spillovers and economic growth.

[1] Musgrave defines tax handles as a term which appears to include varying opportunities to levy taxes as well as tax administration costs (Hettich & Winer, 1988)

1.1 Statement of the Problem

The economic performance of the SADC region remains subdued as the region faces a vicious cycle of high unemployment, fiscal strain, increasing debt and high inflation (AfDB, 2018). Furthermore, individual economies consist of little fiscal policy space in the current sluggish growth environment. The trajectory to attaining sustainable economic growth rates is limited by high dependency on volatile and declining Southern African Customs Union (SACU) revenues (AfDB, 2018).

According to the International Monetary Fund (IMF), the government expenditures as a percentage of GDP in 2019 for the region is 27.97 % (IMF, 2019). Hence the overall fiscal balance as a percentage of GDP stood at -5.15 % in 2019. This worrying economic environment is further aggravated by sizeable persistent government debt as a share of GDP. Moreover, due to spending pressures because of poor health indicators and insufficient infrastructure coupled with elevating public debt burden, the region faces an increasing possibility of debt distress (AfDB, 2018). In a nutshell, the region`s escalating expenditures are financed by limited domestic revenues thus breeding to outsized deficits, which negatively affect economic growth and undermines its sustainability.

Despite the mismatch between revenues and expenditures, the relationship between these fiscal policy variables and how they affect economic growth remains mixed and vague, and to some extent, unexplored in the region. Several studies considered the impact of tax revenues and/or government expenditures on economic growth in isolation. A growing body of literature has focused more on the causality of government revenues and expenditures to address the budget deficit problem (Eita & Mbazima, 2008; Raza et al., 2019). However, the results are contradictory and as of now, there is no consensus as to the optimal approach to solving the problem of budget deficits.

Up to now, far too little attention has been paid to the role of space (or geography) on how a country`s fiscal policy decision affects the economic growth of other regions due to contiguity. The present study takes a turn from previous studies and argues that spatial dependence is important to consider since observations are very likely not independent. As an illustrative argument, countries like Lesotho and Eswatini are overwhelmingly dependent on South Africa for their international trade. There are beneficial or harmful externalities that emerge from fiscal policies in one region on neighbouring regions (Geys, 2006). The spatial spillover effect is regarded as "…the impact of government policy in one country on the performance of other economies in respect to the distance in space" (Kopczewska et al., 2017, p. 78).

The region`s inability to meet initial convergence towards economic integration is due to heterogeneity and overlapping regional memberships (Ade et al., 2018). The existence of competition amongst countries to boost local economies forces many countries to react to neighbours' fiscal policy decision. Thus, a focus on spatial aspects of the SADC region instead of other countries is not without merit since the SADC region aims at regional integration despite the looming debt distress. Thus there is a need for policy harmonization to support other member states for a common goal.

1.2 Objectives

This study's broad objective is to establish the relationship between fiscal variables and spatial spillover effect on economic growth for the SADC region.

Specific objectives are to;

a) Analyze the relationship between fiscal policy variables and economic growth
b) Determine the causality between the fiscal variables and economic growth
c) Determine whether there are spatial interdependencies in SADC
d) Investigate the magnitude and significance of fiscal variables spillovers on economic growth

1.3 Hypothesis

a) There is no Impact of government revenues, government expenditures and public debt respectively on economic growth

b) There is no causality between fiscal variables and economic growth

c) Spatial interdependencies between expenditure and economic growth in the region exist.

1.4 Justification of the Study

Numerous studies have tried to answer how fiscal policy variables relate (Narayan & Narayan, 2006; Raza et al., 2019) and their effect on economic growth (Lien & Thanh, 2017). Notably, studies considered the economic growth of a specific country or several countries as the dependent variable and considered country-specific factors as independent variables. However, the known studies employed the traditional econometrics approaches that do not consider the effect of geographical space following Tobler's law of geographic contiguity. Thus, the studies have not dealt with the influence of location in their analysis. Therefore, considering contiguousness is crucial due to the existence of spatial dependencies between regions. Moreover, studies that evaluated panel causality between government expenditures, revenues, public debt, and economic growth are concentrated on developed countries with a paucity of literature on developing countries despite the debt distress that they are faced with.

The present study particularly intends to address the literature gaps by considering how fiscal policy decisions in one country affect other countries' economic growth. These are achieved by adopting spatial panel data modelling techniques. Moreover, the study will investigate the causality between the fiscal variables and economic growth by adopting a multivariate econometric model based on the Vector Autoregressive model. There is still no consensus about the relationship between public debt and economic growth. Therefore, public debt is included as an additional variable. Thus contribute to the literature for developing countries` studies.

Concluding Remarks: The relevance of fiscal variables on economic growth cannot be overlooked, especially in the SADC region. The SADC region is experiencing escalating expenditures, high public debt, and low tax revenue coupled with subdued economic growth rates. This study`s primary goal is to consider the persistent heterogeneity in the SADC region and establish whether spillover effects in the region promote or undermine the regional integration efforts. The subsequent chapter describes the behaviour of fiscal variables and economic growth in the SADC region.

1.5 Organisation of the Study

The study is organized as follows. The first chapter introduces the study. In this chapter, the research problem, objectives and the rationalization of the study are deliberated. Chapter two discusses the fiscal behaviour and economic growth in the SADC region. The subsequent chapter discusses the theoretical and empirical literature review of prior studies examining the relationship between fiscal variables and economic growth at both country level and panel data analysis. Chapter four presents the model to be estimated and the estimation techniques to be employed. The following chapter presents the empirical results and provides a detailed discussion of the results, whereas chapter six entails the concluding remarks and recommendations of the study.

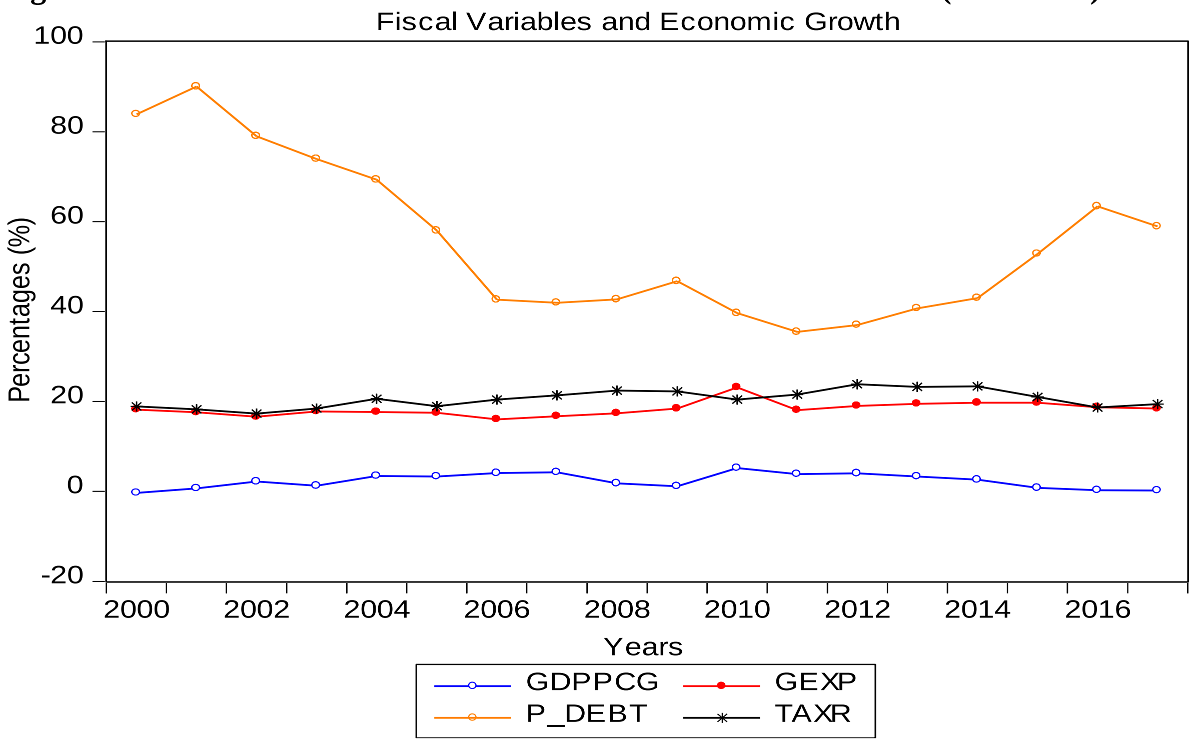
CHAPTER 2

FISCAL BEHAVIOUR AND ECONOMIC GROWTH IN THE SADC REGION

2.1 Introduction

The behaviour of fiscal variables and economic growth among the countries raises general issues that arise due to heterogeneity among the SADC countries. The composition of government expenditure and level of government debt across the region influence economic growth. Thus, a spatial visualization of fiscal variables and economic growth in the region is discussed in the following section. Moreover, there is an examination and comparison of public debt levels in the region compared to other African trading blocs. Furthermore, it provides a brief discussion of the region.

Figure 2.1: Economic Growth and Fiscal Variables Trends in SADC (2000-2017)



Source: author`s computations

The individual years are computed from the average of all member states. Where GDPPCG, GEXP, P_DEBT and TAXR represent GDP per capita growth, Government expenditure, Public Debt and Tax revenue respectively.

The annual average public debt as a percentage of GDP for the region declined from 90% in 2001 to 43% in 2006 and increased to 63% in 2016. The subsequent years show that debt levels decreased and grew until it peaked at 63% in 2016. The general trend for the debt levels indicates that the debt levels from 2009-2013 were average at 36% of GDP during the post-recession period, whereas in the subsequent years from 2014-2018, the levels hurdled to 50%. The public debt levels remained stable from 2016-2018 at an average of 54% (SADC, 2019). Several developed and developing countries have experienced persistent government budget deficits and fiscal positions deteriorated due to limited fiscal space. Therefore, the region is within its macroeconomic convergence target of 60%. The average tax revenue remains subdued at an average of 24% for the sample period. While tax revenue remains low, the evidence from figure 2.1 suggests that government expenditure remains relatively lower than tax revenues. Post-global financial crises, the expenditure level increased to 23% in 2010. The expenditures were possibly ideal for boosting local economies. The economic performance of the region remains at 4.5% reaching 1% during the financial crises. The general view from figure 2.1 indicates that prudent fiscal policy can be an impetus for the country's welfare. The individual averages of each country will be discussed later.

2.2 Heterogeneity within the region: The SADC region is faced with socio-economic factors such as low life expectancy, poor infrastructure, high infant child mortality and morbidity, high unemployment, and HIV/AIDS among others. This is typical of the African socio-economic profile. The SADC member states employ different policies to tackle socio-economic challenges. These competitive strategies promote excessive heterogeneities in the region. Figure A1 found in the appendix shows that several countries in the SADC region spend around 10%-26% while only Lesotho spends above 30%. There is no evidence of a linear relationship between economic growth and government expenditures. Figure A2 shows an inverse relationship between economic growth and public debt in the SADC region, with Mozambique being an outlier. Interestingly, figure A4 shows a positive relationship between tax revenues and government expenditures in the SADC region. The countries that collect more tax revenues tend to spend more. Lesotho is an outlier since its government expenditures and tax revenue surpass other member states.

Table 2.1 present the sample average of real GDP per capita growth, public debt, government expenditures, and tax revenue for SADC countries.

Table 2.1: Economic Growth and Fiscal Variables Sample Average, (2000-2017)

COUNTRY	Ln(GDP)[1]	PDEBT[2]	GEXP[3]	TAXR[4]	POP[5]
Angola	2.58	40.74	21.27	33.41	30.81
Botswana	2.39	29.26	19.87	23.45	2.25
DRC	1.44	77.32	12.26	6.89	84.07
Eswatini	2.52	18.92	19.54	23.38	1.14
Lesotho	3.33	51.03	35.76	39.91	2.11
Malawi	1.48	53.25	10.82	12.09	18.14
Mozambique	4.05	123.05	17.84	14.53	29.50
Namibia	2.58	41.25	23.46	28.66	2.45
South Africa	1.46	36.65	19.74	24.95	57.78
Tanzania	3.42	39.72	15.02	9.80	56.32
Zambia	3.24	79.09	12.11	14.75	17.35
Zimbabwe	-0.49	75.81	12.31	15.93	14.44
SADC	2.31	55.51	18.33	20.65	316.36

Source: author`s computations

[1]Real GDP per capita growth, [2] Public debt as a percentage of GDP, [3]Government expenditure as a percentage of GDP, [4]Tax revenue as a percentage of GDP, and [5]Total population (in millions) as at 2018

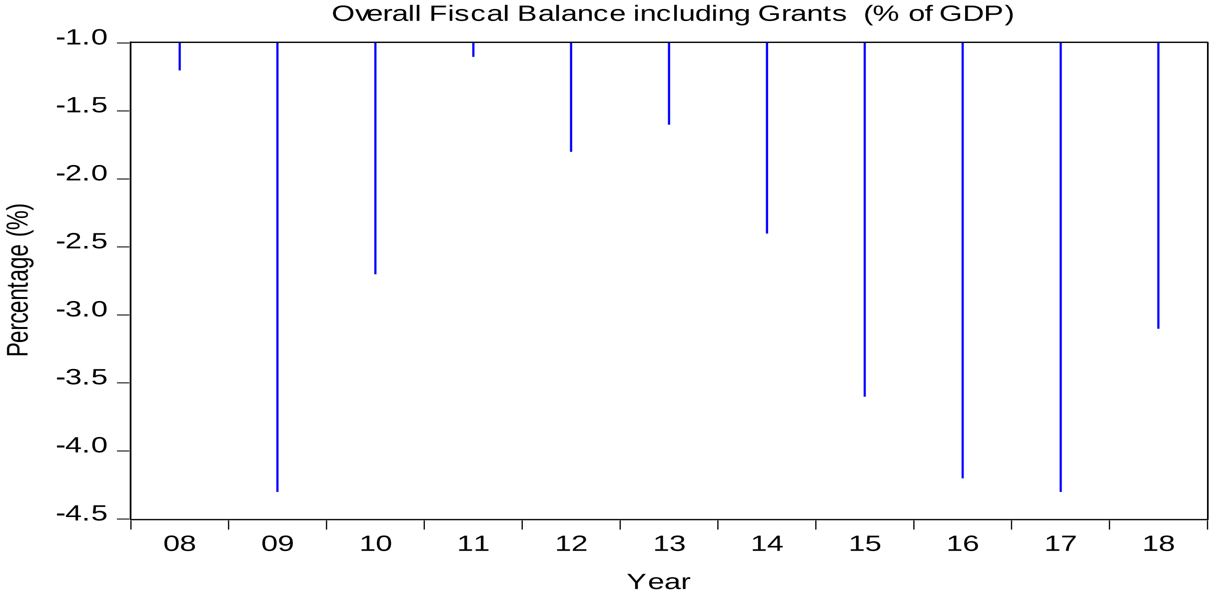
**The data for the total population is from World Bank database for 2018.*

The evidence from the table suggests that the average range of real GDP per capita is 4.54 %. Most countries` average percentage economic growth rates ranges between 1% and 4%, Zimbabwe experienced negative growth rates, whereas Mozambique recorded the highest positive growth rate in the region. The average economic growth for the region is 2.31%. The average public debt level stands at 56%. Out of which, 58% of the SADC countries experience more than 50% average debt levels for the considered sample. Average debt levels above 70% are recorded for DRC, Mozambique, Zambia, and Zimbabwe.

On average, the region`s tax revenue is marginally greater than government expenditures. Although this is plausible, the closeness in terms of differentials between tax revenue and government expenditures is still a concern for budgetary purposes. Lesotho`s average government expenditures are the highest in the region with almost 36%, while almost 92 % of the SADC countries` average government expenditures are less than 30%. Moreover, Lesotho`s tax revenue is nearly 40% and the highest in the region followed by Angola and Namibia respectively. Tanzania and DRC recorded less than 10% average tax revenues over the sample period. Government revenue in 2017 and 2018 was 23% and 24.1%, respectively (SADC, 2019). In 2008 the revenues peaked at almost 30% and the general trend shows a consistent yearly decline over the years. The IMF (2019) classified Botswana, Eswatini, South Africa, and Tanzania as debtors and the remaining countries included in the sample as creditors.

The region`s population was around 316.36 million in 2018. DRC has the highest population in the region at around 27% of the regional population. Eswatini has the lowest population that accounts for around 0.36% of the regional population. Against the total regional population, tax revenue remains very low coupled with marginally lower expenditures as evidenced by the table. However, debt levels are persistently high associated with depressed GDP per capita growths. Despite the heterogeneous population in each country, tax revenue remains low as indicated earlier; this might be motivated by limited tax handles, high unemployment, and dominant informal sector. As the economy gets more formalized, the ability to collect revenues is enhanced.

Figure 2.2: Overall Fiscal Balance including Grants in SADC, (2008-2018)



Source: author's computation
**Data were taken from (SADC, 2019)*

The disparity between government revenues and expenditures is reflected in figure 2.2. The trend indicates that from 2011 to 2017 government expenditures exceeded tax revenues. The region experienced serious budgetary issues from 2015 to 2017 recording 4.3% budget deficits that declined to 3.1% in 2018. The budgetary issues were prominent in 2009 following the 2008/09 financial crunches. However, the budget improved the subsequent years in 2010 and 2011 as the economies recovered. The 2008/09 economic downturn burden heavily impacted Botswana`s fiscal stance compared to other members (SADC, 2019). The region has progressed well toward curbing budget deficits from 2010 to 2014. Despite the budget improvement, the overall fiscal balance deteriorated in recent years (2015-2017).

2.3 Visualization of SADC Fiscal Variables and Economic Growth: The consideration of spatiotemporal is critical to explore the role of space in the evolution of fiscal variables and economic growth in the SADC region. The SADC percentile map[2] shows that Mozambique has the highest average economic growth in the region. South Africa, Eswatini, DRC, Zambia, and Malawi experienced average growth rates between 10 and 50 percentiles indicating low

[2] The maps used for visualizations are in the appendix map B1

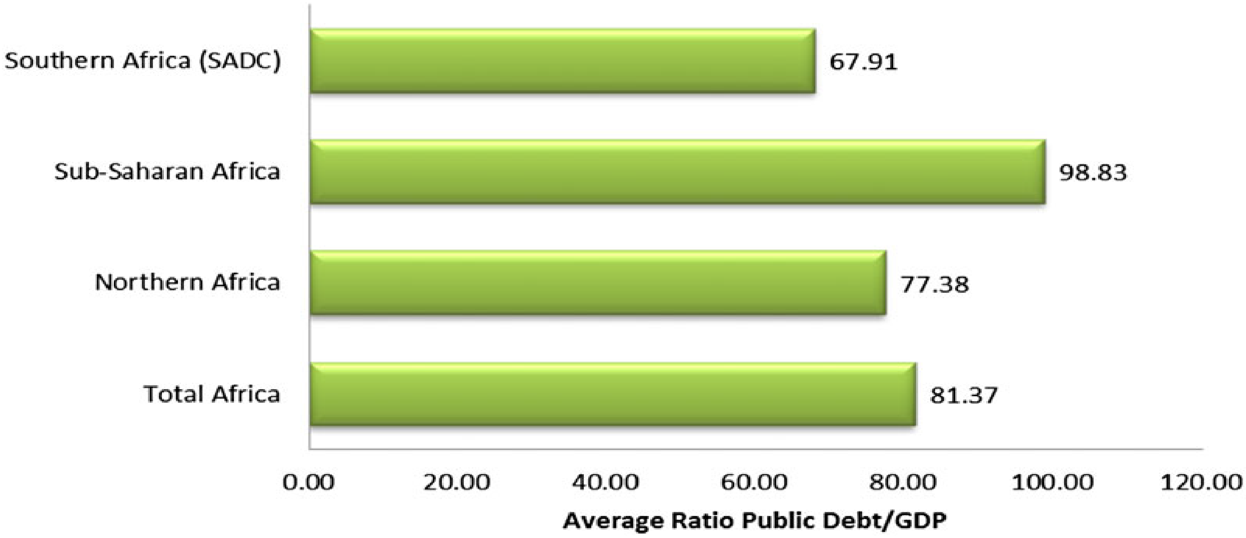
average growth rates. The average economic growth episodes between 50 and 90 percentiles are found for Tanzania, Angola, Namibia, Lesotho, and Botswana. In contrast, Zimbabwe recorded the slowest average economic growth.

Concerning government expenditure distribution in the region, Lesotho recorded the highest percentage values of expenditures. In contrast, five countries (DRC, Tanzania, Zambia, Zimbabwe, and Mozambique) recorded moderate average expenditures in the northeast region. Furthermore, five countries in the southwestern part of the region displayed higher values of expenditures. The evidence from the map indicates that Malawi, on average, spends the lowest as compared to its counterparts. The heterogeneity in expenditure patterns can be due to individual countries` fiscal rule and prioritization. The visualization of government expenditure for the SADC region is plausible because countries close to each other tend to experience similar expenditure patterns. However, distant countries will have different expenditures patterns.

The average debt levels in the region are notably high, as shown in Table 2.1. The map shows that extreme public debt levels are observed for Mozambique, whereas Eswatini has the region's lowest debt levels. Countries with pronounced debt levels include Lesotho, Zimbabwe, Zambia, Malawi, and Democratic Republic of Congo (DRC). The remaining countries are within the 10 and 50 percentile category.

Lesotho has the highest tax revenues and DRC recorded the lowest tax revenues as a percentage of GDP in the region. On average Mozambique, Zimbabwe, Malawi, Tanzania, and Zambia record the lowest tax revenue after DRC. The remaining countries recorded high tax revenues. The overall evidence indicates a need for improved tax handles to raise more revenues for the countries. These lagging tax handles are apparent for several African countries, thus engendering sluggish economic growth in several countries.

Figure 2.3: Ratio of Public Debt to GDP for African Economies by Geographical Areas

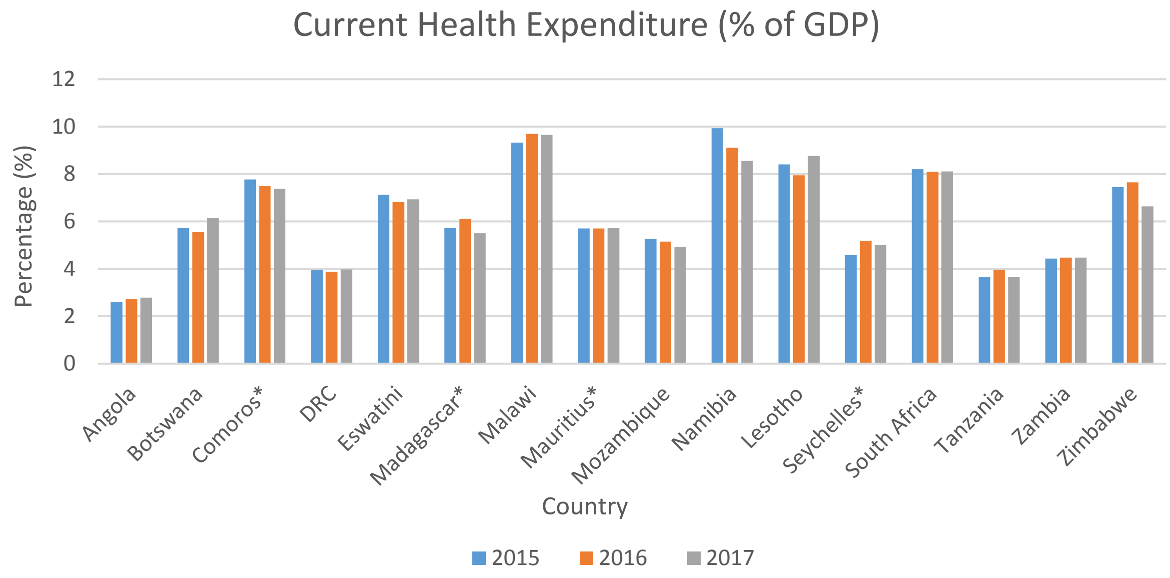


Source: Da Veiga et al. (2016, p. 303)
**Sub-Saharan Africa excludes SADC and Comoros is not among SADC countries*

Figure 2.3 shows the average ratio of public debt to GDP for African economies by geographical areas. It is crucial to mention that the Sub-Saharan Africa (SSA) region has the highest debt-to-GDP ratio (98.83%). The SADC region's public debt to GDP ratio is almost 68%, with a 31% difference from Sub-Saharan Africa. Low levels of Public debt-to-GDP ratio are observed from Northern Africa as compared to SSA. The evidence from time series data from 1950 to 2012 suggests that public debt-to-GDP stands at almost 81%. The public debt crises and the inherent fiscal deficit constitutes a concern in African economies, particularly in SSA, where the persistent fiscal deficit is stimulated by uncontrolled public expenditures (Da Veiga et al., 2016).

2.4 Composition of Government Expenditure: Governments in the region differ considerably in size and expenditure priorities. The member states countries adopt both monetary and fiscal policy to boost local economies for economic growth prospects. On the fiscal policy side, several governments prioritise education, health, and military expenditures.

Figure 2.4: Average Public Health Expenditure in SADC



Source: author's computation
**Countries not considered for further investigation*
Data sourced from World Health Organization (WHO)

Health expenditure as a percentage of GDP for Malawi is the highest in the region at an average of almost 10%, as shown in figure 2.4. The share of health expenditures for Namibia declined from 10% to 8% over the period. Current health expenditures for Angola, Botswana, DRC, Madagascar, Mauritius, Mozambique, Seychelles, Tanzania, and Zimbabwe remained less than 6% share of GDP. Comoros, Lesotho and South Africa recorded 8% health expenditure as a percentage share of GDP over the period. The expenditures are below the Abuja declaration commitment that each country should pledge 15% of expenditures on health. SADC's health profile is characterized by a high child mortality rate, Malaria, HIV/AIDS, and poor health systems. This appeals to the Keynesian proposition to the health sector in the region. The recent COVID-19 pandemic raises awareness for improving and strengthening the health system by increasing expenditures on the public health sector. This is a clarion call to the global society. Health expenditure reflects domestic resource mobilization and the degree of prioritization to health (Piatti-Fünfkirchen et al., 2018).

Concluding Remarks: The behaviour of fiscal variables and economic growth has been examined utilizing trends. This behaviour is also visualized on a regional map to show a pictorial view of tax revenues and expenditure patterns of the adjacent countries in the SADC. Furthermore, the region's economic characteristics have been discussed to reflect the heterogeneity in the region. The trends show that government expenditures and public debt has been increasing over time, whereas economic growth remained subdued. The following chapter will present the literature on the relationship between fiscal variables and economic growth.

CHAPTER 3

LITERATURE REVIEW

3.1 Introduction

A view of the behaviour of fiscal variables and economic growth in the SADC region discussed in chapter two leads to the review of previous studies that pursued an investigation of the relationship between fiscal variables and economic growth. In this chapter, there is a formal introduction of both the theoretical and empirical literature review. The chapter provides an intuitive discussion of the research gaps from the previous literature on how fiscal variables relate to economic growth. This study's analytical framework is based on examining what has been done in the last literature and occupying the identified gaps.

3.2 Theoretical Literature Review

Fiscal Synchronization Hypothesis: The hypothesis was pioneered by Musgrave (1966) and Richard (1981), who suggested that taxes and spending decisions are determined simultaneously. That is, there is bidirectional causality between these variables. The public simultaneously determines the levels of government revenues and expenditures by contrasting their marginal benefits and marginal costs of government services (Darrat, 1998). According to Mehrara *et al.* (2011, p. 200), “Barro`s (1979) tax smoothing model provided further credence to the fiscal synchronization hypothesis”.

Spend-and-Tax Hypothesis: The hypothesis was pioneered by Barro (1974) and Peakcock and Wiseman (1979), suggesting that an increase in government expenditure will ultimately lead to higher revenues (Demirhan & Demirhan, 2013). They pointed out that any large-scale exogenous turbulences like wars and unstable political conditions will prompt an increase in government spending and consequently increase in revenues through taxation. There is unidirectional causality from government expenditures to revenues. Keho (2010) indicated that this hypothesis fits well with Barro`s view that today`s deficit-financed spending means increased tax liabilities in the future.

Tax-and-Spend Hypothesis: The hypothesis was established by Friedman (1978) and Buchanan and Wagner (1978). The theory indicates that causality runs from government revenues to expenditures. Nonetheless, the two pioneers had different views about the causal relationship. Buchanan and Wagner (1978) postulated a negative causal relationship, whereas Friedman purported that the causal relationship was positive. These diverging views led to two different ways to correct deficits. Friedman contends that raising taxes will only breed imbalances thus can be corrected by cutting on taxes. However, Buchanan and Wagner argue that a decline in taxes will foster an illusionary belief in the public, leading them to wrongly perceive government programs' actual cost (Petanlar & Sadeghi, 2012).

Institutional Separation/Fiscal Neutrality Hypothesis: This hypothesis suggests no causation between government revenues and expenditures. Empirical evidence supporting the institutional hypothesis was found by Ram (1988) for the case of India, Paraguay, and Panama (Demirhan & Demirhan, 2013). Baghestani and McNown (1994) explicitly pointed out that government revenues and expenditures are unrelated. This may lead to the budget deficit if expenditure rises above revenues.

Government Expenditures and Economic Growth: Several theories have been proposed to explain how fiscal policy affects growth. These include the Keynesian hypothesis, Wagner`s Law, and Barro`s growth model, among others. The government is an influential target required to incentivize aggregate demand during high unemployment rates (Keynes, 1936). Thus an increase in government expenditures (exogenous variable) would lead to a rise in national income.

Wagner (1883) treated public expenditure as an endogenous variable. Wagner`s law indicated that increasing state activities through increased expenditures resulted from economic growth. Therefore, expenditures are a function of national income. Moreover, as the economy grows, the public sector will grow faster than the private sector. Wagner state that with economic growth, urbanization and industrialization would lead to an increase in government expenditures. Moreover, an increase in national income will stimulate demand for basic infrastructure. Wagner's approach implies that public expenditure growth is a spontaneous consequence of economic growth (Dritsaki & Dritsaki, 2010).

In the line of endogenous growth models, the Barro`s (1990) economic growth model with public goods incorporates the government sector (fiscal policy) to explain growth (Barro & Sala-i-Martin, 1992). Public services are viewed as productive inputs in the private sector, leading to the emergence of the government's connection and economic growth (Barro, 1990). Moreover, externalities associated with public expenditures and taxes might lead to a suboptimal private valuation of savings and economic growth (Bleaney et al., 2001).

Public Debt and Economic Growth: Through the Keynesian framework, public debt can be perceived as a stimulus for aggregate demand and output in the short-run. However, in the long-run, there is the crowding-out effect on capital and reduces output. High public debt leads to disinvestment due to an increased long-term interest rate, which translates to low economic growth. Moreover, high debt constrains the extent of countercyclical fiscal policies, which lead to volatility and low growth rates (Kumar & Woo, 2010). Reinhart and Rogoff (2010) investigated the relationship between public debt levels and growth. They found that the relationship between public debt and growth is weak and similar across emerging markets and advanced economies.

3.3 Empirical Literature Review

The relationship between government revenues, expenditures, public debt, and economic growth has ignited great attention to researchers in recent years (Perotti, 2004; Reinhart & Rogoff, 2010; Stoilova & Patonov, 2012; Ash et al., 2017; Lupu et al., 2018).

Government Expenditure and Economic Growth: Using data for UK, Greece and Ireland from 1960-1995, Loizides and Vamvoukas (2005) offer an extensive analysis of the causal relationship between government expenditures and economic growth within the framework of trivariate causality testing. They found that causality runs from government expenditures to economic growth for UK and Ireland except for Greece that supports the reverse causation.

An Autoregressive-Distributed lag (ARDL) model was employed by Lupu *et al.* (2018) to examine the impact of public expenditures on growth in a sample of 10 selected European countries using quarterly data from 1995-2015. The results indicated that expenditures directed towards education and healthcare positively impacted the economy, whereas expenditures on general spending and social welfare have a negative impact.

Connolly and Li (2016) applied GMM for 34 OECD panel data spanning from 1995-2015 and finds that government consumption expenditure and public investment has no significant effect on growth. However, public social expenditures have a negative impact on economic growth. Sáez *et al.* (2017) utilized a panel regression for the European Union (EU) and found no clear relationship between government expenditure and growth throughout 1994-2012.

Chu *et al.* (2018) compared a panel of high income against low to middle-income economies using panel data spanning from 1993-2012. The findings based on the OLS fixed effects and GMM models suggested that a shift of expenditures from non-productive to productive expenditures are pro-growth. Gumus and Mammadov (2019) applied the Dynamic Ordinary Least Squares (DOLS) and the Vector Error Correction model and finds a positive relationship between growth and government expenditures from a panel data spanning from 1990-2016 for Caucasus countries.

Mazorodge (2018) employed a battery of econometric tests on annual data spanning from 1979-2017 for Zimbabwe and observed that government expenditures improve economic growth. Thabane and Lebina (2016) for Lesotho applied ARDL bounds test on annual time series data from 1980-2012 and found a stable long-term relationship between economic growth and government expenditures. Moreover, there is evidence of Wagner`s law in Lesotho.

To study the effects of fiscal policy on economic growth in OECD considering different sample periods for five countries, Perotti (2004) employed the Structural Vector Autoregression (SVAR) approach and observed that tax cuts do not work faster or more effectively than spending. Generally, the effects of fiscal policy on economic growth were small.

Kweka and Morrissey (2000) found that increased productive expenditures have a negative impact on growth whereas consumption expenditures have a positive effect on the Tanzanian economy from 1965 to 1996. A unidirectional causality running from economic growth to government expenditures was found for South Africa, supporting the Wagnerian proposition (Menyane & Wolde-Rufael, 2012; Odhiambo, 2015; Molefe & Chonga, 2017). However, Ziramba (2008) concluded that the proposition is not supported in the South African economy.

The evidence from adopting ARDL for Botswana on the data spanning from 1985-2016 by Amusa and Oyinlola (2019) suggested that total expenditure negatively affect economic growth in the short run. However, the relationship is positive in the long run. Furthermore, recurrent and development expenditures have a significant positive impact on economic growth. However, the positive impact is only observed for recurrent expenditure in the long run. Expansionary fiscal policy was found to be instrumental in achieving faster economic growth in Namibia from 1980-2015 (Shafuda & De, 2020).

Tax Revenues and Economic Growth: Trends in the distribution of the total tax burden in twenty-seven European Union (EU) member states for the period spanning from 1995-2010 was examined by Stoilova and Patonov (2012) and found that tax structures reliant on direct taxes are more efficient in supporting economic growth.

The effects of a tax increase on the economic growth of 47 developing countries were examined by Nantob (2014), who used a system GMM estimator on the panel data spanning from 2000-2012. The result established a non-linear relationship between economic growth and taxes. Adopting a more robust two-step system GMM for a panel data spanning from 2000-2015 for developed and developing countries, Lien and Thanh (2017) find that the impact of tax revenue and spending are mixed and substantial.

Utilizing the VAR and VECM models, Quashigah *et al.* (2016) disaggregated government expenditures to model the relationship between expenditures, revenues, and growth for Ghana and discovers that tax revenue, investment, and transfer payments positively affected economic growth. Egbunike *et al.* (2018) employed a regression analysis and found that tax revenue positively affects gross domestic product for Ghana and Nigeria for 2000-2016. Khumbuzile and Khobai (2018) utilizes ARDL for South Africa for the period 1981-2016 and find a negative relationship between taxes and economic growth.

Government Revenues and Expenditures: Investigating the relationship between fiscal policy and economic growth for Portugal, Italy, Ireland, Greece and Spain using time series data from 1995-2009, Hamdi and Sbia (2013) used the Toda and Yamamoto (hereafter TY, 1995) procedure and found the presence of fiscal synchronization hypothesis for Portugal. Tax-spend for Greece and unidirectional causality from government revenues to GDP for Italy. Chang and Chiang (2008), using panel data of 15 OECD countries from 1992-2006, find a bidirectional relationship between government expenditures and revenues within the Vector Error Correction model.

Narayan and Narayan (2006) applied TY procedure for 12 developing countries and found the tax-spend hypothesis (Mauritius and Chile), fiscal synchronization (Haiti) and institutional separation (Peru, South Africa). Wolde-Rafael (2008) adopted the TY causality test, which found mixed results for 13 African countries. The results suggested fiscal synchronization for Mauritius, Swaziland, and Zimbabwe. The institutional separation was found for Botswana, Burundi, and Rwanda. The tax-spend hypothesis was found for Kenya, and the spend-tax hypothesis was discovered for Burkina-Faso.

Demirhan and Demirhan (2013) employed the TY procedure using annual data from 2000-2010 and finds a tax-spend hypothesis in Turkey. Fiscal synchronization was established by Raza *et al.* (2019) for Pakistan using the Non-linear ARDL on annual data spanning from 1972-2014. Saungweme (2013) applied multivariate models for Zimbabwe using annual data traversing from 1975-2004 and finds the spend-tax hypothesis.

Fiscal synchronization was found in Ghana by Takumh (2014), who used the ARDL bounds testing procedure for cointegration on data spanning from 1986-2012. Nwosu and Okafor (2014), using the VAR model, find the spend-tax hypothesis for Nigeria. The presence of the tax-spend hypothesis was found in Namibia by Eita and Mbazima (2008), who test causality within the cointegrated VAR method for 1977-2007.

Through the utilization of quarterly data spanning from 1991-2009, Masenyetse and Motelle (2012) find a unidirectional causality from revenue to expenditure by using the Granger causality test and ECM. Sere and Chonga (2017) find the institutional separation hypothesis for South Africa for 1980-2015 using the VECM. A unidirectional causality running from tax revenue to government expenditure was found by Moalusi (2004) by applying the bivariate and multivariate models for Botswana from 1976-2000. Mupimpila *et al.* (2015) employed the multivariate models and finds the tax-spend hypothesis for Botswana from 1995-2010.

Public Debt and Economic Growth: Reinhart and Rogoff (2010) employed a new multi-country historical data on public debt and economic growth for 44 countries spanning 200 years. They found that the relationship between public debt and growth is weak and similar across emerging markets and advanced economies. However, a high debt-to-GDP ratio above the estimated thresholds is associated with lower growth outcomes. Lower levels of external debt-to-GDP lead to adverse effects on growth, particularly in emerging markets. However, Herndon *et al.* (2014) found that data coding issues lead to erroneous average results of Reinhart and Rogoff (2010) when debt levels are above 90% debt threshold. They indicated that the corrected growth rate when debt levels are above 90% is 2.2% rather than -0.1%, formerly reported in Reinhart and Rogoff (2010). Nonetheless, they maintained that high debt levels are associated with slower growth.

Checherita-Westphal and Rother (2011) applied panel regression analysis for twelve euro area over 40 years and found a non-linear impact of debt on growth with a thresh-hold (90-100% of GDP) beyond which public debt-to-GDP ratio has a negative effect on growth. Cecchetti *et al.* (2011) also find that at moderate debt levels economic growth is enhanced for 18 OECD countries from 1980-2010. However, beyond a particular tolerable level, debt has an adverse impact on growth. A regression analysis study based on a panel of 38 advanced and emerging economies for the period of 1970-2008 by Woo and Kumar (2015) indicated that high initial public debt is associated with slower subsequent growth.

Panizza and Presbitero (2012) used an instrumental variable approach on the sample of OECD countries and found a negative correlation between debt and growth. Egbetunde (2012) utilised the Vector Autoregressive (VAR) to examine the causal nexus between public debt and economic growth for Nigerian from 1970-2010. The study found bi-directional causality between public debt and economic growth. Kharusi and Ada (2018) employed the Autoregressive Distributed Lag cointegration approach on time series data from 1990-2015 and found a negative relationship between external debt and growth for Oman. Roşoiu (2019) employed the Vector Autoregressive model on time series data spanning from 1995-2020 for the Romanian economy and finds that economic growth is stimulated by public debt. However, the unmonitored increase has a negative impact on the economy.

A negative relationship between external debt and economic growth was found for Zimbabwe (Matandare & Tito, 2018; Munzara, 2015). Senadza *et al.* (2018) found that external debt adversely affects economic growth for Sub-Saharan Africa. Abdelaziz *et al.* (2019), using data spanning from 2000-2017 for 22 developing countries, found evidence from the seemingly unrelated regression model that external debt significantly decreases economic growth. While several studies suggested a unidirectional causality running from public debt to economic growth, Ash *et al.* (2017) found little evidence of a negative relationship. They cited that causality runs from economic growth to public debt than the reverse for 22 developed countries.

Spatial Effect: In a different dimension of spatial modelling, Karjoo and Sameti (2015) examined the spatial effect of government expenditures on economic growth in the United States of America from 2006-2009 using the geographic aspect to global regression models. The results showed that government expenditures do not affect economic growth. However, growth of each state was influenced by the growth of contiguous states.

A study on Ecuador regions by Flores-Chamba *et al.* (2019) applied the Spatial Durbin Model (SDM) with fixed effects on spatial economic convergence and public expenditure for 2001-2015 found the slight process of convergence per capita and productivity. Ojede *et al.* (2018) employed the dynamic Spatial Durbin Model using 48 contiguous U.S states. They found that productive government expenditures positively affect economic growth in both the short-and long-run direct effect and the indirect spillover effects. Kopczewska *et al.* (2017), through the Spatial Durbin Model found that taxes have a negative and significant local impact on economic growth. In contrast, external spillover impact gives positive stimuli on economic growth for 34 European countries from 2002 to 2011.

Goujard (2013) indicated that episodes of fiscal policy actions in OECD are found to have spillovers on growth. The spillovers are large between countries that belong to a currency union, and GDP growth is reduced when trading partners amalgamate. In a similar vein, Auerbach and Gorodnichenko (2013) document that fiscal stimulus in one country of the OECD bloc has spillover effects in other countries. Segura (2017) utilized the dynamic spatial Durbin model for 48 contagious American states from 1977-2012 and finds local fiscal policy is growth deterrent. Positive shocks to fiscal variables in a particular country are pro-growth to contiguous states.

Concerning state taxes and spatial misallocation, Fajgelbaum *et al.* (2015) found that a revenue-neutral harmonization is pro-growth. In contrast, individual states' tax cut adversely impacts on own-state tax revenues and economic activity, thus generating contiguous spillovers provisional on trade links. Through the use of a system generalized method of moments (S-GMM) for 31 developing countries from 1970-2005, Daud and Podivisky (2012) find that accumulation of external debt stifles economic growth. However, countries are free from the debt overhang hypothesis. Furthermore, there is evidence of spatial dependence, suggesting a positive spillover effect of growth among contiguous countries.

3.4 Literature Review Synthesis

Many studies tested different theoretical underpinnings using different econometric approaches to establish the relationship between fiscal variables and economic growth. The reviewed studies show that the relationship between expenditures and economic growth is not clear (Sáez et al., 2017; Perotti, 2004; Connolly & Li, 2016). However, some argue that the relationship is positive (Gumus & Mammadov, 2019; Mazorodge, 2018). In contrast, Lupu *et al.* (2018) argue that expenditure on education and health positively affect economic growth and expenditure on general spending will negatively affect economic growth. On the other strand of the literature, empirical evidence indicated a positive relationship between tax revenues and economic growth (Stoilova & Patonov, 2012; Quashigah et al., 2016).

The causality between government expenditures and tax revenues is mixed (Hamdi & Sbia, 2013; Narayan & Narayan, 2006; Mupimpila et al., 2015; Raza et al., 2019). The relationship between public debt and economic growth was negative (Kharusi & Ada, 2018; Panizza & Presbitero, 2012). Conversely, some studies highlighted that the relationship is weak because controlled public debt stimulates economic growth (Reinhart & Rogoff, 2010; Egbetunde, 2012; Woo & Kumar, 2015; Roşoiu, 2019). While the focus is on how public debt affects long term growth, the empirical evidence remains unsettled and grossly weak. Generally, the literature presented insufficient and contradictory results about the relationship between fiscal variables and economic growth, allowing the present study to seek further empirical evidence in developing economies comprehensively.

The studies focused on a panel of developed countries, and some studies are single country concentrated. The panel studies suffered from a methodological weakness. The studies did not consider spatial dependence, thus treating countries as isolated units. However, the influence of location (space) might motivate biased results when using traditional econometric methods

(Anselin, 1988). Furthermore, only limited panel studies for developed countries explicitly explored space's role on the effect of fiscal policy on growth.

The studies only considered local regions in a specific country (Karjoo & Sameti, 2015; Flores-Chamba et al., 2019). However, spatial aspects of contiguity have been largely ignored in most of the studies. The present study is different from these studies because it considers neighbouring countries instead of counties.

Concluding Remarks: The present study aims to apply spatial modelling to a panel of SADC countries and then apply panel causality of fiscal policy variables and economic growth. The theoretical and empirical literature review paved the way for developing a conceptual framework for this study. In contrast, the empirical literature review signaled the stock of research knowledge's progress and highlighted the knowledge “gaps” that need attention for further enquiry.

CHAPTER 4

METHODOLOGY

4.1 Introduction

The theoretical and empirical literature review mapped out the theoretical and empirical framework pursued in this study. Here, a full description of the mechanics of how the main goal and objectives of this study will be achieved are presented. Furthermore, data sources and variable definitions are provided in this chapter.

4.2 Theoretical Framework

This section presents the conceptual framework for spatial analysis of the nexus between fiscal variables and economic growth by synthesizing empirical and theoretical literature. The model discussed in the present study takes into consideration of government expenditure hypothesis (Wagner, 1883), the model of tax revenue and economic growth (Engen & Skinner, 1996), and the model public debt and economic growth hypothesis (Reinhart & Rogoff, 2010).

a) **Government Expenditures and Economic Growth:** Three functional forms of testing Wagner`s law have been proposed by Peacock and Wiseman (1961), Goffman (1968), and Gupta (1967). In the present study, the model proposed by Peacock and Wiseman (1961) that traces the relationship between growth of government expenditure (GEXP) and Gross Domestic Product (GDP) is specified below,

$$\ln(GEXP_t) = \alpha + \beta \ln(GDP_t) + \varepsilon_t \qquad \text{…. (4.1)}$$

b) **Tax Revenue and Economic Growth:** Considering the accounting framework developed by Solow (1956), Engen and Skinner (1996) trace how taxes might affect economic growth. High taxes can discourage the investment rate, weaken labour supply growth, thus discourage labour force participation and discourage productivity growth (Engen &

Skinner, 1996). If $\dot{y}_i$ denote the GDP growth rate in country i, $\dot{k}_i$ represents the change over time in capital stock, $\dot{m}_i$ is the percentage growth rate in the effective labour force overtime, μ_i measures the overall economic productivity, α_i measures the marginal productivity of capital and β_i the output elasticity of labour, their model, is specified as;

$$\dot{y}_i = \alpha_i \dot{k}_i + \beta_i \dot{m}_i + \varepsilon_i \qquad \text{…. (4.2)}$$

The dynamic effects of shocks in government spending and taxes on output activity for the US examined by Blanchard and Perotti (2002) observed that positive government spending shocks have a positive effect on output and positive tax shocks as having a negative effect on economic growth.

c) **Public Debt and Economic Growth:** The Reinhart and Rogoff (2010**)** model indicate that the relationship between public debt and economic growth is weak for debt/GDP ratios for a threshold of 90 percent of GDP. However, the threshold above 90 percent, median growth declines by one percent and average growth declines substantially. The threshold for public debt is similar across both advanced and emerging economies. Their model considered real GDP growth (RGDPG), public debt as a percentage share of GDP$\left(\frac{Pdebt}{GDP}\right)$, external debt as a percentage share of GDP$\left(\frac{Edebt}{GDP}\right)$, and the inflation rate (Infl). Reinhart and Rogoff specified their model as;

$$RGDPG = \beta_0 + \beta_1 \left(\frac{Pdebt}{GDP}\right)_t + \beta_2 \left(\frac{Edebt}{GDP}\right)_t + \beta_3 \ INfl_t + \varepsilon_t \qquad \text{…. (4.3)}$$

Encompassing all the above models and expanding the model with tax revenue as a percentage of GDP (TAXR) the vector is expressed as

$$Y \equiv [Ln(GDP), GEXP, TAXR, PDEBT] \qquad \text{…. (4.4)}$$

Extending the Peacock and Wiseman model (1961), Mann (1980) considered government expenditure as a percentage of GDP and estimated the relationship between share of expenditures and economic growth. The relationship between public debt-to-GDP and economic growth is expected to be negative but for certain (above 90% debt-to-GDP ratio) thresholds (Reinhart & Rogoff, 2010). Blanchard and Perotti (2002) purported that positive tax shocks have a negative effect on growth.

4.3 Empirical Framework

To address the objective (s) of the relationship between fiscal variables and economic growth the present study considers the empirical models for individual countries and the panel of 12 countries. The rationale for considering country-level both and panel examination is to account for the panel problem of treating different countries as an entity.

Model Specification: For the country-level, the relationship between fiscal variables and economic growth is specified as

$$Ln(GDP_t) = \beta_0 + \beta_1 GEXP_t + \beta_2 TAXR_t + \beta_3 PDEBT_t + \varepsilon_t \qquad \text{…. (4.5)}$$

For the panel, the relationship is specified below

$$Ln(GDP_{it}) = \lambda_0 + \lambda_1 GEXP_{it} + \lambda_2 TAXR_{it} + \lambda_3 PDEBT_{it} + \mu_{it} + \varepsilon_{it} \qquad \text{…. (4.6)}$$

Here, ln (GDP) denote real GDP per capita growth for country i where i =1,…N represent each of the SADC countries considered at time t and t = 1,…T denote each year from 2000 to 2017, $GEXP_{it}$ total government expenditures as a percentage of GDP, $TAXR_{it}$ is the total tax revenue as a percentage of GDP, $PDEBT_{it}$ is debt as a proportion of GDP, μ_{it} represent country-specific effects, and ε_{it} is the error term.

Unit Root Tests: For the individual countries, the stationarity aspect of the variables have been examined by employing the Augmented Dickey-Fuller (ADF) and the Philips-Perron (PP) test

(Gujarati & Porter, 2009). To explore the stationarity of variables for the panel are conducted using the Im Pesaran and Shin-(IPS), Levin Lin, and Chu-(LLC), PP-Fisher (Asteriou & Stephen, 2011).

Causality Analysis: The country-wise causality tests are conducted by applying causality tests based on the Toda and Yamamoto (TY) non-Granger causality test.

The conventional Granger causality is widely used in empirical studies because of its simplistic nature (Alimi & Ofonyelu, 2013). They advanced two issues that lead to flaws when testing for causality between variables using the traditional Granger causality approach. First, a conventional bivariate Granger causality test neglects other variables' influence, subject to possible specification bias. Second, the time-series data are often non-stationary; thus this could exemplify the problem of spurious regression and inefficient estimates (Alimi & Ofonyelu, 2013).

The main merit of the Toda-Yamamoto procedure is that it can be applied to situations where the time series in the system are integrated of different orders, cointegrated or non-cointegrated or both (Zombe et al., 2017). However, the order of integration does not have to exceed the exact lag length of the model. The Toda and Yamamoto (1995) procedure allows for causal inference reliant on an augmented level vector autoregressive (VAR) with the cointegrated and integrated process (Narayan & Narayan, 2006). The procedure utilizes a modified Wald test to conduct restrictions on parameters of the VAR(k) model. The test consists of an asymptotic χ^2 distribution with k degrees of freedom in the limit when a VAR[$k+d_{max}$] (Narayana & Narayana, 2006; Alimli & Ofonyelu, 2013). Where d_{max} is the optimal order of integration for series in the model.

Hamdi and Sbia (2013) indicated that the Toda–Yamamoto procedure is performed in two steps. The initial step is to determine the optimal lag length of the VAR model and the maximum order of integration (d) of time series variables in the model. The subsequent step then requires the application of the standard Wald tests on the first (k) on the VAR coefficient matrix to employ the Granger causality inferences using the Chi-square distribution. Narayana and Narayana (2006) advance reasons forth that optimal lag length can be chosen using Schwarz Bayesian Criterion (SBC) and Akaike Information Criterion (AIC). The order of integration of the variables is obtained through employing the Augmented Dickey-Fuller (ADF) and Phillips Perron (P-P) tests.

To determine the direction of influence between the fiscal variables and economic growth for the 12 countries panel, the study employed the panel causality test proposed by Dumitrescu and Hurlin (2012). This procedure is a similar bivariate testing proposed by Granger (1969) but applied in a panel setting. The other approach pursued is to test for panel causality within the vector autoregressive framework. To perform this, five crucial steps are sought. After determining the order of integration, the second step is to determine the lag length of the information set or the variables considered in the sample. The next step is to perform residual autocorrelation tests in the residuals of the VAR model. The subsequent procedure is to check for the stability of the model. Based on these steps, then panel causality is investigated.

Co-integration Test: The next procedure is to determine the existence of a long-run relationship, especially when the variables are I (1) series. For country-level analysis, the study employs the Johansen co-integration test, whereas, for the panel, the Pedroni residual, Kao residual cointegration tests are used. The Pedroni test allows for country-specific short-run dynamics and long-run relationships (Alfonso & Alessandro, 2008).

4.4 Spatial Framework

To address spatial interdependencies, this study takes a turn from the simple linear regression model (SLM), which is known for establishing the relation between regressand and the regressors. The main weakness with regression models based on independence is embedded in their inability to account for spatial spillover effects (LeSage & Pace, 2014). In the presence of spatial effects on the data, the Ordinary Least Squares (OLS) estimates tend to be biased and inconsistent (Niebuhr, 2002; LeSage & Pace, 2014; Myovella, 2018). Myovella (2018) highlights that the criterion for evaluating an estimated model will be misleading due to the presence of spatial effects. The apparent solution to this problem will be contingent on the form of spatial effects. Thus different spatial models can be pursued for estimation.

Spatial Autocorrelation

The choice of spatial models to use is established after verifying the presence of spatial autocorrelation in the data. Fiscal policy shocks in one state can affect the economic process of neighbouring region via several mechanisms such as the mobility of firms, labour, and goods (Ojede et al., 2018).

Spatial Contiguity Matrix: LeSage (1999) has explained various types of contiguity. To investigate the spatial effects of SADC region, a binary "queen" contiguity matrix is employed. The spatial weights matrix W=(w_{ij}) is an exogenously determined non-negative matrix of dimensions $n \; x \; n$ which measures the proximity between regions with a common border. The main diagonal elements $w_{ii} = 0$ to eliminate own neighbourhood and $w_{ij} \geq 0$ if two regions share a border and zero otherwise. It has been argued that "selecting an appropriate spatial weight matrix and the explanatory variable is central to the analysis of growth empirics and substantive interpretation of research" (LeSage & Fischer, 2008 p. 277). The weights are set according to the contiguity:

$$w_{ij} = \begin{cases} 1, & when \; region \; i \; and \; j \; are \; share \; a \; border \\ 0, & when \; region \; i \; and \; j \; do \; not \; share \; a \; border \end{cases}$$

$$where \; i = 1, \ldots 12 \; and \; j = 1, \ldots 12$$

Note that W is symmetric, and by convention, the matrix always has zeros on the main diagonal. By way of illustration, a standardized version of W is a spatial contiguity matrix, A, can be expressed in the following general form

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix}$$

Where a_{ij} is a measurement that captures the contiguous relationships between region i and region j. For principal diagonals, $a_{ii} = a_{11} = a_{22} \dots = a_{nn} = 0$ to prevent a region from being defined as a neighbour to itself.

Spatial Weight Matrix (Normalization): In order to standardize the neighbourhood influence upon each country or region, the spatial weight matrix is row normalized such that the weight of each row sums to unity. The construction of the normalized spatial weights matrix can be defined as

$$W = \frac{A}{A_0} = \begin{bmatrix} w_{11} & w_{12} & \cdots & w_{1n} \\ w_{21} & w_{22} & \cdots & w_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ w_{n1} & w_{n2} & \cdots & w_{nn} \end{bmatrix}$$

Where

$$A_0 = \sum_{i=1}^{n} \sum_{j=1}^{n} a_{ij}, \qquad \sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij} = 1$$

Spatial Autocorrelation Test: Spatial autocorrelation is defined as the coincidence of value similarity due to locational similarity (Anselin, 1995). Spatial autocorrelation points out to the fact that observations in neighbouring regions portray dependency. This implies that changes in values for particular observations spillover to affect the values of other observations.

Therefore, neighbouring observations of the same phenomenon tend to be correlated. In principle, what happens in a particular region might be largely influenced by the characteristics of neighbouring regions. This spurs a need to examine the consequences of proximity relations due to regional dependency. It is crucial to note that spatial autocorrelation can be examined at global and local levels. The former indicates spatial clustering for each year of the considered regional sample as a whole and it is measured through the Moran`s I statistic. The latter shows every cross-sectional unit spatial clustering and it is measured by Moran`s scatter plot and Local Indicators of Spatial Association (LISA). More precisely, these indicators allow for the decomposition of global indicators such as Moran`s I statistic into the contribution of each individual observation (Anselin, 1995).

Global Spatial Autocorrelation (GSA): After defining the spatial connectivity matrix, Moran`s I statistic is used to examine the spatial patterns. This method test for global spatial autocorrelation between locations by examining the presence and extent of spatial dependencies. Moran I`s statistic is as follows;

$$I = \frac{n}{S_0} \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} (X_i - \bar{X})(X_j - \bar{X})}{\sum_{i=1}^{n} (X_i - \bar{X})^2}, \quad -1 \leq I \leq +1 \qquad \text{…. (4.7)}$$

Where $S_0 = \sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij}$, w_{ij} is the spatial weight between observation i and j, S_0 is the sum of all w_{ij}, X_i variable value at region i, X_j is the variable value at region j, $\bar{X}$ is the mean value, and n is the number of observations. In matrix form, Moran`s I is expressed as follows:

$$I = \frac{n}{s_0} \frac{z^T W z}{z^T z} \qquad \text{…. (4.8)}$$

Where z represents a vector of observed values, and Wz denotes a vector of spatially weighted mean of neighbouring values. In the case of row normalization S_0= n. Moran`s I range between negative one and positive one. The former implies that distinct values are next to each other, and the latter occurs when similar values are next to each other, whereas zero implies no spatial autocorrelation.

It is conventional to expect a positive autocorrelation between regions and a negative autocorrelation might imply competition process between neighbours (Haining, 2004). Hypothesis testing is conducted under the null hypothesis of no spatial autocorrelation. The significance of Moran's I statistic is tested for by using the standardized statistic, Z, computed as follows:

$$Z = \frac{I - E(I)}{\sqrt{VAR\ (I)}} \sim N(0,1) \quad \text{…. (4.9)}$$

Where I is Moran's I statistic, $E(I)$ are the expected values of I and $VAR\ (I)$ is denote variance of Moran`s I index under the spatial randomization.

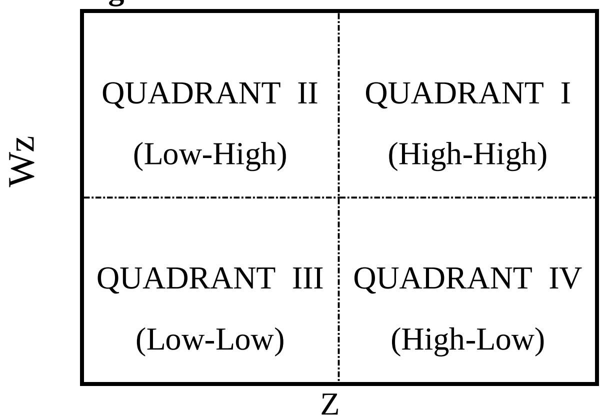
Local Indicators of Spatial Autocorrelation (LISA): It becomes interesting to measure local spatial autocorrelation and detect the presence of spatial heterogeneity among the SADC countries. This makes it easy to appreciate the regional structure of spatial autocorrelation (Le Gallo & Ertur, 2003). Local measures have the ability to give a full description of regional contribution to the global spatial autocorrelation. The global measure of spatial autocorrelation masks atypical localizations and it is not clear whether local spatial clusters are high or low values (Le Gallo & Ertur, 2003). With the use of LISA, contiguous countries that deviate from the global pattern of positive spatial autocorrelation can be spotted. The LISA statistic can be interpreted as indicators of local spatial clusters and as a diagnostics for local instability (Anselin, 1995). Anselin (1995) extend Moran`s I statistic to measure local spatial autocorrelation as follows;

$$I_{it} = \frac{x_{it} - \mu_t}{c_0} \sum_i w_{ij}\, x_{jt}(x_{jt} - \mu_t) \quad \text{…. (4.10)}$$

With $c_0 = \sum_i \; (x_{it} - \mu_t)^2/n$, I_{it} represent Moran`s statistic for each country/region i at year t, and the summation of j allows for including only neighbours of j. The LISA has to fulfil two requirements; firstly, the LISA for each observation reveals the extent of spatial clustering of similar values around a particular observation. Secondly, the aggregate of all the LISAs for all observations is proportional to a global indicator of association (Anselin, 1995). The interpretation of the LISA is the same as in the understanding of global Moran`s I statistic.

Moran`s I Scatter Plot: Anselin (1995) proposes using the Moran scatter plot as an additional measure to reveal the presence of local spatial autocorrelation among units. The scatter plot illustrates the correlation or the degree of linear association between z original values and the spatial lag Wz. Moran scatter plot offers a different view of the spatial connectivity between the regional unit and the adjacent unit (Anselin, 1995). Furthermore, it illustrates the transitional paths of the spatial distribution in the considered region. However, Moran scatterplot cannot be viewed as a LISA since no indication of significant local spatial clustering is obtained (Anselin, 1995).

Figure 4.1: Moran`s Scatter Plot



The description of Moran`s scatter plot given can be visualized in figure 4.1. The scatterplot is partitioned into four quadrants, which correspond to four types of local associations between a region and its neighbours. The first quadrant (quadrant I) signifies a region with high value surrounded by regions with high values (H-H). The second quadrant (quadrant II) indicates a region with low values surrounded by regions with high values (L-H). A region with low values enclosed by regions with low values is found in the third quadrant (L-L). The fourth quadrant describes a region with high value but surrounded by regions with low values (H-L). The first and third quadrants imply positive spatial autocorrelation whereas the second and fourth quadrants suggest a negative spatial autocorrelation among the regions or spatial units. Positive spatial autocorrelation suggests spatial clustering of similar regions with similar values whereas negative spatial autocorrelation indicates spatial clustering of regions with dissimilar values (Le Gallo & Ertur, 2003). Thus, Moran`s scatter plot provides the basis of visualizing typical and or atypical locations.

4.5 Modeling Spatial Effects

Spatial econometrics literature has pioneered models that account for three types of interaction effects among units: endogenous interaction among the dependent variable, exogenous interaction among the explanatory variables, and the interactions among the error term (Vega & Elhorst, 2013).

The empirical strategy of this study has been to estimate the basic functional form proposed by ordinary least squares and examine whether there is evidence of spatial autocorrelation among SADC countries. Upon establishing the presence of spatial dependence, either the Spatial Autoregressive (SAR), the Spatial Error Model (SEM) and the Spatial Durbin Model (SDM) can be used. Spatial dependence can be incorporated in two discrete ways in the standard linear regression model (Anselin 1988). Firstly, as an additional regressor in the form of spatially lagged dependent variable and secondly in the error structure. Incorporating these forms of spatial dependence occurs when the interaction between spatial units (regions) is specified.

Ordinary Least Squares (OLS): The first consideration is a simple pooled linear regression model that accounts for spatial specific effects, but not the spatial interaction effects. The fundamental reasoning behind spatial specific effects is that they control space-specific time-invariant variables whose omission could potentially bias the estimates (Elhorst, 2010). The simple linear regression model is used as a benchmark for comparison with the spatial models. The model is thus specified as

$$y_{it} = X_{it}\beta + \mu_i + \varepsilon_{it} ; \quad \varepsilon_{it} \sim N(0, \sigma^2 I_n) \qquad \text{…. (4.11)}$$

Where i represent the cross-sectional dimensions with i = (1,…,N), t denotes time dimension with t = 1,…,T. y_{it} is the dependent variable at region i and time t. X_{it} is a $1 \times k$ row vector of explanatory variables, and β is a $k \times 1$ vector of fixed unknown parameters. μ_i denote spatial specific effect, ε_{it} denote independently and identically distributed error term. As noted earlier, spatial effects lead to biased ordinary least squares estimates due to wrong model characteristics (estimates significance, estimates, the direction of influence, etc.).

Spatial Autoregressive Model (SAR): The SAR model suggests that the regressand of a particular spatial unit depends on the dependent variable observed in the neighbouring units and on a set of local characteristics. The model is appropriate when there are spillover effects from neighbouring units (regions). The SAR model is theoretically consistent with the state where expenditures and taxation of a particular region spillover with taxation and expenditures on public services in nearby regions (Brueckner, 2003). Following the notational conventions used by Elhorst (2010) the model is specified as

$$y_{it} = \rho \sum_{j=1}^{n} w_{ij} y_{jt} + X_{it}\beta + \mu_i + \delta_t + \varepsilon_{it}; \ \varepsilon_{it} \sim N(0, \sigma^2 I_n) \qquad \text{…. (4.12)}$$

Where ρ is spatial autoregressive coefficient and w_{ij} is an element of a spatial weights matrix W describing the spatial arrangement of units (regions) in the sample. $w_{ij}y_{jt}$ represent the spatial lag term and is correlated with the disturbances although they are i.i.d. δ_t denote time fixed effect. The description for other notations are as discussed earlier. Due to the stated correlation, OLS will be bias and inconsistent owing to the simultaneity bias. The SAR model generates a process of global spillover that indicates that changes in an independent variable for a particular region will affect the value of the dependent variable everywhere (Golgher & Voss, 2016)

Spatial Error Model (SEM): The model assumes that one or more relevant regressors have been omitted from the model, whereas they influence the regressand and are spatially correlated. Spatial dependence can also happen due to the correlation of error terms in neighbouring regions. That is the dependent variable depends on a set of observed local characteristics of a spatial unit whereas the error terms are correlated across space (Elhorst, 2010). The SEM is a distinct case of a regression with non-spherical error term. The off-diagonal elements of the covariance matrix express the structure of spatial dependence. In this case, the OLS remains unbiased, however, not efficient and classical estimators of standard errors will be biased. The spatial error model is expressed as

$$y_{it} = X_{it}\beta + \mu_i + \delta_t + \phi_{it} \qquad \text{.... (4.13)}$$

Where $\phi_{it} = \lambda \sum_{j=1}^{n} w_{ij}\phi_{it} + \varepsilon_{it}; \qquad \varepsilon_{it} \sim N(0, \sigma^2 I_n)$

Where ϕ_{it} represent spatially autocorrelated error term and λ is the spatial error correlation coefficient. λ measures the degree of influence of the error shock of spatial units with regard to the dependent. The other notations are as discussed earlier. Elhorst (2010) notes that, the SEM is consistent with a situation where determinants of taxation or expenditures on public services omitted from the model are spatially autocorrelated. Furthermore, this model does not require any theoretical model for spatial process. The interval for ρ and λ is not necessarily restricted to the interval of -1 and +1 as normally suggested in the body of the literature (Anselin, 1988; Elhorst, 2010).

Spatial Durbin Model (SDM): The SDM account for the fact that dependencies in the spatial relationships can also occur in the regressors. The model consists of spatial lags of the dependent and independent variables whilst taking account of exogenous and endogenous interaction effects with the exclusion of autocorrelated error term (Elhorst, 2010). This makes the possibility of endogeneity since own GDP per capita growth and neighbour`s GDP per capita growth are determined simultaneously and spatial dependence between observations could have an impact on fixed effects is addressed by several studies (Elhorst, 2010; Lee & Yu, 2010; Ganau, 2017; Langer, 2019).

The SDM is specified as;

$$y_{it} = \rho \sum_{j=1}^{n} w_{ij}\, y_{jt} + x_{it}\beta + \sum_{j=1}^{n} w_{ij}\, x_{ijt}\gamma + \mu_i + \delta_t + \varepsilon_{it} \quad \text{.... (4.14)}$$

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

Where y_{it} is $nx1$ vector of independent variables, ρ is the coefficient of spatial lagged dependent variables and it measures the response of the neighbouring country, in growth regression $0 < \rho < 1$, $w_{ij}y_{jt}$ is the endogenous interaction effect among the dependent variable and it describes the impact of a country by their neighbours, $w_{ij}x_{ijt}$ denote the exogenous interaction effect among the regressors, and it describes the characteristics of the neighbouring country, γ is a $kx1$ vector of fixed unknown parameter that measures the indirect spillover effect. $\beta`s$ Gives the direct effects. The other parameter implication is the same as the ones discussed earlier. Setting $\gamma = 0$ can be tested to investigate whether this model can collapse to the SAR model and setting $\gamma + \rho\beta = 0$ to examine whether the model can be simplified to SEM.

Estimation and Post Estimation: Due to unobserved heterogeneity, the econometric interest of panel data models has been the result of two types of motivations categorized in the literature as fixed effects (FE) and random effects (RE) (Arellano, 2003). In the estimation of spatial panel data models these effects are considered. The choice between these effects can be determined through Hausman`s specification test (Elhorst, 2010). Kopczewska *et al.* (2017) point out that the choice between the two effects can be purely based on theoretical grounds.

The introduction of specific effects to the model allows controlling for unobserved time in variant heterogeneity and studying dynamics of the cross-sections (Arellano, 2003). Time effects are also introduced to account for each time period. The distinction between spatial fixed and random effects and their relevance is fully described in Elhorst (2010).

The post estimation issue relates to describing the procedure to assess the goodness-of-fit of the regressions. This process is different from other econometric models; the primary method involves comparing the Akaike Information Criterion (AIC) and the Log-likelihood (Kopczewska et al., 2017). Other measures comprise considering the significance of the beta coefficients and the spatial terms since the main objective is to find a model with the highest number of significant variables (Kopczewska et al., 2017). This study will also utilize the Lagrange Multiplier and Robust Lagrange Multiplier tests to select a parsimonious model.

Coefficient Interpretation: In many empirical applications the coefficients of spatial models are often subject to misinterpretations since they are incorrectly interpreted as partial derivatives as in the typical simple linear regression model (LeSage & Dominguez, 2012).

The use of point estimates of one or more spatial regression model specifications (γ, λ and ρ) to draw conclusions about the presence of spatial spillovers may lead to erroneous conclusions (LeSage & Pace, 2009). However, the interpretation of the coefficients is correct for a properly specified simple linear regression model and for a spatial error model (Golgher & Voss, 2016). This is because in spatial error and simple linear regression models only direct effects appears. These interpretations are, however, not possible for the SAR and the SDM. The interpretation of coefficients for the models mentioned above should be interpreted differently with caution since they are not simple partial derivatives.

To interpret these models, summary measures of direct, indirect and total effects are calculated and interpreted as model coefficients. Explicitly defined, changes in the regressors associated with a particular region directly affect that region plus indirect spillover effects that fall on neighbouring regions (LeSage & Dominguez, 2012). More precisely, if there is any fiscal policy decision to increase government expenditure in a particular country, direct effects on the concerned country and indirect spillover effects will be felt by neighbouring countries. The total effect of a changing regressor is presented as the sum of these two effects. Government officials will be more interested in direct effects (LeSage & Dominguez (2012). However, indirect effects are arguably essential to consider regional integration aspects.

Empirical Model Specification: The Spatial Durbin Model has been considered for spatial growth regressions models (Ertur & Koch, 2007; LeSage & Fischer, 2008). The SDM is adopted as the starting point for a general specification. However, if the SDM fails to analyse the data best, the robust Lagrange Multiplier (LM) test developed by Anselin *et al.* (1996) is applied to test for the relevance of the SAR or SEM.

To model the spatial interdependencies in the SADC region, the model is specified as;

$$Ln(GDP_{it}) = \rho \sum_{J=1}^{N} w_{ij} Ln(GDP_{jt}) + \beta_1 GEXP_{it} + \beta_2 TAXR_{it} + \beta_3 PDEBT_{it} + \gamma_1 \sum_{J=1}^{N} w_{ij} GEXP_{ijt} + \gamma_2 \sum_{J=1}^{N} w_{ij} TAXR_{ijt} + \gamma_3 \sum_{J=1}^{N} w_{ij} PDEBT_{ijt} + \mu_i + \delta_t + \varepsilon_{it} \quad \text{....(4.15)}$$

Where $\mathrm{W \cdot Ln(GDP)}$ is the spatial lag variable of real GDP per capita growth in the neighbouring countries, $\mathrm{W \cdot GEXP}$, $\mathrm{W \cdot TAXR}$ and $\mathrm{W \cdot PDEBT}$ are the spatial lag variables in the neighbouring countries government expenditure, tax revenue and public debt in the SADC region, W is a non-negative nxn weighting matrix. $\beta's$ and $\gamma's$ are estimated parameters, μ_i and δ_t denote the country fixed effects and time fixed effect respectively while ε_{it} is a normally, identically, and independently distributed error term.

4.6 Data sources

The study pursues this empirical investigation by sourcing data from World Bank Development Indicators (WDI), United Nations University data portal (ICTD UNU-WIDER), and the African Development Bank Group (AfDB) for a sample of 12 SADC countries spanning from 2000 to 2017. The remaining four member states (Mauritius, Madagascar, Seychelles, and Comoros) are not considered under this study. Their inclusion in the sample would mean the spatial weight matrix configuration will consider them zeros since they would not have any neighbour as they are islands. However, it is imperative to highlight that not sharing borders does not imply the absence of spatial spillover effects to and from those countries. However, capturing those effects is beyond the scope of this study.

The data for GDP per capita growth is sourced explicitly from WDI. At the same time, public debt and government expenditure data are sourced from AfDB. Data on tax revenue had gaps for Angola for 2006, Zambia for 2017, Botswana from 2000 to 2002, Democratic Republic of Congo (DRC), and Eswatini for 2017. To fill the gaps for Angola and Zambia, data was taken from WDI database. After plotting the tax revenue data, the decision was made utilizing data from WDI and ICTD/UNU WIDER. The graphs indicated a similar trend, although data from WDI had successive gaps for some countries compared to data from ICTD/UNU WIDER.

The data for DRC and Eswatini was filled using the data point for 2016, assuming that revenue collected in 2017 will not vary much from the one collected in 2016. This assumption was based on the trend of tax revenue for the countries as well. Finally, the data for Botswana during the period of 2000 to 2002 were extracted from the Bank of Botswana (BoB) 2008 annual report. The proportion of tax revenue to GDP from the BoB annual report was expressed in percentages. The outcomes were multiplied by the proportion of tax revenue from ICTD/UNU WIDER and BoB report for 2003 to fill the gaps from 2000-2002.

Concluding Remarks: In the present chapter, the various aspects of the methodology have been discussed. The theoretical/conceptual model that informs the empirical models employed in this study has been explained. A methodological procedure used in this study has been presented. These comprise of the time series and panel data tests for causality and regression models. The framework for spatial econometrics has been procedurally described. Finally, there is a description of the data used in this study. The subsequent chapter will present the analysis and discussion of the empirical investigation.

CHAPTER 5

RESULTS ANALYSIS AND DISCUSSION

5.1 Introduction

The methodology section presented a systematic approach to how the organization of this chapter. Here, the estimated results and their detailed discussions are presented in an organized sequence set out in the methodology. The chapter brings together a detailed analysis of both country-level and panel data. The research's main framework involves country level, panel data, and spatial econometric approach, respectively.

5.2. Country Level Framework

Stationarity Test: The results for country-level stationarity are presented in Table 5.1. Ln(GDP) is non-stationary for Lesotho and Zambia but stationary for all the remaining countries. The null hypothesis of unit root among Ln(GDP) is rejected for all countries except for two. This evidence suggests that Ln(GDP) is integrated of order zero, whereas for Lesotho and Zambia is integrated of order one.

Considering the public debt variable, the null hypothesis of unit root is rejected for Angola, Botswana, DRC, Eswatini, Lesotho, and Zambia. Therefore, public debt for those countries is stationary at level since the p-values are less than the significance levels. The remaining countries indicate a unit root problem since the null hypothesis was not rejected at the levels of significance. The ADF results are similar to the Phillips-Perron results provided in Appendix table A1.

Table 5.1: Country-wise Unit Root Tests Results (SADC), 2000-2017

COUNTRY	ADF test							
	Ln(GDP)	P-value	PDEBT	P-value	GEXP	P-value	TAXR	P-value
Angola	$I(0)_{ct}$	0.0975	$I(0)_{n}$	0.0213	$I(0)_{n}$	0.0377	$I(1)_{n}$	0.0005
Botswana	$I(0)_{n}$	0.0025	$I(0)_{nc}$	0.0743	$I(1)_{n}$	0.0000	$I(1)_{n}$	0.0006
DRC	$I(0)_{n}$	0.0080	$I(0)_{ct}$	0.0014	$I(0)_{n}$	0.0162	$I(0)_{c}$	0.0716
Eswatini	$I(0)_{c}$	0.0558	$I(0)_{c}$	0.0062	$I(1)_{n}$	0.0001	$I(1)_{n}$	0.006
Lesotho	$I(1)_{c}$	0.0000	$I(0)_{n}$	0.0071	$I(0)_{n}$	0.0541	$I(1)_{n}$	0.0002
Malawi	$I(0)_{n}$	0.0442	$I(1)_{n}$	0.0017	$I(0)_{c}$	0.0517	$I(1)_{n}$	0.0014
Mozambique	$I(0)_{c}$	0.0031	$I(1)_{n}$	0.0027	$I(1)_{n}$	0.0037	$I(1)_{n}$	0.0351
Namibia	$I(0)_{n}$	0.0259	$I(1)_{n}$	0.0002	$I(1)_{n}$	0.0001	$I(0)_{ct}$	0.0186
South Africa	$I(0)_{nc}$	0.0553	$I(1)_{n}$	0.0005	$I(0)_{ct}$	0.0286	$I(0)_{c}$	0.0697
Tanzania	$I(0)_{c}$	0.0043	$I(1)_{n}$	0.0285	$I(1)_{n}$	0.0006	$I(1)_{n}$	0.0005
Zambia	$I(1)_{n}$	0.0000	$I(0)_{n}$	0.0688	$I(0)_{c}$	0.0570	$I(1)_{n}$	0.0590
Zimbabwe	$I(0)_{n}$	0.0227	$I(1)_{n}$	0.0052	$I(1)_{ct}$	0.0069	$I(1)_{n}$	0.0009

Source: author's computations

*Note **c**, **ct**, and **nc** implies **constant**, **constant & trend** and **none** models*

I (0) - series is stationary at levels and I (1) series is stationary at first difference

Based on the ADF and Phillips-Perron tests, Government expenditure is non-stationary for Eswatini, Namibia, Tanzania, and Zimbabwe. However, for the remaining countries, GEXP is stationary at levels since the null hypothesis is rejected at the 1%, 5% and 10% levels of significance. Tax revenue for DRC, Lesotho, Zambia and Namibia is stationary at level thus it is integrated of order zero whereas for the remaining countries the null hypothesis is not rejected at all levels of significance. Therefore, TAXR for the remaining countries is integrated of order one. Since there is a unit root problem amongst the variable there is a possibility of long-run relationships between the variables.

Multiple Regression Model (Country-wise): The relationship between economic growth and fiscal variables has been using OLS method for each country and the results are presented I Table 5.2.

***Public Debt and Economic Growth*:** The empirical results presented in Table 5.2 suggest that the relationship between public debt and economic growth is very weak. Public debt affects economic growth negatively in all countries except DRC and Zambia. These results show that the public debt in SADC region has not contributed to economic growth. The results further suggest that for Zimbabwe and Angola any positive in the public debt leads to a decline in economic growth suggesting an inverse relationship. Exclusively, the results for the two countries are consistent with other studies (Panizza & Presbitero, 2012; Kharusi & Ada, 2018). More specifically the results for Zimbabwe are consistent with prior studies that investigated the relationship between growth and debt for Zimbabwean economy (Munzara, 2015; Matandare & Tito, 2018). The overall view of the relationship between public debt and economic growth is weak strongly supporting the studies that suggested that intolerable debt levels adversely affect economic growth but moderate debt levels are impetus for growth (Reinhart & Rogoff, 2010; Woo & Kumar, 2015; Checherita-Westphal & Rother, 2011; Cecchetti et al., 2011)

Table 5.2: Country-wise Regression Results, 2000-2017

Dependent V: Ln(GDP)		Regressors						
Country	Constant	PDEBT	P-value	GEXP	P-value	TAXR	P-value	R^2
Angola	-1.7468	-0.1491	0.089*	0.5112	0.046	0.2643	0.143	0.376
Botswana	40.746	-0.2300	0.119	-1.6191	0.040	-0.2821	0.559	0.368
DRC	-10.230	0.0245	0.151	0.0076	0.865	1.4012	0.001	0.621
Eswatini	5.5268	-0.1551	0.337	-0.0444	0.839	0.0660	0.569	0.141
Lesotho	-56.624	-0.0018	0.959	1.6479	0.018	-0.0686	0.369	0.369
Malawi	8.7237	-0.0174	0.651	-0.7357	0.117	1.1485	0.087	0.266
Mozambique	8.647	-0.0007	0.972	-0.2333	0.009	-0.0243	0.940	0.515
Namibia	6.1663	-0.0596	0.624	0.0345	0.948	-0.1174	0.684	0.039
South Africa	16.299	-0.0562	0.591	-1.6216	0.023	0.6900	0.081	0.403
Tanzania	3.511	-0.0485	0.245	-0.0090	0.947	-0.4183	0.226	0.161
Zambia	10.495	0.0131	0.109	-0.0312	0.843	-0.7567	0.131	0.224
Zimbabwe	0.0069	-0.5748	0.000	0.2821	0.630	-0.0499	0.870	0.691

Source: author`s computations
** denote 10% and better*

The negative relationship between public debt and economic growth is in contrast with the opinion that public borrowing can be a growth stimulant provided it is channelled to capital goods not current consumption (Blanchard & Giavazzi, 2004; Cecchetti et al., 2011). Public debt has not significantly improved economic growth in SADC which is contrary to the result found by (Reinhart and Rogoff, 2010).

Government expenditures and Economic growth: Any positive shock in government expenditures leads to a decline in economic growth for Botswana, Mozambique and South Africa. For Botswana, the results are consistent with the study by Amusa and Oyinlola (2019). These results are, however, contrary to expectations as government expenditures are thought to boost economic growth. Nonetheless, the results can be plausible based on the Barro (1990) growth model which explicitly differentiate the effect of productive and non-productive expenditures on economic growth.

For Angola and Lesotho, the results are according to expectations. An increase in government expenditures positively affect economic growth. The effect of any positive shock in government expenditures is more pronounced for Lesotho as compared to Angola. The relationship between government expenditures and growth is insignificant for the remaining countries.

Government expenditures contributes positively in Angola and Lesotho and negatively in Botswana and South Africa in other countries it is insignificant. The negative effect of government expenditure on economic growth in Botswana, Mozambique and South Africa is due to high government expenditure on health.

Tax Revenue and Economic growth*:* The relationship between tax revenue and economic growth is positive and statistically significant for Democratic Republic of Congo, Malawi and South Africa. The results are similar to Quashigah *et al*. (2016) and Egbunike *et al*. (2018) who found that tax revenue positively affected economic growth for Ghana. However, the results are counterintuitive since an increase in taxation is a disincentive to start a business or getting employment this negatively affect economic growth. However, direct taxes are more effective to support economic growth (Stoilova & Patonov, 2012). A negative but insignificant relationship was found for Botswana, Lesotho, Mozambique, Namibia, Tanzania, Zambia, and Zimbabwe. Furthermore, it was positive and insignificant for Angola and Eswatini.

Granger Causality: The description of the country-wise causality test is based on the synthesis of Toda and Yamamoto Granger causality results provided in the Appendix A from Table A2, A3, A4, and A5 respectively. The optimal lag length (k) based on the Akaike Information Criterion (AIC) is one and the maximum order of integration (d_{max}) for the variables is one. This, therefore, implies that the augmented lag length $k + d_{max}$ is 2. Following the works of Toda and Yamamoto (1995), a VAR (2) model is specified to perform a country level causality amongst SADC member states.

Fiscal Variables and Economic Growth: The first reference of analysis is investigating causality between fiscal variables and economic growth. There is evidence of bidirectional causality between GDP per capita growth and tax revenue for Eswatini and South Africa. Furthermore, there is a unidirectional causality running from tax revenue to economic growth for Lesotho, Malawi, Mozambique, and Namibia. Suggesting that improved tax handles for resource mobilization is likely to affect economic growth. Otherwise, there is no causality between tax revenue and economic growth for the remaining countries.

A unidirectional causality running from economic growth to public debt is established for Botswana, DRC, Mozambique, South Africa, and Zambia. However, reverse unidirectional causation between economic growth and public debt was found for Malawi, Tanzania, and Zimbabwe. Considering the causal relationship between economic growth and government expenditure, a bidirectional causality is found for Namibian and Tanzanian economies. Whereas for South Africa causality runs from government expenditure to economic growth supporting the theoretical perspective from Keynes (1936) that expenditures are exogenously determined. Furthermore, for DRC, Malawi, Mozambique, and Zimbabwe the results suggest a unidirectional causality running from economic growth to government expenditures. This supports Wagner`s law, thus increased state activities through expenditures is influenced by economic growth. Therefore, growth of expenditures is a spontaneous consequence of economic growth.

Tax revenue and Government Expenditures: The second consideration is to determine the causality between tax revenues and government expenditures in the region. There is an existence of bidirectional causality between tax revenues and government expenditures for DRC. The findings support the fiscal synchronization hypothesis for DRC.

A unidirectional causality running from government expenditures to tax revenues is found in the South African economy. This supports the spend-tax hypothesis for the South African economy contrary to the institutional separation hypothesis found by Narayan and Narayan (2006) and Sere and Chonga (2017). A unidirectional causality running from tax revenues to government expenditures for Zimbabwe, Tanzania, Namibia, and Malawi supported the presence of tax-spend hypothesis. The results for the Namibian economy are consistent with the results found by Eita and Mbazima (2008). There is no causal relationship between the tax revenues and government expenditures for countries not mentioned since the null hypothesis of no Granger causality was not rejected at all levels of significance. This suggested the institutional separation hypothesis for Angola, Botswana, Eswatini, Lesotho, Mozambique and Zambia. A focus on Botswana, the results are consistent with Wolde-Rafael (2008) but contrary to those found by Moalusi (2004) and Mupimpila *et al.* (2015), who found the tax-spend hypothesis. Interestingly, Angolan economy indicated that there is no causal relationship between fiscal variables and economic growth.

Cointegration: The Johansen cointegration test determines the rank of matrix Π or the number of cointegrating equations. There are two methods which are based on estimates for the cointegration matrix Π. The first method, based on the maximum eigenvalue statistic tests the null hypothesis that the rank of Π is r against the alternative that the rank is r + 1.Where r is the number of cointegrating equations. The other method based on the trace of a matrix tests the null hypothesis that the rank of the matrix is less than or r. Johansen cointegration test results given in Table A6 from the appendix suggest that the null hypothesis of r = 0 is rejected for all the countries with I(1) data. The trace statistic (λ_{trace}) and max-eigenvalue statistic (λ_{max}) both indicate that the null hypothesis is rejected. The conclusion is that the fiscal variables and economic growth in the SADC region share at least one cointegrating equation thus there is an existence of the long-run relationship.

5.3 Panel Framework

Analysis of panel data provides an explicit description of the group of countries reflecting a time constant and unobserved effect. Adopting panel data gives more information, more variability, and more degrees of freedom and efficiency (Gujarati & Porter, 2009). Panel data capture effects that could not be captured by purely time series and cross-section data.

Table 5.3: Descriptive Statistics for the SADC region, 2000-2017

Variable	Ln(GDP)	GEXP	PDEBT	TAXR
Observations	216	216	216	216
Mean	2.3332	18.3330	55.5072	20.5788
Median	2.7963	18.2492	39.0960	18.7704
Max	18.066	70.0647	241.6910	56.91614
Mini	-18.4911	1.7720	4.9726	0.9545
Std. Deviation	4.1324	8.6590	42.5676	10.6215
Skewness	-0.9641	1.4426	1.6437	0.6757
Kurtosis	8.9186	8.1525	5.7311	3.2604
Jarque-Bera	348.7270	313.8495	164.3879	17.04823
P-value	0.0000	0.0000	0.0000	0.0002
Cross-sections:12 Time period (T):18				

Source: author`s computations

Panel Descriptive statistics: Table 5.3 presents the descriptive statistics for the data on government expenditure (hereafter, GEXP), tax revenue (hereafter, TAXR), public debt (hereafter, PDEBT), and real GDP per capita growth (hereafter, Ln(GDP)). The study considers a strongly balanced panel of 12 SADC member states for 18 years, considering 216 observations. On average, the region experiences high public debt (55.51) with low Ln(GDP).

Interestingly, on average, the region`s tax revenue (20.57) exceeds government expenditure (18.33). However, the median values of government expenditure and tax revenue do not vary much in the region

The ranges for Ln(GDP), GEXP, PDEBT and TAXR are 36.55, 68.29, 236.71 and 55.96 respectively. These wide ranges are attributed to huge heterogeneity in the region. In terms of variability, public debt and tax revenue varies more than other variables in the region. Ln(GDP) is slightly skewed to the right as shown by a negative value whilst other variables are skewed to the left. The Jarque-Bera test of normality indicate that the null is rejected since the p-value (s) are less than all levels of significance. Therefore, the residuals are not normally distributed. The next procedure involves investigating the degree of association between fiscal variables and economic growth. The information is presented in table 5.4.

Correlation Matrix

Table 5.4: Correlation Matrix between Fiscal Variables and Economic Growth, 2000-2017

	Ln(GDP)	GEXP	PDEBT	TAXR
Ln(GDP)	1.0000			
GEXP	0.1820	1.0000		
P-value	0.0073**			
PDEBT	-0.1195	-0.1634	1.0000	
P-value	0.0797*	0.0162**		
TAXR	0.1191	0.6746	-0.3138	1.0000
P-value	0.0807*	0.0000***	0.0000***	

Source: author's computations
****, **,* denote 1%, 5% and 10% level of significance respectively*

TAXR and GEXP are significantly and strongly positive correlated with a correlation coefficient of 0.67. This implies that tax revenue moves in tandem with government expenditure. Thus, a rise in tax revenue leads to expenditure increase the reverse being true. PDEBT is negatively correlated with Ln(GDP), GEXP and TAXR. When public debt increases in the region Ln(GDP), GEXP and TAXR tend to decline for the considered period. However, the correlation coefficient is weak, suggesting a weak negative correlation.

Government expenditures are positively correlated to economic growth. An increase in government expenditures will result in a rise in economic growth; the reverse is true. Similarly, tax revenue is positively correlated with economic growth. On a comparison basis, government expenditure is more correlated with economic growth than tax revenue in the SADC region. In spite of the correlation between the fiscal variables and economic growth, the causal relationship between the variables remains unclear. This is because correlation does not imply causation. To perform causality tests, the next procedure is to examine the stationarity behaviour of the data at panel level for the whole SADC region.

Stationarity Tests: Table 5.5 describes stationarity results from the LLC, IPS and PP-Fisher tests. The LLC result strongly provides evidence against the null to suggest that all the variables considered are stationary at level since all the p-values are less than the 1%, 5% and 10% level of significance. More precisely, Ln(GDP) is stationary at levels since the p-value (0.0002) is less than 1% level of significance. Thus the null hypothesis is rejected. Public debt is also stationary at levels as the null hypothesis of unit root is rejected at 1% level of significance. GEXP and TAXR are stationary at level since the null hypothesis is rejected at 5% level of significance.

Table 5.5: Panel Unit root tests for SADC region, 2000-2017

Variable	Levin, Lin & Chu (LLC)		Im, Pesaran and Shin (IPS)		PP-Fisher	
	t-statistic	P-value	t-statistic	P-value	Chi-sq.	P-value
Ln(GDP)	-3.5853	0.0002***	-3.0373	0.0012***	-6.7219	0.0000***
PDEBT	-2.5497	0.0054***	-1.0558	0.1455	25.8365	0.3615
GEXP	-2.209	0.0136**	-1.5697	0.0582*	59.9820	0.0001***
TAXR	-1.9790	0.0239**	-1.0167	0.154	34.2321	0.0806*

Source: author's computations
****, **,* reject the null at 1%, 5% and 10% level significance respectively*

The IPS test indicate that Ln(GDP) and GEXP are stationary at levels since the null hypothesis of unit root is rejected at 1% and 10% level of significance respectively. However, the null is not rejected for PDEBT and TAXR. According to IPS test, PDEBT and TAXR variables have unit root problems. The PP-Fisher test provides similar conclusions as the ones drawn from

LLC except that only PDEBT variable was found to have a unit root problem since the p-value (0.36) is more than the levels of significance. The IPS and PP-Fisher tests suggest that there is no sufficient evidence against the null hypothesis hence it is not rejected at all level of significance for PDEBT. On the basis of a power of a test argument, all the variables under consideration are considered to be stationary at levels as indicated by the LLC test. Therefore, the variables are not suffering from a unit root problem in such cases they are viewed to be an I(0) series. Since the considered variables are stationary at level the Vector Autoregressive (VAR) model is pursued to investigate the causal relationship between fiscal variables and economic growth for the SADC region.

To determine the lag length of Ln(GDP), TAXR, GEXP, and PDEBT a Vector Autoregressive model is estimated as the starting point. Then the optimal lag length for the variables was determined by Akaike information criterion (AIC). According to AIC the optimal lag for this VAR model is the second lag. Therefore, the pursued parsimonious vector autoregressive model that best fits economic growth and fiscal variables is VAR (2) process. The next procedure involves a residual diagnostic test for the presence of autocorrelation.

Table 5.6: Serial Correlation Test

H_0: No serial correlation at lag h						
Lag	LRE* stat	Df	Prob.	Rao F-stat	Df	P-Value
1	30.607	16	0.0151**	1.9424	(16, 538.3)	0.0151**
2	23.303	16	0.1059	1.4689	(16, 538.3)	0.1059

Source: author`s computations
****, **,* reject the null at 1%, 5% and 10% level significance respectively*

Table 5.6 presents LM test results for autocorrelation in the residuals. The table shows that at the second lag the null hypothesis is not rejected since the p-value is greater all at levels of significance. The conclusion is that there is no autocorrelation among the residuals. Thus the model is dynamically complete. Furthermore, the estimated VAR model is stable (stationary) since all roots have modulus less than one and lie inside the unit circle.

Panel Causality: Granger causality was conducted through the use of Dumitrescu and Hurlin (2012) Non-causality test (hereafter, DH) and vector Autoregressive model. The main advantage of the D-H test is that it takes into account of the heterogeneity of the regression employed to test for Granger causality in a panel setting and takes the null hypothesis of homogeneous non-causality (Dumitrescu & Hurlin, 2012). The results for DH test and VAR model are discussed below.

Table 5.7: Dumitrescu and Hurlin Non-causality Test

Null Hypothesis	W-bar	Z-bar	Z-bar tilde
PDEBT does not Granger-cause Ln(GDP)	1.6538	1.6015 (*0.1093*)	0.8970 (*0.3697*)
Ln(GDP) does not Granger-cause PDEBT	2.1184	2.7395 (*0.0062*)	1.7526 (*0.0797*)
GEXP does not Granger-cause Ln(GDP)	2.1526	2.8234 (*0.0048*)	1.8156 (*0.0694*)
Ln(GDP) does not Granger-cause GEXP	1.1126	0.2758 (*0.7827*)	-0.0996 (*0.9207*)
TAXR does not Granger-cause Ln(GDP)	1.4392	1.0759 (*0.2820*)	0.5019 (*0.6157*)
Ln(GDP) does not Granger-cause TAXR	2.4677	3.5950 (*0.0003*)	2.3957 (*0.0166*)
TAXR does not Granger-cause GEXP	3.4749	6.0621 (*0.0000*)	4.2504 (*0.0000*)
GEXP does not Granger-cause TAXR	1.3469	0.8497 (*0.3955*)	0.3318 (*0.7400*)

Source: author's computations
Alternative hypothesis is that the independent variable does Granger-cause the dependent variable for at least one panelvar (id)
P-value is given in parenthesis

Dumitrescu and Hurlin Non-causality Test: Table 5.7 reports the panel causality results from the Dumitrescu and Hurlin (2012) causality test. At 5 % level of significance, it is evident that the null hypothesis that public debt does not Granger-cause Ln(GDP) is not rejected. Therefore, public debt does not homogeneously Granger-cause economic growth in the SADC region. The economic growth of the SADC countries has a causality effect on public debt. This implies a unidirectional causality running from economic growth to public debt in the SADC countries.

The null hypothesis that GEXP does not Granger-cause Ln(GDP) is rejected at 5% level of significance. This suggests that government expenditure granger causes economic growth in the SADC region. The null hypothesis that economic growth does not Granger-cause government expenditures is not rejected at 5% level of significance. Thus, there a unidirectional causality running from government expenditures to economic growth. There is a unidirectional causality running from economic growth to tax revenue. The results further show that tax revenues Granger-cause government expenditures suggesting a tax spend hypothesis in the SADC region.

Table 5.8: VAR Granger Causality/Block Exogeneity Wald Tests for the SADC region

Dep. Variable	Excluded	Chi-square	P-value
Ln(GDP)	GEXP	3.2366	0.0720*
	PBEBT	1.4634	0.2264
H_0: "Excluded variables does not Granger cause Ln(GDP)"	TAXR	1.3888	0.2386
	All	5.2063	0.1573
GEXP	Ln(GDP)	1.3020	0.2539
	PDEBT	4.9060	0.0268**
H_0: "Excluded variables does not Granger cause GEXP"	TAXR	28.5281	0.0000***
	All	29.8851	0.0000***
PDEBT	Ln(GDP)	6.6731	0.0098***
	GEXP	0.0808	0.7762
H_0: "Excluded variables does not Granger cause PDEBT"	TAXR	0.0196	0.8886
	All	7.6324	0.0543*
TAXR	Ln(GDP)	2.0707	0.1502
	GEXP	3.1881	0.0742*
H_0: "Excluded variables does not Granger cause TAXR"	PDEBT	0.7698	0.3803
	All	7.0566	0.0701*

Source: author's computations
****, **,* reject the null at 1%, 5% and 10% level of significance respectively*

There is evidence of unidirectional causality running from economic growth to public debt in the region (Table 5.8). The null hypothesis that economic growth does not Granger cause public debt is rejected at 1% level of significance. This empirical evidence is similar to Ash *et al*. (2017) who indicated that causality runs from economic growth to public debt. Therefore, fiscal deficits arises because of slow economic growth that dampens tax revenue and increases the need for public spending. Furthermore, there is a unidirectional causality running from government expenditure to economic growth in the region thus supporting the Keynesian view. Otherwise, there is no causality between tax revenue and economic growth in the SADC region. Bidirectional causality between tax revenues and government expenditures is observed in the region. More precisely, taxation and government spending can be determined simultaneously. Thus suggesting fiscal synchronization in the region.

Table 5.9: Pedroni Residual Cointegration and Kao Residual Cointegration Test

H_0: No cointegration	Stat.	P-value	W-Stat.	P-value	Group-tests	Stat.	P-value
Panel V-Stat.	-0.0275	0.5110	-1.6471	0.9502	Group rho-Stat.	0.9318	0.8243
Panel rho-Stat.	-0.4179	0.3380	-0.5227	0.3006	Group PP-Stat.	-6.1350	0.0000
Panel PP-Stat.	-3.1859	0.0007	-5.0672	0.0000	Group ADF-Stat.	-3.6851	0.0001
Panel ADF-Stat.	-2.9258	0.0017	-4.3978	0.0000	Kao-Test-ADF	-4.6730	0.0000

Source: author's computations
W denote weighted statistic

Panel Cointegration Tests: Table 5.9 provides the panel cointegration test results. The Pedroni cointegration test indicate that the null hypothesis is rejected at 1% level of significance for six statistics, whereas, the null is not rejected for the remaining test statistics. The main conclusion is that the variables are cointegrated hence suggesting the existence of a long-run relationship. The Kao residual cointegration test supports the conclusion drawn from the Pedroni cointegration test. The empirical evidence from the test indicates that there is a long-run relationship between the variables.

5.4 SPATIAL ANALYSIS

This section provides an analysis of the spatial spillovers of fiscal variables on economic growth in the region. The essence of spatial inter-connectedness in the region has both empirical and policy relevance for the region. The argument for the region`s policy harmonization can be viewed through the scope of spillover effects. The strategic interactions among member states in the SADC region lead to the emergence of positive or negative externalities. Therefore, the rationale for spillover investigation is pivotal for regional integration aspirations. The starting point is deliberating the SADC contiguity matrix.

Description of the SADC spatial weights (W) matrix: The spatial binary contiguity matrix describes a country configuration in terms of sharing borders or neighbourhood in the SADC region[3]. As noted from the methodological section, this matrix (W) captures the potential connections or spatial dependence between different countries in the SADC region based on adjacency. The dimension of the SADC`s spatial weights matrix is $12 \times 12$ due to the number of countries considered for investigation following Tobler`s law of geographical contiguity. In terms of spatial configurations, Angola shares borders with the Democratic Republic of Congo (DRC), Namibia and Zambia. Botswana has four neighbours being Namibia, South Africa, Zambia, and Zimbabwe. Angola, Tanzania, and Zambia are neighbours to DRC.

Eswatini shares borders with South Africa and Mozambique. Lesotho shares a border with South Africa. Malawi has three neighbours being Mozambique, Tanzania and Zambia. Mozambique shares borders with Eswatini, Malawi, South Africa, Tanzania, Zambia, and Zimbabwe. Namibia has four neighbours being Angola, Botswana, South Africa, and Zambia. South Africa has six neighbours being Botswana, Eswatini, Lesotho, Mozambique, Namibia, and Zimbabwe. DRC, Malawi, Mozambique, and Zambia shares borders with Tanzania. Zambia has eight neighbours: Angola, Botswana, DRC, Malawi, Mozambique, Namibia, Tanzania, and Zimbabwe. Lastly, Zimbabwe has four neighbours being Botswana, Mozambique, South Africa, and Zambia.

The country with most neighbours is Zambia. Lesotho has the least number of neighbours. The SADC`s W matrix is utilized to examine the proximity relations and their consequences as a result of fiscal policy choices in one country on the economic growth of other member states within the SADC region. It is crucial to highlight that the binary contiguity matrix is row

[3] *Spatial Binary Contiguity Matrix is given in Appendix B Table B1 that is derived from map A1*

standardized such that each row sums to one[4]. Throughout the study, the W matrix is row standardized for further analysis.

**Global Spatial Autocorrelation (GSA): Moran`s I Test:** Moran`s I test is considered at the variable level for each year and all the sample countries. Likewise, Moran's I for the level of residuals obtained from the OLS panel regression model is also estimated. All of the variables considered are investigated for the possible presence of spatial autocorrelation in the sample countries. The statistical significance of Moran`s index is calculated under the null hypothesis of no autocorrelation (or randomness). If Moran`s I value is significantly zero, then there is no spatial autocorrelation in the sample. Table 5.10 gives a description of the test results of the global spatial autocorrelation determination of GDP per capita and public debt among 12 SADC countries for the selected years from 2000 to 2017.

Table 5.10: Moran`s I (Global) Test for GDP per capita and Public Debt

Variable	Year[$]	I[1]	E (I)	Sd(I)	Z	p-value
Ln(GDP)	2000	-0.054	-0.091	0.141	0.263	0.396
	2005	-0.126	-0.091	0.149	-0.238	0.406
	2010	0.005	-0.091	0.166	0.821	0.206
	2015	-0.287	-0.091	0.175	-1.117	0.132
	2016	-0.037	-0.091	0.154	0.352	0.362
	2017	0.200	-0.091	0.172	1.692	0.045*
Mean value (sample average)	2000-2017	-0.270	-0.091	0.160	-1.119	0.132
PDEBT	2000	-0.054	-0.091	0.149	0.244	0.404
	2005	-0.004	-0.091	0.168	0.514	0.304
	2010	-0.095	-0.091	0.149	-0.028	0.495
	2015	-0.173	-0.091	0.152	-0.540	0.295
	2016	-0.198	-0.091	0.130	-0.827	0.204
	2017	-0.209	-0.091	0.120	-0.982	0.162
Mean value (sample average)	2000-2017	-0.160	-0.091	0.159	-0.436	0.331

Source author's computation
[1]*I denote Moran`s I statistic and E (I) mean value*
[$] *For presentation purpose, the choice of the selected years is based on a five year gap from 2000 to 2015 then successive years follow.*

[4]*The row standardised matrix given at the Appendix*

The results considering GDP per capita indicate a competitive process in SADC since the Moran`s I statistic for the years 2000, 2005, 2015, and 2016 is negative. However, The results show that Moran`s I values did not pass a significance level test for all the years except for 2017. Moran`s I for the year 2017 suggest spatial autocorrelation in the region since the null is rejected at 5% level of significance. Nonetheless, the sample average (2000-2017) Moran`s I statistic suggested a negative spatial autocorrelation. However, the null is not rejected at all levels of significance. Based on the results, Moran`s I values for all the countries during each year and the average sample suggest no evidence of spatial correlation for regional GDP per capita growth in the SADC region.

The results further indicate the absence of spatial autocorrelation for public debt in the SADC region. Moran`s I statistic, including the sample average, suggests a competitive process in the SADC region since the statistic is negative, indicating negative spatial autocorrelation. This shows that countries vary in terms of debt levels. However, Moran`s I values for each year in the sample did not pass all levels of significance.

The conclusion is that the results do not provide any evidence for the presence of spatial autocorrelation for the regional public debt in the SADC region. In a nutshell, Moran`s I values for public debt and GDP per capita are not significant with an exception of GDP per capita growth during the year 2017. This result offers an interesting position to inquire about the region`s integrated efforts to achieve regional integration and growth. This would be consistent with Ertur and Koch (2007) assertion that a countries economic growth tends to influence neighbouring countries.

Table 5.11: Global Moran`s I Test for Tax Revenue and Government Expenditure

Variable	Year	I	E (I)	Sd(I)	Z	P-value*
TAXR	2000	0.110	-0.091	0.170	1.184	0.118
	2005	0.273	-0.091	0.174	2.099	0.018**
	2010	0.139	-0.091	0.168	1.369	0.085*
	2015	0.422	-0.091	0.176	2.924	0.002***
	2016	0.478	-0.091	0.175	3.251	0.001***
	2017	0.383	-0.091	0.174	2.720	0.003***
Mean value (sample average)	2000-2017	0.268	-0.091	0.172	2.086	0.018**
GEXP	2000	0.062	-0.091	0.173	0.883	0.188
	2005	0.032	-0.091	0.158	0.780	0.218
	2010	-0.123	-0.091	0.124	-0.256	0.399
	2015	0.108	-0.091	0.163	1.219	0.111
	2016	0.190	-0.091	0.169	1.668	0.048**
	2017	0.305	-0.091	0.170	2.322	0.010**
Mean value (sample average)	2000-2017	0.178	-0.091	0.150	1.792	0.037**

Source: author's computations

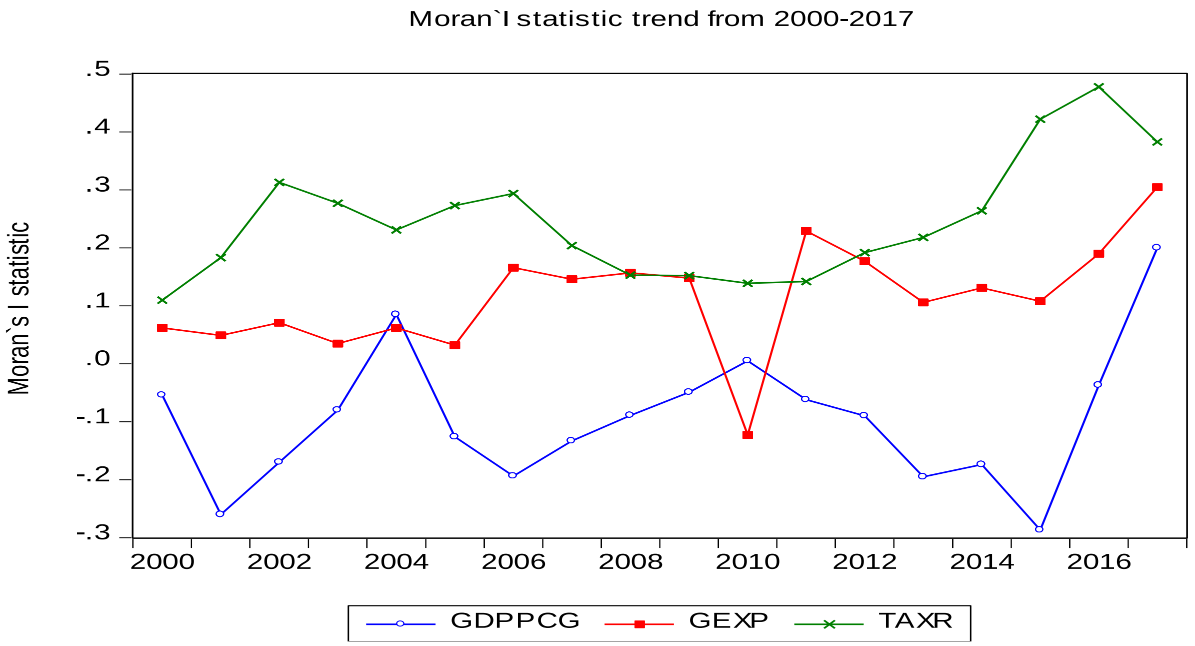
Moran`s I statistic for tax revenue is not significant for the year 2000 but significant for the remaining years. The government expenditure variable is significant from 2006-2009, 2011-2012 and 2014 provided in the appendix

Table 5.11 describes Moran`s I statistic for tax revenue and government expenditure for each year and average sample from 2000-2017. The results for tax revenue provide strong evidence of spatial autocorrelation for each year (except for 2000), including the sample average. Moran`s I value in 2016 is the highest (0.478) and the lowest is 0.110 in the year 2000. The evidence from the table indicates that there is a positive spatial autocorrelation for tax revenues.

In 2015 the spatial dependence of tax revenue enhanced such that it peaked the following year. These results provide strong evidence that tax revenue variable in space is correlated; thus, it cannot be assumed as an independent observation. Similarly, the government expenditure variable is correlated in space. Moran`s I statistic did not pass the significance test from the year 2000-2005 and the following years from 2006 to 2009 it passed the test.

In terms of the extent of spatial autocorrelation, government expenditure is not pronounced compared to the tax revenue. The sample average Moran`s I statistic (0.178) for government expenditure is significant at 5% level; thus, the null of no spatial autocorrelation is rejected. The results from Table 5.11 shows that government expenditure and tax revenue decisions in one member state has the possibility of affecting nearby member states. In light of these results, spatial analysis considerations become critical since tax revenue, GDP per capita, and government expenditures seem to be correlated in space across the SADC region.

Figure 5.1: Moran`s I statistic for the SADC region for the considered sample period



**Sample average and public debt not considered*

Moran`s I statistic trend for the SADC region considering the sample average (2000-2017) is shown in figure 5.1. It is evident that spatial autocorrelation for tax revenue, government expenditure, and GDP per capita growth changed over time. Moran`s I statistic for tax revenue increased from 2007 to 2016 where spatial autocorrelation intensified for the region. However, the spatial extent decreased from 0.478 in 2016 to 0.383 the following year.

The Moran`s I statistic for GDP per capita growth shows erratic trend overtime. However, in 2015 to 2017 the statistic improved marginally to 0.200. Similarly, the trend for Moran`s I statistic for government expenditure is erratic. In contrast, spatial autocorrelation strength is felt more on tax revenue than government expenditure and GDP per capita growth. The graph portrays a positive spatial autocorrelation for tax revenue and government expenditure in the SADC region. In contrast, Moran`s I value for GDP per capita growth generally indicates a negative spatial autocorrelation. Therefore, the above results show that tax revenue level, government expenditure, and GDP per capita growth for a particular member state in the SADC region are not only countries specific but also affected by neighbouring countries.

Local Spatial Autocorrelation: The preceding investigation considered the global spatial autocorrelation using Moran`s I statistic and hypothesis testing procedure in the SADC region on a preliminary basis. The statistic discretely provides a single outcome per period or a sample average for the entire data set. However, it fails to distinguish between the spatial clustering of high values and low values in describing the positive spatial autocorrelation. The possible existence of local spatial autocorrelation is further examined by using the LISA and Moran`s scatter plot, as proposed by Anselin (1995).

Local indicators of Spatial Autocorrelation (LISA): To examine local spatial autocorrelation in 2000, 2017 and sample average (2000-2017) for GDP per capita, tax revenue, government expenditure, and public debt are considered. The full description of the results for the entire sample period is reported in the appendix. Table 5.12 reports the spatial heterogeneity of the SADC region.

Table 5.12: Sample Average LISA in the SADC Region, 2000-2017

Country	Li^a	P-value	Li^b	P-value	Li^c	P-value	Li^d	P-value
Angola	0.016	0.410	-0.161	0.438	-0.537	0.182	-0.202	0.406
Botswana	-0.028	0.436	-0.050	0.457	0.013	0.398	-0.093	0.497
DRC	-0.487	0.199	0.306	0.189	0.198	0.279	-0.067	0.480
Eswatini	0.059	0.401	0.013	0.428	-0.027	0.460	-1.176	0.034**
Lesotho	-0.638	0.266	0.561	0.215	0.900	0.146	0.112	0.408
Malawi	-0.776	0.072*	0.575	0.070*	0.707	0.053*	-0.075	0.486
Mozambique	-0.497	0.079*	0.039	0.326	0.254	0.115	-0.440	0.112
Namibia	0.015	0.392	-0.010	0.415	0.304	0.164	0.171	0.250
South Africa	-0.041	0.431	0.101	0.252	0.171	0.181	-0.026	0.411
Tanzania	0.174	0.248	0.385	0.104	1.009	0.003**	-0.577	0.105
Zambia	-0.101	0.482	0.246	0.071*	0.163	0.110	0.142	0.146
Zimbabwe	-0.935	0.015**	0.130	0.279	0.063	0.352	0.309	0.152

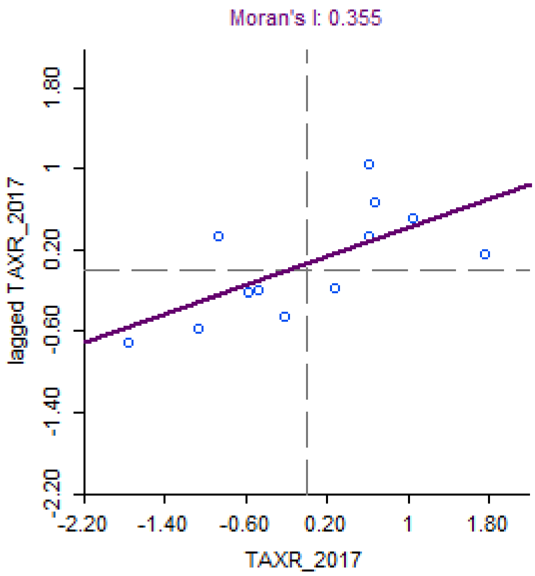
Source: author`s computations
****, **,* reject the null at 1%, 5% and 10% level of significance respectively*
$Li^{a, b, c, d}$ denote LISA`s statistic for Ln(GDP), GEXP, TAXR and PDEBT respectively

The table above shows a negative local spatial autocorrelation for Malawi, Zimbabwe and Mozambique`s economic growth over the sample period. More precisely, the countries' economic growth is not the same as its neighbouring member states. The deviations from the global trend are marginal and predominantly there is evidence of negative spatial autocorrelation. These countries form a cluster in the northeast part of the SADC region. In terms of government expenditures, Malawi and Zambia exhibit a positive local spatial clustering in the region. It is detected that these countries are surrounded by countries with the same government expenditures in the region. This is the visualization displayed in figure 5.4. Although the spatial clustering is not even across the region, countries with similar expenditure patterns share a border.

Considering tax revenues, Malawi and Tanzania show the presence of positive local spatial clustering. Most countries exhibit the same pattern except for a few atypical countries being Eswatini and Angola. This pattern of local association reflects the global trend of positive spatial autocorrelation in the SADC region. The idea is that countries with similar tax revenues patterns are clustered together. Moran`s scatterplot evidences the visualization of these results in figure 5.5. The only country that contributes to the global spatial association of public debt is Eswatini, suggesting that it shares borders with countries that have similar debt levels. This effect is negligible since there is no evidence of a global spatial association in the region. Thus a country`s debt level is independent for each country, which is intuitively plausible. A detailed description of spatial clustering is visualized with Moran's scatterplots provided below.

Moran`s I Scatter Plot: The study considered investigations for the year 2017 and sample average (2000-2017) for tax revenue and government expenditure.

Figure 5.2: Moran`s scatterplot for Tax Revenues in 2017

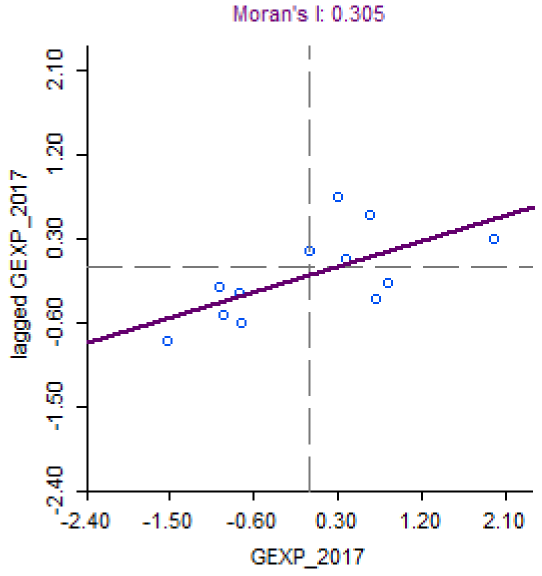


Source: author's computations

The figure above shows the relationship between tax revenue and the average value of tax revenue for neighbouring countries in SADC for the year 2017. The SADC member states are characterized by positive spatial autocorrelation. This is indicated by the positive regression line in the diagram. However, there are little atypical member states which deviate from the pattern of positive autocorrelation. In the first quadrant (top right) countries with high values are next to each other. These countries include Namibia, Lesotho, Eswatini, Zambia and Zimbabwe. South Africa is found in the second quadrant (top left). The third quadrant (bottom left) countries include DRC, Botswana, Angola, Malawi, and Mozambique. The fourth quadrant consists of only Tanzania.

The first quadrant implies that those countries mentioned have high tax revenues and are surrounded by countries with high tax revenues in 2017. The second quadrant implies that South Africa is a country with low tax revenue surrounded by countries with high tax revenues. The third quadrant suggests that the mentioned countries experience low tax revenues and are surrounded by countries with low tax revenues. The last quadrant indicates that Tanzania has high tax revenues and is surrounded by countries with low tax revenues. In 2017, 83% of the SADC member state showed an association of similar values.

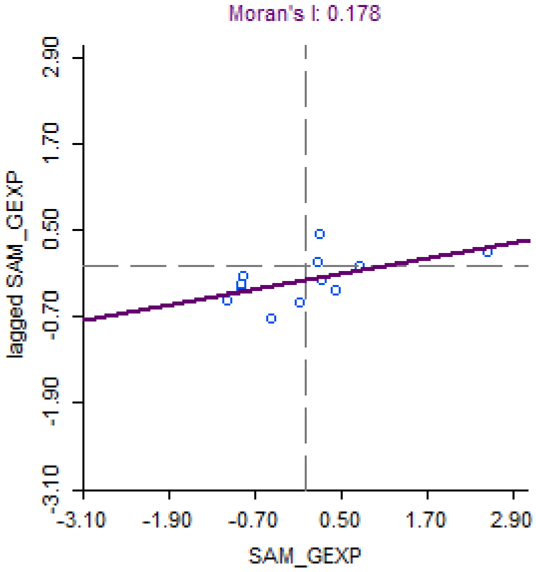
Figure 5.3: Moran`s scatterplot for government expenditure in 2017



Source: author's computations

There is a positive spatial association of the region's government expenditure variable, as seen in figure 5.3. The positive regression line shows this. In 2017 Moran's I statistic was 0.305. The first quadrant (quadrant I) consists of Lesotho, Namibia, South Africa, Zambia, and Zimbabwe. These countries` government expenditures are high and they are surrounded by countries that spend high as well. The third quadrant (quadrant III) has the following countries Angola, Malawi, DRC, Mozambique, and Botswana. These are countries with low government expenditures and they are adjacent to countries with low expenditures as well. Tanzania and Eswatini are countries with high government expenditure but are surrounded by countries with low expenditures.

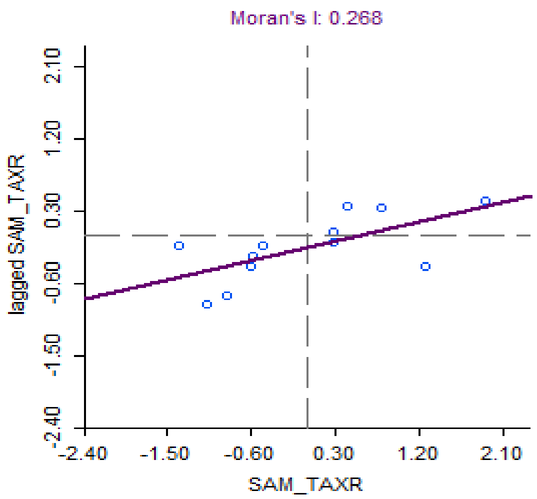
Figure 5.4: Moran's scatterplot for government expenditures (average sample)



Source author's computations

The evidence from figure 5.4 shows that for the whole sample, on average, there is positive autocorrelation in the SADC region. This is indicated by 33.3% of countries with high government expenditures surrounded by countries with high expenditure patterns and 41.6% of the countries with low government expenditures are adjacent to countries with low government expenditures. Mozambique and Namibia experience high government expenditures and are surrounded by countries with low government expenditures. Thus they deviate from the positive spatial association pattern in the region.

Figure 5.5: Moran's scatterplot for tax revenue (average sample)



Source: author's computations

There is a positive spatial correlation for the sample tax average and lagged sample tax average shown by the positive regression line in figure 5.5. The only countries that deviate from this are Mozambique and Zambia. These countries have high tax revenue and are surrounded by countries with low tax revenues. Quadrant I consist of Zimbabwe, Eswatini, Lesotho, and Namibia; these are countries with high tax revenues and are surrounded by countries with high tax revenues for the whole sample. In contrast, the remaining countries have fewer tax revenues and share borders with countries with less tax revenue in the SADC region.

As indicated earlier, the process of detecting spatial autocorrelation does not dictate how spatial effects ought to be modelled. The presence of spatial autocorrelation among the SADC countries only indicates that proximity relations are present in the sample data. Nonetheless, spatial lags and spatial errors cannot be distinguished; given the above analysis of Moran`s I. Therefore, nothing can be said about how to model these spatial effects. The next procedure is to establish the type of model to adapt to accommodate the type of spatial effects for the SADC region.

5.5 Model Specification Test for Spatial Dependence: Based on the presence of spatial autocorrelation among the countries in the SADC region. This means that spatial modelling techniques can be utilized to investigate the relationship between fiscal variables and economic growth in the region. As emphasized before, there is a need to determine whether the spatial effects should be incorporated as a lag of the dependent variable or in the error structure. There is a need to execute the Lagrange Multiplier (LM) test of errors and lags to achieve this. The tests' outcomes will lead to determining whether to use the SEM, the SAR or SDM to model spillover effects in the SADC region.

Table 5.13: Ordinary Least Squares for the SADC Region 2000-2017

Dependent Variable: Ln(GDP)	Coefficient	Std. Err.	t-stat	P>t
PDEBT	-0.0099	0.0069	-1.43	0.154
GEXP	0.0933	0.0436	2.14	0.033**
TAXR	-0.0174	0.0369	-0.47	0.638
Intercept	1.5273	0.8660	1.76	0.079*
Cross Sections Number=12 Sample Size=216 R^2=0.0424 AIC=1223.57 *Durbin-Watson stat 1.1611* *F-Test = 3.129 P-Value > F(3 , 212)= 0.0267* *Global Moran MI = 1.0000 P-Value > Z(10.599) 0.000*				

Source: author's computations

In order to perform the LM tests, a simple linear regression model (SLM) (non-spatial model) is estimated by OLS. Evidence from OLS described in Table 5.13 indicates that all coefficients for the regressors have anticipated signs. Therefore, as expected public debt and tax revenue increase may have an adverse effect on economic growth in the region. Moreover, high proportions of government expenditure positively influence growth in the region.

The results, however, indicate strong statistical significance for the government expenditure variable only. The p-value is 0.033, thus implying that the null hypothesis that government expenditure does not influence economic growth in the region is rejected at 5% level of significance. Individual influence of tax revenue and public debt on economic growth is not felt for the region for the considered sample. The null hypothesis is not rejected at all levels of significance (1%, 5%, and 10%) for these variables.

The model explains only 4.24% of the variation in economic growth. Furthermore, it suffers from positive autocorrelation since the Durbin-Watson statistic (1.16) is less than 2. Despite low R^2 value, all of the considered variables jointly influence economic growth in the region since the F-statistic is statistically significant with a p-value of 0.027, which is less than 5% level of significance.

The SLM estimated by OLS seems to demonstrate reasonable results, although not plausible. However, the residual diagnostic performed suggested a need for considering a spatial model due to spatial autocorrelation. Moran`s test on residual of the SLM estimated shows strong evidence against the null of no spatial autocorrelation in the residual. The p-value of 0.000 leads to the rejection of the null hypothesis at all levels of significance. It is vital to perform the LM tests of spatial dependence in the OLS residuals due to contiguous areas in the region. The results of the Lagrange multiplier are summarized in Table 5.14.

Table 5.14: Lagrange Multiplier tests on OLS Residuals

LM TEST		LM value	P-value	
LM Error (Burridge)	$H_0: \lambda = 0$	104.037	P-Value > Chi2(1)	0.000
LM Error (Robust)		21.167	P-Value > Chi2(1)	0.000
LM Lag (Anselin)	$H_0: \rho = 0$	104.037	P-Value > Chi2(1)	0.000
LM Lag (Robust)		19.701	P-Value > Chi2(1)	0.000

Source: author's computations

The LM error test suggests that the null of no spatial autocorrelation amongst the errors is rejected since the probability value is less than 5% level of significance. Therefore, spatial lambda is significantly different from zero. Similarly, the LM lag test proposed by Anselin *et al.* (1996) provides strong evidence against the null suggesting that there is spatial autocorrelation among the lagged dependent variables.

The results from both tests provide strong evidence against the null hypothesis and suggest that either the SAR or the SEM can fit the data. The robust LM tests also suggest strong evidence against the null hypothesis. The outcome, however, remains unclear as to which model to prefer. Based on the results, further diagnostic tests are essential to diagnose the relevance of these models (SAR and SEM) as opposed to using the SDM for capturing the spatial dependence in the SADC region.

Table 5.15: Testing for the relevance of SAR and SEM against the SDM

Model Testing	Chi-Square	Prob > Chi-Square
Testing for SAR $H_0: \gamma = 0$	chi2(3) = 7.12	0.0683*
Testing for SEM $H_0: \gamma + \rho\beta = 0$	chi2(3) = 7.76	0.0511*

Source: author`s computations
**significant at 10% level of significance*

Table 5.15 describes the relevant model to capture spatial effects among SADC region. To examine the relevance of SAR, the null hypothesis that indicates the spatial effects can be modelled by the SAR model is rejected at 10% level of significance since the probability value (0.069) is less than 10% level of significance.

Thus, the SDM model cannot be collapsed to a SAR model as suggested by the null hypothesis. The results for the SEM model likewise indicate that the null is rejected at 10% level of significance. Hence indicating that the model cannot be simplified to the SEM. On this basis, the null hypothesis of estimating the spatial effects within the SADC region through the use of the SAR or the SEM is rejected and the conclusion is that the SDM is appropriate to capture these spatial effects.

In a specific-to-general approach of model selection, Elhorst (2014) indicates that if both hypotheses $H_0: \gamma = 0$ and $H_0: \gamma + \rho\beta = 0$ are rejected, then the SDM would best describe the data. LeSage and Fischer (2008) argue that the SDM is always the best option as a point of departure. Therefore, the results indicate that to model spatial effects in the SADC region, the SDM is an ideal model to describe the data. The strategy proposed by Elhorst (2014) and LeSage and Fischer`s proposition for model comparison will be integrated. This implies that in this study, the OLS, SAR, SEM, and SDM are estimated for comparison and further analysis.

Estimation and Model Comparison: The results from Table 5.16 presents estimates from the spatial autoregressive model, the spatial error model and the spatial Durbin model based on twelve nearest neighbours in the SADC region. The neighbourhood and time fixed effects are controlled for. Failure to account for these effects might lead to the spatial interaction and spillover effects to be biased upwards (Elhorst, 2010)

Table 5.16: Model Comparison

	Spatial Autoregressive Model		Spatial Error Model		Spatial Durbin Model	
Dependent variable: L(GDP)	Random Effect	Fixed Effect	Random Effect	Fixed Effect	Random Effect	Fixed Effect
Cons. *P-value*	0.9485 *0.321*	-	1.0904 *0.345*	-	7.7750 *0.000****	-
PDEBT *P-value*	-0.0119 *0.012***	-0.0009 *0.885*	-0.0097 *0.052**	-0.0013 *0.846*	-0.0067 *0.203*	-0.0015 *0.748*
GEXP *P-value*	0.0905 *0.325*	0.0965 *0.247*	0.0912 *0.316*	0.0969 *0.242*	0.1108 *0.227*	0.1082 *0.235*
TAXR *P-value*	0.0003 *0.996*	0.2662 *0.549*	0.0039 *0.941*	0.0319 *0.479*	0.0124 *0.773*	0.0077 *0.842*
W* PDEBT *P-value*	-	-	-	-	-0.0365 *0.004****	-0.0128 *0.387*
W* GEXP *P-value*	-	-	-	-	-0.0539 *0.581*	-0.0519 *0.572*
W* TAXR *P-value*	-	-	-	-	-0.2286 *0.005****	-0.1856 *0.014***
rho *P-value*	0.1568 *0.059**	-0.2132 *0.002****	-	-	0.0771 *0.434*	-0.2957 *0.003****
Lambda *P-value*	-	-	0.1610 *0.083**	-0.1976 0.017**	-	-
Log likelihood	-605.839	-588.478	-605.946	-588.759	-597.795	-584.401
AIC	1225.68	1186.96	1225.89	1187.52	1215.59	1184.80
Hausman Test *H_0: RE appropriate* *P-value*	χ^2_4 =15.6 *0.0037****		χ^2_4 =35.0 *0.0000****		χ^2_7 =36.9 *0.000****	

Source: author`s computations
****, **,* indicate 1%, 5% and 10% level of significance*

Before considering the interpretation of the coefficients, it is necessary to examine the individual fixed and random effects. The Hausman test conducted suggested that the null hypothesis of the appropriateness of the random effect model is rejected since the p-value is highly significant at 1% level of significance. The conclusion is that the fixed effect model is appropriate for all models in this context. The Log-likelihood and the AIC model selection criteria suggest that the SDM with fixed effects is a suitable model to capture the spatial effects within the SADC region. This is consistent with the results presented in Table 5.15.

The spatial rho and lambda are statistically significant, thus suggesting the presence of spatial dependence in the region. More precisely, the negative and significant rho from the SDM model suggests a competitive process that triggers an outflow of resources from one member state to another in the region. Therefore, there is no spatial clustering of similar patterns of high or low values in the SADC region. Simply put, economic growth of other states is not affected by other states. This can be re-emphasized by recalling the results from Moran`s I and the LISA statistics for Ln(GDP). As previously stressed, the SDM coefficients' interpretation is not the same as for a simple linear regression model. To determine the signs and impacts of the regressors, the direct and indirect effects presented in Table 5.17 are considered for interpretation.

Table 5.17: Direct, Indirect and Total effects for the SAR and SDM models

Direct effect	SAR	SDM
PDEBT	-0.0007 *(0.920)*	0.0006 *(0.898)*
GEXP	0.0937 *(0.252)*	0.1075 *(0.228)*
TAXR	-0.0231 *(0.595)*	0.0199 *(0.591)*
Indirect effect		
PDEBT	-0.0001 *(0.928)*	-0.0111 *(0.378)*
GEXP	-0.0171 *(0.291)*	-0.0668 *(0.391)*
TAXR	0.0047 *(0.581)*	-0.1641*** *(0.008)*
Total Effect		
PDEBT	-0.0008 *(0.886)*	-0.0118 *(0.342)*
GEXP	0.0766 *(0.255)*	0.0407 *(0.693)*
TAXR	-0.0184 *(0.603)*	-0.1441** *(0.049)*

Source: author`s computations
****, ** denote significance level at 1% and 10% respectively*
P-values are in parenthesis

The interpretation will be exclusively based on the SDM estimates since the results from Table 5.15 and 5.16 suggested that it is a parsimonious model. However, the results from the SAR model shows that signs for direct effects conform to theory. Based on theoretical grounds, it is expected that public debt and tax revenue negatively affect economic growth whereas government expenditure tends to have a stimulus effect on growth.

Direct Effect: Considering the Spatial Durbin model, it can be noticed from the direct effect that the signs are contrary to theoretical expectations, especially for public debt and tax revenue. Furthermore, the direct impact of an increase in public debt, government expenditure, and tax revenue are not significant. Thus, suggesting that an increase in these variables does not have any impact on economic growth for individual member states. Although the results are contrary to theoretical expectations, the outcome for public debt provides strong support for prior studies that purported that only high debt levels harm growth (Reinhart & Rogoff, 2010; Woo & Kumar, 2015; Cecchetti et al., 2011). According to the direct impact evidence, fiscal policy is ineffective in stimulating economic growth for SADC member states. The results strongly support Engen and Skinner (1992), who purported that fiscal policy stifles dynamic economic growth due to the distortionary effects of taxation and inefficient expenditures.

Indirect Effect: The indirect spillover effect of increasing tax revenue is negative and significant. This suggests that increased tax revenues in neighbouring member states have a negative spillover impact on other countries' economic growth. This is counterintuitive since the expectation is that a positive tax shock is a disincentive to invest and getting employment, thus negatively affect economic growth. More precisely, a rise in corporate and income tax will lead to firms' mobility and labour to contiguous countries. Therefore, a positive impact is expected in neighbouring countries. The total effect of tax revenues is negative and encompasses most of the indirect effect.

The coefficients from the indirect effect for government expenditures and public debt are statistically insignificant. This empirical evidence shows that an increase in government expenditures or public debt does not affect economic growth in a country nor contiguous countries within the SADC region. The lack of indirect spillover effect due to positive shocks in government expenditures is contrary to expectations since positive or negative externalities might surface. This can be argued in line with the hypothesis poised by Tiebout (1956), who indicated that rational consumers are knowledgeable and sensitive to revenue and expenditure changes. Thus differences in these variables will trigger their migration patterns to satisfy their preference for public goods.

The insignificant result of government expenditure indirect spillover effects can be motivated by stringent controls to access public goods. Such goods can be access to healthcare, housing, employment, and doing business despite the relaxed migration controls in the region. This can be perceived as negative externalities to positive government expenditure shocks in the other regions. More specifically, the findings are consistent with the idea that public goods are not provided as economic growth stimulants but rather to redistribute public welfare and pool risk (Segura, 2017). The results diverge from other empirical evidence such as Case *et al.* (1993), Ojede *et al.* (2018), Segura (2017), and other theoretical models of spillovers.

Intuitively, the public debt variable from the indirect effect is not significant, suggesting that public debt in a particular member state does not influence neighboring countries' economic growth. The results are plausible because these variables' relationship is not clear from both theoretical and empirical perspectives. Generally, indirect effect on average exceeds the direct effect, suggesting that economies are inter-connected and variations in one economy's parameter lead to changes in other contiguous economies (Kopczewska et al., 2017).

Concluding Remarks: In this chapter, the results have been explained and thoroughly discussed. Moreover, the results have been linked with empirical evidence from the literature review. The results discussed include the regression, causality, and spatial spillovers analysis. The following chapter provides the conclusion drawn from this study and the recommendations.

CHAPTER 6

CONCLUSION, POLICY IMPLICATIONS AND RECOMMENDATIONS

Introduction

This study comprehensively investigated the relationship between economic growth and fiscal variables in the SADC region. In doing so, both time series and panel data analysis were pursued. The essence of considering time series analysis was to overcome the shortcomings of panel data models and account for pronounced heterogeneity in the region. One novelty of this study was to account for spatial spillover effects that might impede regional integration efforts.

The relationship between Fiscal Variables and Economic Growth: Considering country heterogeneity, public debt is inversely related to economic growth for Angola and Zimbabwe, whereas there was no evidence for other member states. There is a positive and significant relationship between government expenditures and economic growth for Angola and Lesotho. A negative and significant relationship is found for Botswana, Mozambique, and South Africa. Tax revenue and economic growth are positively and significantly related for DRC, Malawi, and South Africa. Based on the results, government expenditures are positively associated with economic growth and the other variables are statistically insignificant for the SADC region.

The direction of Influence between Fiscal Variables and Economic Growth: The study results show that tax revenues and economic growth influence each other for South Africa and Eswatini. Moreover, tax revenue influences economic growth for Malawi, Mozambique, Lesotho, and Namibia. There was no evidence of causality for the remaining countries. Economic growth influenced public debt for Botswana, DRC, Mozambique, South Africa, and Zambia. However, for Malawi, Tanzania and Zimbabwe, public debt influenced economic growth.

Government expenditures and economic growth influence each other for Namibia and Tanzania. Furthermore, government expenditures influence economic growth in South Africa. For DRC, Malawi, Mozambique, and Zimbabwe it is economic growth that influences increased government expenditures. There is evidence of fiscal synchronization for DRC. A Spend-Tax hypothesis is supported in South Africa. The tax-spend hypothesis is supported in Namibia, Malawi, Zimbabwe, and Tanzania. The institutional separation hypothesis was found for Angola, Botswana, Eswatini, Lesotho, Mozambique, and Zambia. Based on a panel of SADC countries, the results suggest that economic growth influences public debt in the region. Therefore, economic growth influences the evolution of government debt in the region. Moreover, government expenditures influence economic growth in the region. Furthermore, there is evidence of fiscal synchronization in the region.

Spillover Effects: The spatial interactions have been examined at both the global and local spatial effects. The study has shown evidence of spatial dependence in the region, especially for tax revenues and expenditures. Therefore, spatial considerations are essential when modelling their effects. Not considering some spatial approaches may lead to biased, inefficient and inconsistent results (Anselin, 1988). The results suggest that the potential spatial interactions are facilitated via fiscal policy in the region. Relative to the literature, the spatial dependence result indicated that fiscal variables tend to have spillover effects across interconnected countries. However, the estimates presented in this study are different in magnitude, signs, and statistical significance of the fiscal variables.

There is evidence of negative spillover effects emanating from tax revenues. However, the direct effect of fiscal variables in each economy within the SADC region does not show any relationship with economic growth. This suggests that the adoption of fiscal policy in the region does not have any Keynesian effects particularly on economic growth thus cannot be rendered as pro-growth. Moreover, there is no evidence of the spatial dependence of public debt in the region. Thus, suggesting that debt distribution in the region is purely independent. There are no spillover effects of public debt and expenditures in the region. Therefore, individual countries' debt accumulation and spending behaviour in the region do not impose externalities on other member states due to strategic interactions.

Overall, the results suggest that the fiscal variables respond differently to economic growth for SADC member states. In some countries, these variables are not related meaning that fiscal policy is a weak policy option to boost local economies. Furthermore, the option through which budget deficits are addressed is tailored to each country. However, the results suggest that the region needs to increase expenditures to boost the whole region. To address the issue of budget deficit government expenditures and tax decisions should be made simultaneously. Nonetheless, increased spending in the region does not have any externalities in contiguous countries. Taxes have a negative impact on neighbouring countries. These results are diverting from other studies that found that local tax increase is a growth deterrent but pro-growth for contiguous countries (Kopczewska et al., 2017; Goujard, 2013; Ojede et al., 2019; Segura, 2017). Although the evidence is contrary to expectations, the inference is that public services are not provided to promote economic growth but rather to redistribute welfare and pool risks (Segura, 2017).

Policy implications can be drawn from the results, especially in the emergence of slow economic growth, the existence of spatial dependence, and country interactions. Based on the results, the negative spillover effects for tax revenue calls for tax harmonization in the region. The occurrence of spatial dependence of fiscal variables indicates that coordinated mechanisms are crucial to advance the regional integration efforts. Policy harmonization is vital to smooth out the competition caused by different policies adopted to boost local economies.

The study recommends that there should be policies geared towards tax harmonization in the SADC region. Furthermore, to boost local economies fiscal policy options should be tailored towards each country. It is necessary for the SADC region to increase government expenditures particularly on productive government expenditures to boost economic growth. Boosting economic growth will ultimately reduce public spending and later reduce debt levels. Lastly, to reduce budget deficits spending and tax decisions should be done at the same time.

It is important to note that SADC is not a trading bloc but a regional economic community that has aspirations for regional integration. Therefore, the rationale of considering fiscal and economic growth variables was because the variables tend to be correlated in space. If these variables are correlated, and there is a competitive process among countries, this might be a stumbling block for integration aspirations.

Limitations of the study

A potential limitation of this study is that it pursued empirical investigation based on the aggregate of both tax revenues and expenditures. Some studies indicate that disaggregated data reveals a clear picture of government expenditure and tax revenue on economic growth. This study did not capture that impact categorically on economic growth. It will be interesting to disaggregate taxes and investigate their spatial effect on economic growth in the SADC region. This will help policymakers to understand the nature of tax coordination policies that are pro-growth. Furthermore, employing the binary contiguity matrix meant that only twelve out of sixteen SADC countries are considered for investigation. It is interesting for further studies to adopt different spatial weight matrix that accounts for the inclusion of islands such as Mauritius, Madagascar, Seychelles, and Comoros.

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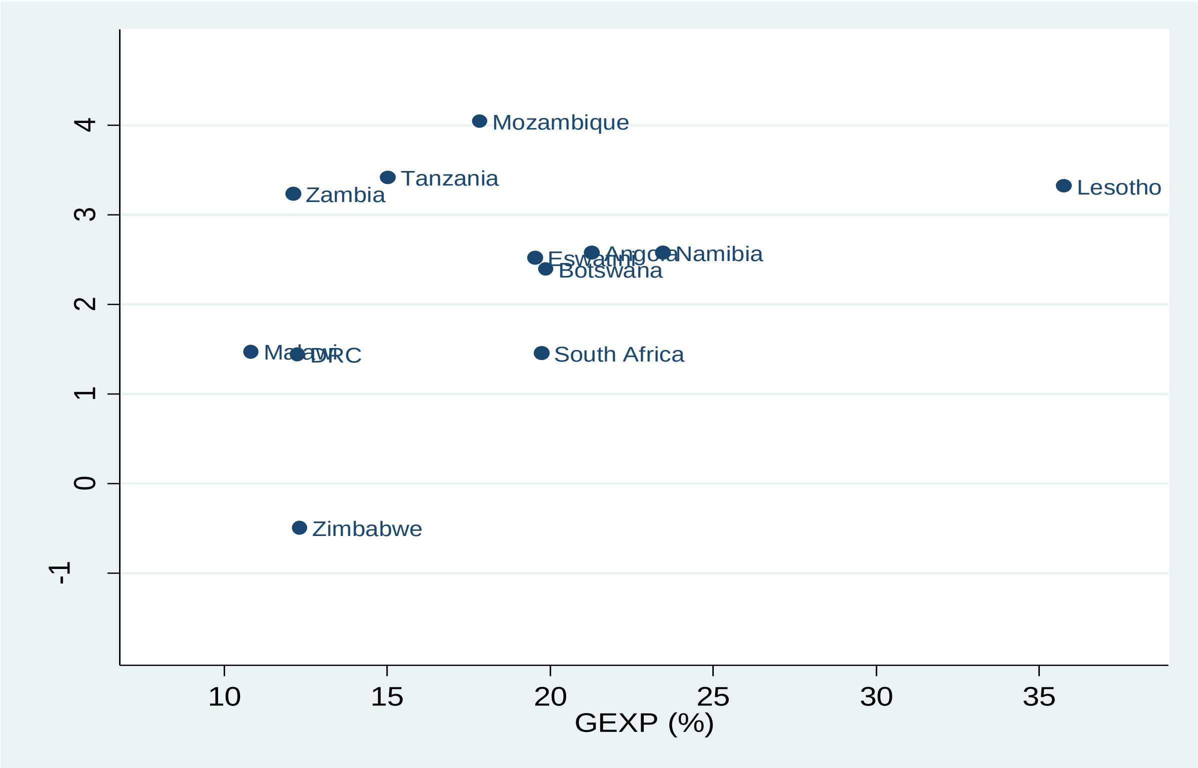
APPENDIX A: Country Level Results

Map A1: Southern African Development Community (SADC)

Source: GADM maps with modifications

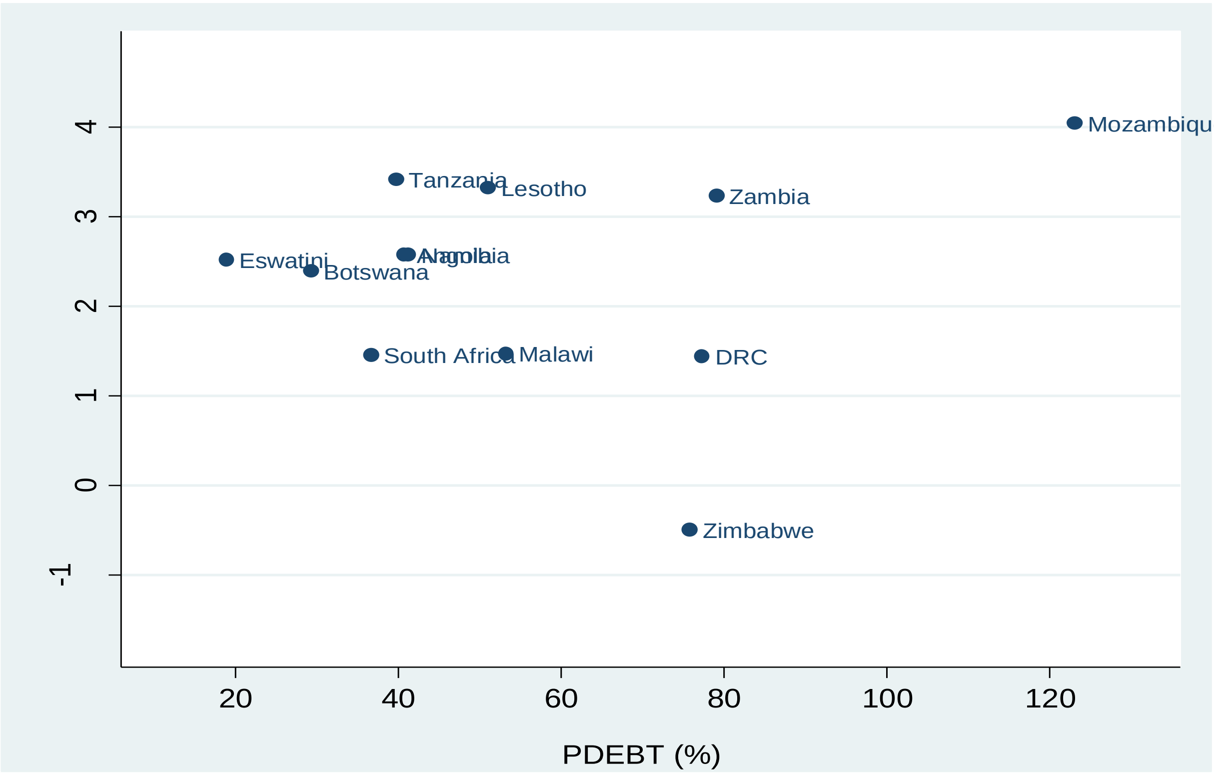
Mauritius, Madagascar, Seychelles, and Comoros are excluded from the analysis following the justification provided at the data section.

Figure A1: The scattergram of Economic Growth and Government Expenditures (Sample Average)



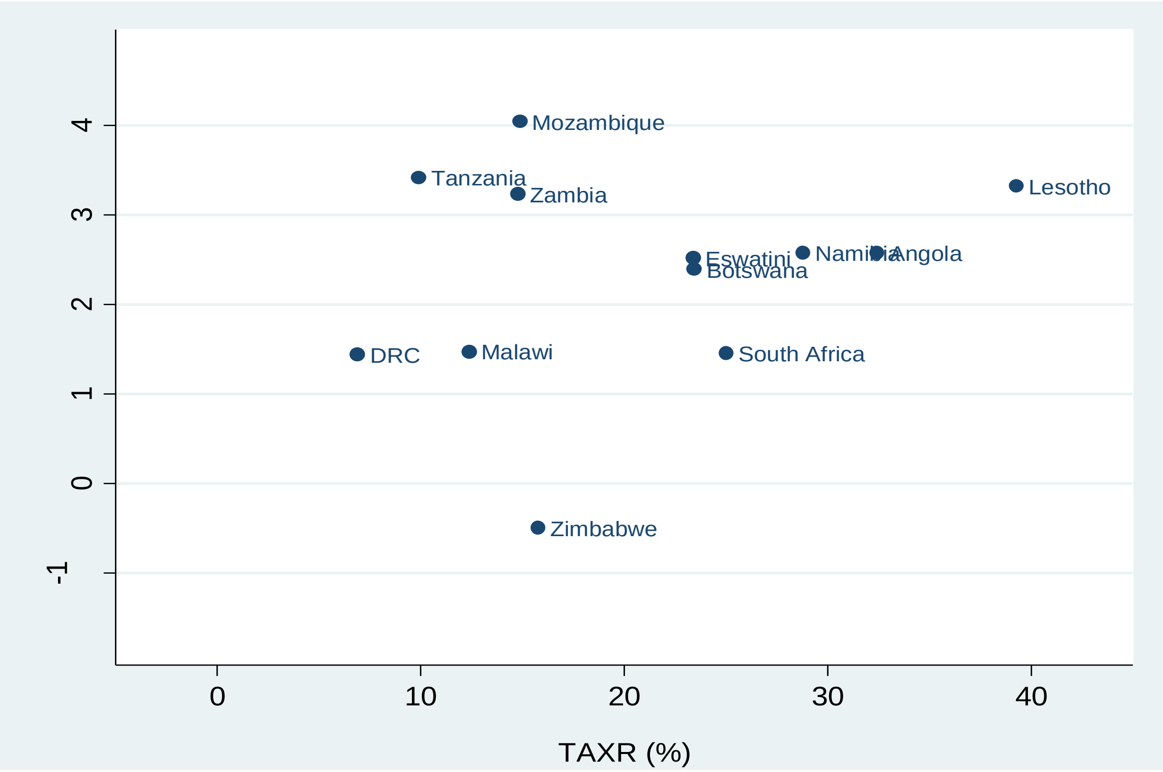
Source: author's computations

Figure A2: The scattergram of Economic Growth and Public Debt (Sample Average)



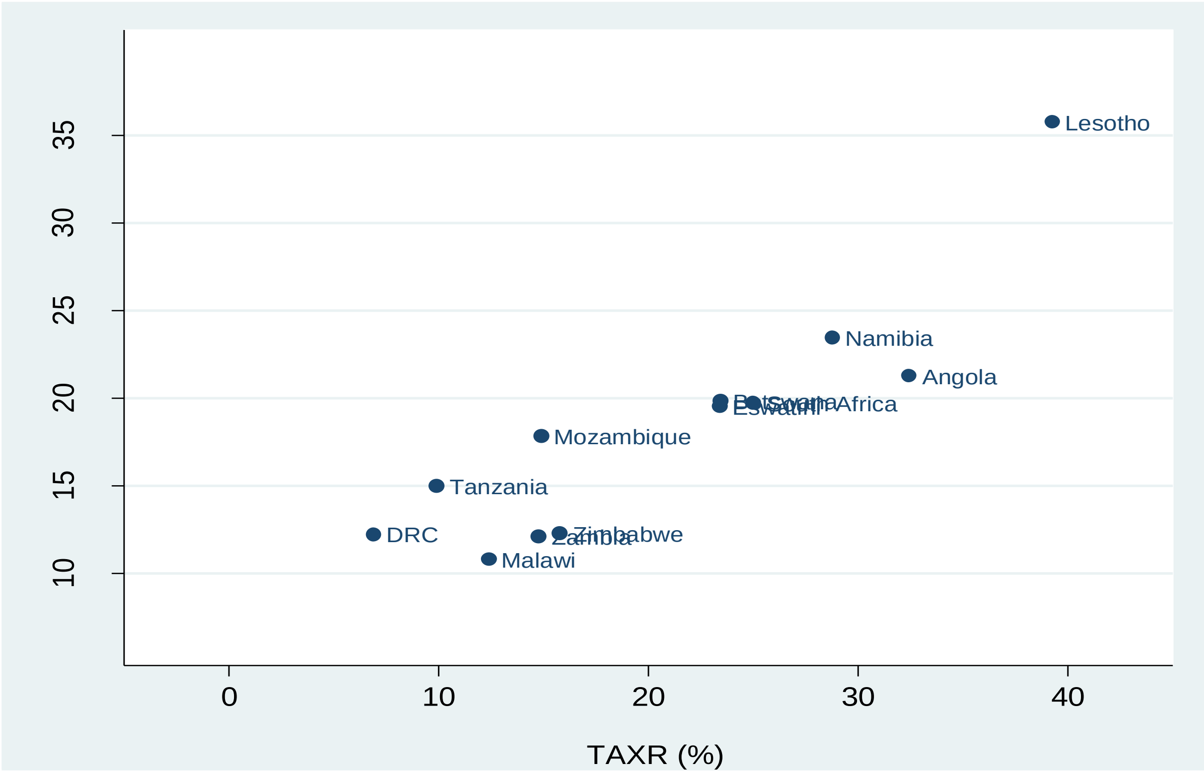
Source: author's computations

Figure A3: The scattergram of Economic Growth and Tax Revenue (Sample Average)



Source: author's computations

Figure A4: The scattergram of Government Taxes and Expenditures (Sample Average)



Source: author's computations

Table A1: Country-wise Unit Root Test for Fiscal Variables and Economic Growth, 2000-2017

COUNTRY	Philips-Perron							
	GDPPCG	P-value	PDEBT	P-value	GEXP	P-value	TAXR	P-value
Angola	$I(0)_{ct}$	0.0975	I(0)	0.0977	$I(1)_{c}$	0.0556	$I(1)_{c}$	0.0077
Botswana	$I(0)_{c}$	0.0003	$I(0)_{ct}$	0.0000	$I(0)_{c}$	0.0003	$I(I)_{c}$	0.0099
DRC	$I(0)_{c}$	0.0029	$I(1)_{ct}$	0.0040	$I(0)_{c}$	0.0127	$I(0)_{c}$	0.0640
Eswatini	$I(1)_{c}$	0.0006	$I(1)_{c}$	0.0017	$I(1)_{c}$	0.0000	$I(1)_{c}$	0.0115
Lesotho	$I(1)_{c}$	0.0001	$I(1)_{c}$	0.0526	$I(0)_{c}$	0.0003	$I(0)_{c}$	0.0037
Malawi	$I(1)_{c}$	0.0013	$I(1)_{c}$	0.0220	$I(0)_{c}$	0.0455	$I(1)_{c}$	0.0001
Mozambique	$I(0)_{c}$	0.0036	$I(1)_{c}$	0.0456	$I(0)_{c}$	0.0022	$I(1)_{nc}$	0.0394
Namibia	$I(0)_{c}$	0.0285	$I(1)_{c}$	0.0010	$I(1)_{c}$	0.0000	$I(1)_{c}$	0.0080
South Africa	$I(0)_{nc}$	0.006	$I(1)_{c}$	0.0031	$I(0)_{ct}$	0.0106	$I(1)_{c}$	0.0595
Tanzania	$I(0)_{c}$	0.0043	$I(1)_{nc}$	0.0264	$I(1)_{c}$	0.0117	$I(1)_{c}$	0.0007
Zambia	$I(1)_{c}$	0.0002	$I(1)_{nc}$	0.0385	$I(1)_{c}$	0.0429	$I(0)_{c}$	0.0042
Zimbabwe	$I(0)_{nc}$	0.0011	$I(1)_{c}$	0.0646	$I(1)_{c}$	0.0098	$I(1)_{c}$	0.0173

Source: author's computations

*Note **c**, **ct**, and **nc** implies **constant**, **constant & trend** and **none** models*

I (0) - series is stationary at levels and I (1) series is stationary at first difference.

CAUSALITY TEST

Table A2: The Toda and Yamamoto Causality Test between Fiscal Variable and Economic Growth

H_0: Excluded variables does not granger cause Ln(GDP)			
Country	Excluded	Chi. Square	P-value
Angola	GEXP	2.529	0.2824
	PDEBT	0.986	0.6106
	TAXR	2.581	0.2752
Botswana	GEXP	1.779	0.4109
	PDEBT	1.879	0.3908
	TAXR	2.304	0.3160
DRC	GEXP	0.365	0.8330
	PDEBT	1.763	0.4142
	TAXR	3.268	0.1951
Eswatini	GEXP	1.887	0.3893
	PDEBT	0.285	0.8673
	TAXR	13.145	0.0014***
Lesotho	GEXP	1.092	0.5793
	PDEBT	3.551	0.1694
	TAXR	6.501	0.0387**
Malawi	GEXP	0.446	0.8001
	PDEBT	6.586	0.0371**
	TAXR	6.477	0.0392**
Mozambique	GEXP	0.150	0.9279
	PDEBT	0.803	0.6694
	TAXR	5.646	0.0594*
Namibia	GEXP	7.858	0.0197**
	PDEBT	0.989	0.6099

	TAXR	7.457	0.0240**
South Africa	GEXP	6.358	0.0416**
	PDEBT	3.466	0.1768
	TAXR	3.331	0.1890
Tanzania	GEXP	5.656	0.0591*
	PDEBT	14.409	0.0007*
	TAXR	3.215	0.2004
Zambia	GEXP	0.102	0.9501
	PDEBT	0.651	0.7221
	TAXR	2.718	0.2570
Zimbabwe	GEXP	0.319	0.8527
	PDEBT	7.499	0.0235*
	TAXR	1.856	0.3954

Source: author`s computation
****, **,* indicates 1%, 5%, and 10% level of significance respectively*

Table A3: The Toda and Yamamoto Causality Test between Ln(GDP), PDEBT and TAXR on GEXP

H_0: Excluded variables does not granger cause GEXP			
Country	Excluded	Chi. square	P-value
Angola	Ln(GDP)	1.929	0.3812
	PDEBT	2.149	0.3415
	TAXR	4.608	0.0999
Botswana	Ln(GDP)	0.643	0.7252
	PDEBT	0.920	0.6312
	TAXR	0.7264	0.6954
DRC	Ln(GDP)	5.665	0.0589*
	PDEBT	17.356	0.0002***
	TAXR	19.067	0.0001***
Eswatini	Ln(GDP)	0.738	0.6913
	PDEBT	1.635	0.4416
	TAXR	0.720	0.6977
Lesotho	Ln(GDP)	4.599	0.1003
	PDEBT	10.349	0.0057**
	TAXR	1.5724	0.4556
Malawi	Ln(GDP)	9.340	0.0094**
	PDEBT	6.110	0.0471**
	TAXR	27.573	0.0000***
Mozambique	Ln(GDP)	4.615	0.0995*
	PDEBT	5.391	0.0675*
	TAXR	2.840	0.2418
Namibia	Ln(GDP)	5.991	0.0500*
	PDEBT	3.649	0.1613
	TAXR	9.320	0.0095**
South Africa	Ln(GDP)	2.532	0.2820
	PDEBT	0.422	0.8096
	TAXR	1.033	0.5966
	Ln(GDP)	13.940	0.0009***

Tanzania	PDEBT	4.311	0.1158
	TAXR	9.517	0.0086***
Zambia	Ln(GDP)	0.029	0.9858
	PDEBT	1.051	0.5912
	TAXR	0.773	0.6793
Zimbabwe	Ln(GDP)	9.204	0.0100**
	PDEBT	7.673	0.0216**
	TAXR	9.880	0.0072***

Source: author`s computation

****, **,* indicates 1%, 5%, and 10% level of significance respectively*

Table A4: Toda and Yamamoto Causality between Ln(GDP), GEXP and PDEBT on TAXR

H_0: Excluded variables does not granger cause TAXR			
Country	Excluded	Chi. square	P-value
Angola	Ln(GDP)	1.779	0.4109
	GEXP	0.150	0.9277
	PDEBT	2.707	0.2583
Botswana	Ln(GDP)	2.310	0.3150
	GEXP	0.630	0.7299
	PDEBT	2.513	0.2847
DRC	Ln(GDP)	0.302	0.8598
	GEXP	5.658	0.0591*
	PDEBT	1.7638	0.4140
Eswatini	Ln(GDP)	4.996	0.0822*
	GEXP	2.407	0.3002
	PDEBT	1.999	0.3681
Lesotho	Ln(GDP)	3.673	0.1593
	GEXP	0.972	0.6151
	PDEBT	0.345	0.8414
Malawi	Ln(GDP)	0.226	0.8933
	GEXP	0.027	0.9866
	PDEBT	0.252	0.8814
Mozambique	Ln(GDP)	0.485	0.7848
	GEXP	2.832	0.2427
	PDEBT	0.454	0.7967
Namibia	Ln(GDP)	2.920	0.2322
	GEXP	0.070	0.9657
	PDEBT	7.819	0.0201**
South Africa	Ln(GDP)	4.758	0.0926**
	GEXP	28.880	0.0000***
	PDEBT	3.372	0.1853
Tanzania	Ln(GDP)	0.260	0.8781
	GEXP	3.575	0.1674
	PDEBT	5.942	0.0513*
Zambia	Ln(GDP)	2.320	0.3135
	GEXP	3.072	0.2152
	PDEBT	8.530	0.0140**
	Ln(GDP)	5.222	0.0735*

Zimbabwe	GEXP	1.046	0.5926
	PDEBT	3.941	0.1394

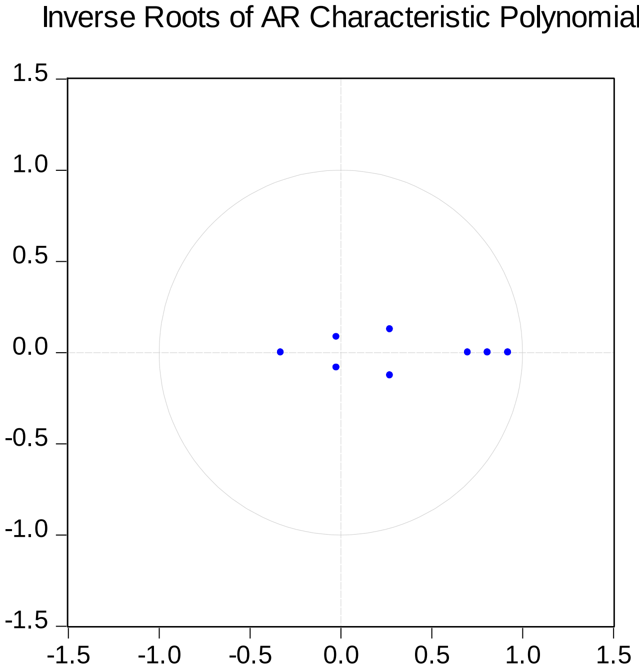
Source: author`s computation
****, **,* indicates 1%, 5%, and 10% level of significance respectively*

Table A5: Toda and Yamamoto Causality between Ln(GDP), GEXP and TAXR on PDEBT

H_0: Excluded variables does not granger cause PDEBT			
Country	Excluded	Chi. Square	P-value
Angola	Ln(GDP)	1.630	0.4427
	GEXP	3.069	0.2156
	TAXR	3.876	0.1440
Botswana	Ln(GDP)	5.133	0.0768*
	GEXP	2.072	0.3548
	TAXR	4.998	0.0822*
DRC	Ln(GDP)	7.176	0.0277**
	GEXP	11.901	0.0026***
	TAXR	13.173	0.0014***
Eswatini	Ln(GDP)	3.419	0.1809
	GEXP	1.519	0.4680
	TAXR	10.924	0.0042***
Lesotho	Ln(GDP)	2.145	0.3421
	GEXP	0.832	0.6598
	TAXR	1.514	0.4690
Malawi	Ln(GDP)	2.902	0.2344
	GEXP	1.188	0.5521
	TAXR	1.085	0.5813
Mozambique	Ln(GDP)	5.895	0.0525*
	GEXP	7.433	0.0243**
	TAXR	10.544	0.0051***
Namibia	Ln(GDP)	0.302	0.8600
	GEXP	5.041	0.0804*
	TAXR	2.129	0.3448
South Africa	Ln(GDP)	6.273	0.0434**
	GEXP	2.506	0.2856
	TAXR	4.191	0.1230
Tanzania	Ln(GDP)	0.543	0.7623
	GEXP	2.654	0.2653
	TAXR	8.126	0.0172**
Zambia	Ln(GDP)	5.748	0.0565*
	GEXP	7.034	0.0297**
	TAXR	2.248	0.3249
Zimbabwe	Ln(GDP)	0.181	0.9134
	GEXP	2.694	0.2600
	TAXR	3.469	0.1765

Source: author`s computation
****, **,* the null hypothesis is rejected at 1%, 5%, and 10% level of significance respectively*

Figure A5: Panel VAR stability Test



COINTEGRATION

Table A6: Johansen Cointegration Test Results, 2000-2017

H_0 : no cointegration	λ_{trace}		λ_{max}	
Country	r = 0	r<1	r=0	r<1
Angola	66.799	24.329	42.470	14.696
P-value	*0.0003****	*0.1869*	*0.0003****	*0.3108*
Botswana	70.483	34.216	36.267	19.223
P-value	*0.0001****	*0.0145***	*0.0030****	*0.0906**
DRC	85.873	39.611	46.263	26.4136
P-value	*0.0000****	*0.0027****	*0.0001****	*0.0082****
Eswatini	91.327	45.49973	45.827	24.423
P-value	*0.0000****	*0.0004****	*0.0001****	*0.0166***
Lesotho	77.724	36.115	41.609	23.097
P-value	*0.0000****	*0.0082****	*0.0004****	*0.0261***
Malawi	107.418	40.937	66.4813	30.937
P-value	*0.0000****	*0.0018****	*0.0000****	*0.0015****
Mozambique	49.698	26.821	22.877	20.557
P-value	*0.0332***	*0.1061*	*0.1788*	*0.0600***
Namibia	66.389	33.659	32.730	18.251
P-value	*0.0004****	*0.0171***	*0.0099****	*0.1207*
South Africa	76.210	0.582	50.145	13.947
P-value	*0.0000****	*0.1268*	*0.0000****	*0.3694*
Tanzania	74.733	39.973	34.760	28.359
P-value	*0.0000****	*0.0024****	*0.0050****	*0.0040****

Zambia *P-value*	65.365 *0.0005****	26.036 *0.1276*	39.329 *0.0010****	14.08557 *0.3581*
Zimbabwe *P-value*	63.949 *0.0008****	33.013 *0.0206***	30.935 *0.0179***	20.805 *0.0555**

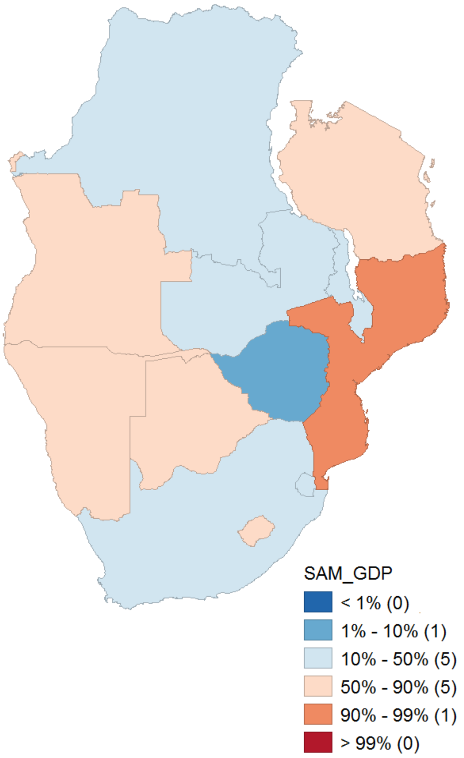
Source: author's computations

****, **,* reject the null at 1%, 5% and 10% level significance respectively*

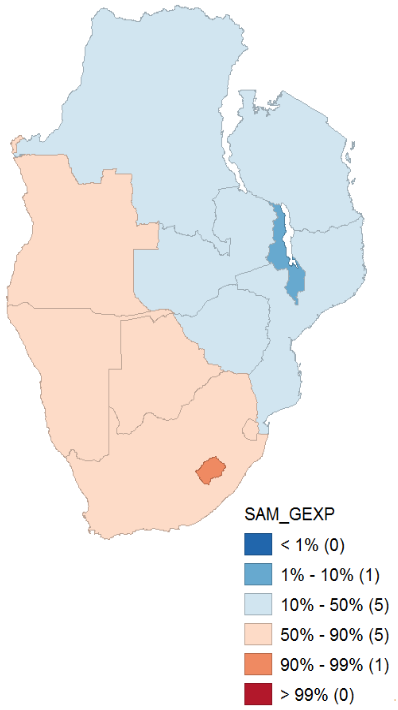
APPENDIX B: Spatial Panel Results

Map B1: Percentile Map for Average TAXR, Ln(GDP), PDEBT, and GEXP in SADC

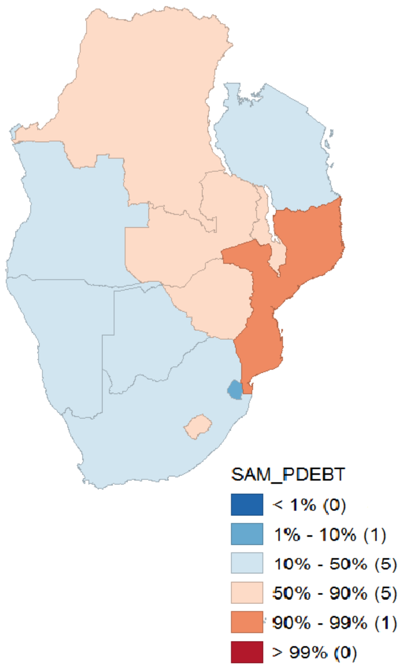
AVERAGE GDP PER CAPITA GROWTH (2000-2017)



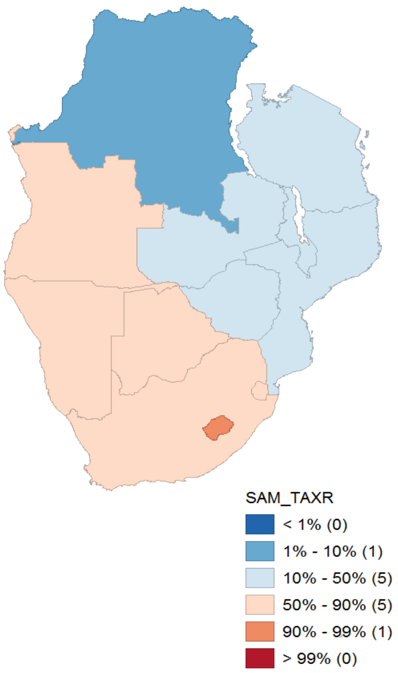
AVERAGE GOVERNMENT EXPENDITURES (2000-2017)



AVERAGE PUBLIC DEBT (2000-2017)



AVERAGE TAX REVENUE (2000-2017)



Source: author's computations
The percentile map is computed using the sample average data
The map shows areas with high extreme values and low extreme values

SPATIAL WEIGHT MATRIX

Table B1: Spatial Binary Contiguity Matrix

i,j	1	2	3	4	5	6	7	8	9	10	11	12
1	0	0	1	0	0	0	0	1	0	0	1	0
2	0	0	0	0	0	0	0	1	1	0	1	1
3	1	0	0	0	0	0	0	0	0	1	1	0
4	0	0	0	0	0	0	1	0	1	0	0	0
5	0	0	0	0	0	0	0	0	1	0	0	0
6	0	0	0	0	0	0	1	0	0	1	1	0
7	0	0	0	1	0	1	0	0	1	1	1	1
8	1	1	0	0	0	0	0	0	1	0	1	0
9	0	1	0	1	1	0	1	1	0	0	0	1
10	0	0	1	0	0	1	1	0	0	0	1	0
11	1	1	1	0	0	1	1	1	0	1	0	1
12	0	1	0	0	0	0	1	0	1	0	1	0

Source: authors' computations

Where 1= Angola 2=Botswana 3=Democratic Republic of Congo 4=Eswatini 5=Lesotho 6=Malawi 7=Mozambique 8=Namibia 9=South Africa 10=Tanzania 11=Zambia 12=Zimbabwe

The row standardised W matrix

Table B2: The Row Standardised Spatial Weight Matrix for the SADC Region

i,j	1	2	3	4	5	6	7	8	9	10	11	12
1	0	0	1/3	0	0	0	0	1/3	0	0	1/3	0
2	0	0	0	0	0	0	0	1/3	1/3	0	1/3	1/3
3	1/3	0	0	0	0	0	0	0	0	1/3	1/3	0
4	0	0	0	0	0	0	1/2	0	1/2	0	0	0
5	0	0	0	0	0	0	0	0	1/1	0	0	0
6	0	0	0	0	0	0	1/3	0	0	1/3	1/3	0
7	0	0	0	1/6	0	1/6	0	0	1/6	1/6	1/6	1/6
8	¼	1/4	0	0	0	0	0	0	1/4	0	1/4	0
9	0	1/6	0	1/6	1/6	0	1/6	1/6	0	0	0	1/6
10	0	0	1/4	0	0	1/4	1/4	0	0	0	1/4	0
11	1/8	1/8	1/8	0	0	1/8	1/8	1/8	0	1/8	0	1/8
12	0	1/4	0	0	0	0	1/4	0	1/4	0	1/4	0

Source: author`s computation

LOCAL INDICATORS OF SPATIAL AUTOCORRELATION (LISA)

Table B3: Real GDP Per Capita Growth LISA in the SADC Region

Country	Li^{2000}	P-value	Li^{2017}	P-value	$Li^{2000\text{-}2017}$	P-value
Angola	-0.009	0.425	0.639	0.069*	0.016	0.410
Botswana	0.020	0.381	0.005	0.406	-0.028	0.436
DRC	-1.086	0.011**	0.001	0.426	-0.487	0.199
Eswatini	0.106	0.359	0.031	0.423	0.059	0.401
Lesotho	1.031	0.076*	0.130	0.407	-0.638	0.266
Malawi	-0.077	0.487	0.334	0.194	-0.776	0.072*
Mozambique	-0.041	0.431	0.177	0.176	-0.497	0.079*
Namibia	0.235	0.188	0.462	0.085*	0.015	0.392
South Africa	0.139	0.212	0.008	0.365	-0.041	0.431
Tanzania	-0.491	0.139	0.395	0.114	0.174	0.248
Zambia	-0.158	0.389	0.014	0.305	-0.101	0.482
Zimbabwe	-0.315	0.272	0.202	0.234	-0.935	0.015**

Source: author`s computations
****, **,* reject the null at 1%, 5% and 10% level of significance respectively*
$Li^{2000,\ 2017,\ 2000\text{-}2017}$ denote LISA`s statistic for the year 2000, 2017 and sample average respectively

Table B4: Government Expenditure LISA in the SADC Region

Country	Li^{2000}	p-value	Li^{2017}	p-value	$Li^{2000\text{-}2017}$	p-value
Angola	-0.980	0.036**	0.520	0.106	-0.161	0.438
Botswana	-0.196	0.398	-0.000	0.411	-0.050	0.457
DRC	-0.040	0.459	1.324	0.002***	0.306	0.189
Eswatini	-0.028	0.461	0.403	0.216	0.013	0.428
Lesotho	-0.004	0.463	0.644	0.215	0.561	0.215
Malawi	0.358	0.181	0.221	0.262	0.575	0.070*
Mozambique	0.448	0.030**	-0.167	0.396	0.039	0.326
Namibia	0.238	0.207	-0.269	0.329	-0.010	0.415
South Africa	-0.001	0.377	0.247	0.120	0.101	0.252
Tanzania	0.661	0.031**	0.472	0.080*	0.385	0.104
Zambia	0.105	0.170	0.223	0.066*	0.246	0.071*
Zimbabwe	0.179	0.252	0.040	0.372	0.130	0.279

Source: author`s computations
****, **,* reject the null at 1%, 5% and 10% level of significance respectively*
$Li^{2000,\ 2017,\ 2000\text{-}2017}$ denote LISA`s statistic for the year 2000, 2017 and sample average respectively

Table B5: Tax Revenue LISA in the SADC Region

Country	Li^{2000}	P-value	Li^{2017}	P-value	$Li^{2000\text{-}2017}$	P-value
Angola	-0.690	0.110	0.132	0.326	-0.537	0.182
Botswana	-0.068	0.477	0.148	0.278	0.013	0.398
DRC	-0.517	0.191	1.345	0.002**	0.198	0.279
Eswatini	0.017	0.432	0.348	0.246	-0.027	0.460
Lesotho	0.425	0.289	1.232	0.082*	0.900	0.146
Malawi	0.669	0.060*	0.141	0.320	0.707	0.053*
Mozambique	0.180	0.173	-0.048	0.441	0.254	0.115

Namibia	0.423	0.100	0.152	0.275	0.304	0.164
South Africa	0.087	0.268	0.542	0.014**	0.171	0.181
Tanzania	0.887	0.007**	0.686	0.028**	1.009	0.003***
Zambia	0.024	0.292	0.171	0.100	0.163	0.110
Zimbabwe	-0.115	0.476	-0.253	0.344	0.063	0.352

Source: author`s computations

****, **,* reject the null at 1%, 5% and 10% level of significance respectively*

$Li^{2000, 2017, 2000\text{-}2017}$ denote LISA`s statistic for the year 2000, 2017 and sample average respectively

Table B6: Public Debt LISA in the SADC Region

Country	Li^{2000}	P-value	Li^{2017}	P-value	$Li^{2000\text{-}2017}$	P-value
Angola	0.098	0.337	-0.005	0.414	-0.202	0.406
Botswana	-0.029	0.435	-0.135	0.449	-0.093	0.497
DRC	-0.075	0.486	0.046	0.365	-0.067	0.480
Eswatini	-0.145	0.462	-1.402	0.003**	-1.176	0.034**
Lesotho	-0.048	0.479	-0.002	0.447	0.112	0.408
Malawi	0.422	0.127	-0.405	0.214	-0.075	0.486
Mozambique	0.054	0.307	-0.485	0.085*	-0.440	0.112
Namibia	-0.344	0.251	-0.015	0.414	0.171	0.250
South Africa	0.285	0.095*	0.001	0.375	-0.026	0.411
Tanzania	-0.262	0.325	-0.261	0.312	-0.577	0.105
Zambia	-0.270	0.218	0.062	0.272	0.142	0.146
Zimbabwe	-0.340	0.255	0.096	0.295	0.309	0.152

Source: author`s computations

****, **,* reject the null at 1%, 5% and 10% level of significance respectively*

$Li^{2000, 2017, 2000\text{-}2017}$ denote LISA`s statistic for the year 2000, 2017 and sample average respectively