# AN INVESTIGATION OF THE RELATIONSHIP BETWEEN PUBLIC INFRASTRUCTURE INVESTMENTS AND FISCAL SUSTAINABILITY IN NAMIBIA

**A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN DEVELOPMENT FINANCE**

**OF**

**THE UNIVERSITY OF NAMIBIA**

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**OCTOBER 2022**

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**Abstract**

The study investigates the relationship between public infrastructure investment and fiscal sustainability in Namibia. The study aimed to determine whether there is a link between public infrastructure investment and fiscal sustainability indicators, such as the budget deficit, public debt, and growth. The study uses indicators of fiscal sustainability to highlight the ability of the Namibian public sector to meet its financial obligations, as well as determine the direction of causality and establish if they have any long-run relationship with public infrastructure investment. The study employs a combination of three dynamic estimation models for robust estimates of co-integration regression derived from empirical evidence for 25 years from 1994 to 2019. There is evidence of a causal relationship between public infrastructure investment and fiscal sustainability indicators (Budget Balance, Public Debt, and Growth). In addition, the study found that public infrastructure investment (PII) had a significant unidirectional positive long-run relationship with GDP growth and budget balance, while total public debt had a bidirectional negative relationship with PII in the long run. The study revealed a short-run unidirectional positive relationship between public infrastructure and total public debt, as well as a negative short-run relationship with budget balance. The research confirmed the existence of causal linkages and established their magnitudes and directions. Thus, it advises that modelling thresholds be concentrated on assisting decision-making for development finance planning and resource mobilisation sustainably.

**Key words:** Fiscal Sustainability; Infrastructure Development; ARDL Namibia

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**Acknowledgements**

My profound and prolific gratitude to the Almighty Heavenly Father for enabling me to reach yet another milestone on my academic and life's journey. **Isaiah 40:31** – "But those who hope in the Lord will renew their strength. They will soar on wings like eagles; they will run and not grow weary; they will walk and not be faint". He is faithful indeed!

Further, I would like to thank my supervisor Prof. Emmanuel Ziramba for his continuous guidance throughout this study, and the European Union's, NAO/NPC Support Programme for the financial support. My sincere gratitude to Prof. David Mpunwa for proof reading and editing this paper.

Special thanks to my daughter Etuna, you are a heavenly sent angel. Beyond your age and despite your own studies, you played a motherly role to your siblings, especially to little Megameno, I couldn't have achieved this without you Tsheeli. To my sisters, Nahenda and Gissel, thank you for standing in as a mother whenever needed. Kenneth and Tawanda you contribution to this study will not go unnoticed. Thanks a million! May the Almighty God Bless you all.

**Dedication**

I would love to dedicate this study to my mother and my late father, for they instilled the value of education in us, “Train up a child in the way he should go; even when he is old, he will not depart from it.” **Proverbs 22:6**. To my children, Etuna, Iyaloo and Megameno, I pass the button on to you.

**Declarations**

I, Anna Niita Etuna Nahambelelwe Shatika, hereby declare that this study is my own work and is a true reflection of my research, and that this work, or any part thereof has not been submitted for a degree at any other institution.



Anna Niita Etuna Nahambelelwe Shatika …… ……

**Name of Student** **Signature** **Date**

**Abbreviations and Acronyms**

| | |
|---|---|
| ADF | Augmented-Dick Fuller |
| AIC | Akaike Information Criterion |
| ARDL | Autoregressive Distributed Lag |
| BON | Bank of Namibia |
| DBN | Development Bank of Namibia |
| DW | Durbin Watson |
| ECT | Error Correction Term |
| GDP | Gross Domestic Product |
| GFCF | Gross Fixed Capital Formation |
| IMF | International Monetary Fund |
| IPO | Initial Public Offering |
| KPSS | Kwiatkowski-Phillips-Schmidt-Shin |
| MOF | Ministry of Finance |
| NAD | Namibian dollar |
| NDP | National Development Plan |
| NSA | Namibia Statistic Agency |
| PII | Public Infrastructure Investment |
| PP | Phillips - Perron |
| PPP | Public-Private Partnership |
| PVBC | Present Value Borrowing Constraints |
| PWC | Price Waterhouse Cooper |
| SACU | Southern African Customs Union |
| SDMS | Sovereign Debt Management Strategy |

| | |
|---|---|
| SOE | State-Owned Enterprises |
| VAR | Vector autoregression |
| VECM | Vector Error Correction Model |

# CHAPTER 1

# INTRODUCTION

## 1.1 Background of the study

Fiscal sustainability is defined as the capability of a government to preserve public finances at a credible and serviceable position over the long term (Organisation for Economic Cooperation and Development, 2013). The long-term objective of fiscal sustainability necessitates estimations of key macroeconomic variables, such as GDP growth, interest rates on government borrowing, currency rates (in the event of external debt), and budgetary outcomes (Pradhan, 2019). Furthermore, fiscal sustainability can be defined as the government's capacity to meet its financial obligations on time. This means the government sector meets the intertemporal budget constraint, which states that the current value of prospective primary surpluses equals the current public debt. While infrastructure investment has been identified as a key to economic growth in many countries, Namibia is not an exception. Heymans, and Erasmus (2014) states that infrastructure investment contributes to growth by lowering the cost of production, consumption, and transactions, thus improving service provision and development outcomes. The Government of Namibia identified increasing investment in public infrastructure as enablers of its national development objectives (Namakalu, Niishinda, Kadhila, Fillipus, Mukasa & Mushendami, 2014). Lora (2007) pointed out that although public infrastructure is needed, there is also a need to consider fiscal sustainability since public infrastructure projects are typically large, long-lived and are usually financed with debt.

A study by Carranza, Daude and Melguizo (2011) on "Public infrastructure investment and fiscal sustainability in Latin America" showed that there are links between fiscal sustainability and public investment in infrastructure as high financing costs due to weak fiscal sustainability can contribute to low levels of infrastructure investment. According to Yülek, Göksal and Yağmur (2018), fiscal sustainability renders the allocation between current and infrastructure expenditures even more critical. The European Community (2009) states that fiscal sustainability is the ability of a government to sustain its current spending, tax, and other policies in the long run without threatening government solvency on its promised expenditures.

With regard to Namibia, a study by Nyambe and Kaulihowa (2020) on "Public debt dynamics and fiscal sustainability in Namibia" found that Namibia's public debt is unsustainable. It is therefore the scope of this study to investigate the relationship between public infrastructure investment and fiscal sustainability in Namibia.

### 1.2 Statement of the problem

Namibia's Fifth National Development Plan (NDP5) proposes infrastructure investment plan of around NAD 74 billion (Namibian dollars) to stimulate economic growth (Santos, 2018). This ambitious investment plan is to be financed by public, private and development funding sources. Although public infrastructure investment is of vital to Namibia, it requires significant funds or debt to finance it. During the period 2010 -2015, Namibia's public debt sustainability and outlook remain below the distress threshold of 60% of GDP, but debt is deteriorating and could reach 70% by 2022 (Santos, 2018). The government expenditure, budget deficits and public debts

should be within the 40%, 5% and 35% of GDP respectively (MOF, 2017). Despite the Namibian government's efforts to maintain the thresholds, the country has exceeded these targets by end of 2015/2016 while total government revenue slowed to 35% of the GDP, inadequacy to preserve with the growing public spending (MOF, 2017). Based on the raising of fiscal sustainability concerns and increase in debt burdens, expenditure, and budget deficits above thresholds in Namibia, it is essential to examine and understand the causal dynamics. This study is therefore intended to investigate the relationship between investment in public infrastructure and financial stability in Namibia.

### 1.3 Objectives of the study

The main objective of this study was to investigate the relationship between public infrastructure investment and fiscal sustainability in Namibia.

The main objective was achieved through the following sub-objectives:

- To examine the long-run relationship between public infrastructure investment and fiscal sustainability indicators.
- To determine the direction of causality between public infrastructure investment and fiscal sustainability indicators.

## 1.4 Hypotheses of the study

To achieve the objectives of this research, the following hypotheses were tested:

**$H^1_0$:** There is no long-run relationship between public infrastructure investment and fiscal sustainability indicators.

**$H^1$:** There is a long-run relationship between public infrastructure investment and fiscal sustainability indicators.

**$H^2_0$:** There are no causal relationships between public infrastructure investment and fiscal sustainability indicators.

**$H^2$:** There are causal relationships between public infrastructure investment and fiscal sustainability indicators.

## 1.5 Significance of the study

The study adds value to the prevailing body of knowledge to the fields of public debt financing, public infrastructure investment, fiscal consolidation and sustainability policies, research, and practice. By investigating the purported relationship between public infrastructure investment and fiscal sustainability indicators in the Namibian context; the study contributes to the growing empirical literature on the long-run relationship between public infrastructure investment, fiscal sustainability, and economic growth. More significantly, the findings are useful to government and policy decision makers to device fiscal strategies to maintain public investment in infrastructure, maintain public debts, and create more fiscal space through public infrastructure.

## 1.6 Limitations of the study

Fiscal sustainability and Public Infrastructure Investment variables are both endogenous variables. Within a causal model, their values are determined or influenced by one or more independent variables, excluding them. Thus, requiring the research to include their determinants when investigating the nature of their causal relationship. Additionally, the secondary annual time series data was used for the period of 1994 to 2019 in the regression analysis were non-linear thus requiring logarithmic transformation to ensure elastic linear interpretation. In economics, elasticity is quantified as a percentage change/response. The advantage of measuring in % terms is that the units of measurement have no bearing on the measurement's value, allowing for direct comparison of elasticities (Hill, Griffiths, & Lim, 2018).

## 1.7 Delimitations of the study

The study's scope was limited to public sector only, focusing on public infrastructure investment and fiscal sustainability. Thus, the results and findings cannot be generalised to private sector in Namibia. In addition, the public infrastructure investment (PII) data was only available from 1994 to 2019, thus delimiting the study period a data range between 1994 to 2019.

## 1.8 Organisation of the Study

The study has five (5) chapters. Chapter one dealt with the background of the study, in the context of Namibia. Following this introductory chapter is chapter two (2),

which gives a detailed discussion of the relevant theoretical and empirical literature on public infrastructure investment and fiscal sustainability determinants. Chapter three (3) discuss the research methodology used in the study. The findings and the interpretation of the results with respect to the study objectives are presented in Chapter four (4), and lastly Chapter five (5) summarised the findings, conclusions, and recommendations for future study and policymakers.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Introduction

This chapter contributes the literature about the relationship of public infrastructure investment and fiscal sustainability in Namibia. It unpacks the conceptual framework, demonstrating the relationship between the two mentioned variables. An empirical review as well, as the theoretical framework are discussed in the following sections.

## 2.2.Theoretical Framework

The theoretical framework for this research adopted Public Sector Minimum Guarantees Model. This model suggests that the government provides patronage or revenue guarantees towards public infrastructure investment for a specific period, but this government guarantee falls off when a revenue threshold is reached. As suggested by PWC (2016), the government can support private financing for a project that it would otherwise have to fund itself, while limiting its financial exposure to the contingent risk that revenue may fall below the expected case. Consequently, the Public Sector Minimum Guarantees Model was applied in Australia Sydney Habour tunnel project where the guarantee from government for the Sydney Harbour Tunnel bonds never expired and minimal private finance was raised.

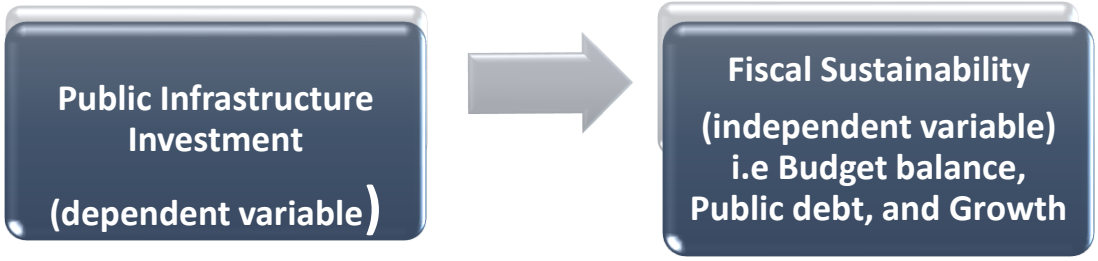
Financial sustainability is also considered as the model is based on the premise that if the private sector initially cannot afford the cost of the project due to revenue risk, then

the government should focus on project work during the development phase and look to sell and develop the project later. The government would design, fund, and build assets and use them and maintain it in the initial years. The purpose there will be to redevelop the project with the capital of the private sector after it has been constructed, and sources of revenue have been identified. An example would be the development of a toll road with expected revenue from tollgate collections as revenue streams that will cover initial public costs, only when the government could set up a special purpose-funded company and equity to improve the project.

### 2.3.Conceptual framework

Public infrastructure investment as a dependent variable calibrates to using government revenues to bring about industrial growth and other support services in the economy. It means that engagements on national capital projects necessitate the government to consider the significance of public infrastructure investment using the national incomes or public debt. On the other hand, public infrastructure expenditure budget is an independent variable while fiscal sustainability is a dependent variable responding to public infrastructure investment.

**Figure 1: Conceptual Framework**




Source Buffie, Berg, Patillio, Patillio and Zanna (2019)

### 2.3.1. Public infrastructure investment

It should be agreed that we are conversant with the term 'infrastructure' as the word is not entirely new. The term infrastructure became very well-known and a prominent topic of discussion by many economists in almost every forum involving government projects (Buffies, Pattilto, Portillio, & Zanna, 2019). However, irrespective of the term being broadly deliberated, public infrastructure investment does not have the standard definition thus far, but Varun (2017) refers to public infrastructure development as infrastructural outlays for different subcategories of infrastructure like road and rail networks, ports, bridges, energy, telecom, water and sanitation networks, government structures and buildings, among others, all of which possess a productive life of many decades. The International Monetary Fund (2015, p.8) defines Public Infrastructure as the network of physical assets created by public investment. These fixed assets include both economic infrastructure such as highways, airports, roads, railways, water and sewer systems, public electric and gas utilities, pipelines, and telecommunications) and social infrastructure like public schools, hospitals, and prisons.

Public Investment is the general government gross fixed capital formation (GFCF) and encompasses of total net value of general government procurements of fixed assets during the accounting period (International Monetary Fund, 2015). A synopsis of general government refers to central and subnational governments, but does not include other public entities, such as state-owned enterprises (SOEs) and public-private partnership (PPP) arrangements.

A standard and a precise definition of infrastructure was still lacking which led different authors to model an assortment of speckled indicators of infrastructure. Additionally, in terms of policymaking, the fact that empirical studies failed to provide a common definition of infrastructure made it very tough to develop uniform policies to concordat with infrastructure development projects. The term "infrastructure" in its context as defined by Carranza, Daude and Melguizo (2011) refers to two major characteristics:

i. Infrastructure is a capital good being bestowed in large units; Capital good in the sense that it is initiated by investment expenditure and is described by long duration, technical indivisibility, and a high capital-output ratio
ii. Infrastructure is also a public good; Public good not primarily in the notion that the public sector owns it, instead towards the more economic side that it completes the conditions of being not excludable and not rival in consumption.

An alternative approach was also developed named as “functional approach” to literate on the meaning of infrastructure. The focus of the functional approach was based on essential functions of infrastructure. The term “essential” borne the idea that infrastructure initiates the transformation in the economic variables. Therefore, we can say that each kind of infrastructure could be defined depending upon its effect. Following the track of this functional approach addressing the disparity in the definition of infrastructure, Torrisi (2009) defined infrastructure as “the sum of all relevant and applicable economic data such as rules, stocks, and measures with the view of mobilising the economic potentialities of economic agents”.

In simple terms, public infrastructure investment can be defined as government initiative in providing many amenities to general communities through which goods and services are being granted to the public. The installations to infrastructure do not manufacture goods and services directly but do give inputs for other socio-economic activities. Total investment in public infrastructure for Namibia is significance to measure the total GDP every year. This investment constitutes government spending in capital projects that involve infrastructure categories not only limited to telecommunications, transport systems, construction, electricity, and water (Buffies, Pattilto, Portillio, & Zanna, 2019).

According to Price Waterhouse Cooper (PWC) (2016), public infrastructure investment is essential for developing any economy and is a driving force for achieving rapid and sustainable economic development. Pereira and Jorge (2011) state that the economic impact of public investment in infrastructure has been at the centre of the academic and policy debate for the last two decades, 1990 - 2010. Consequently, the government should create an environment in which private investment becomes more attractive. However, Javid (2019) further explained that public infrastructure investment could delay private investment and, ultimately, economic growth when public infrastructure investment is financed through borrowing from the external and internal financial market.

### 2.3.2. The Issue of Public Infrastructure

Public infrastructure investments are illustrated by large capital-intensive natural monopolies like railways, highways, water, and sanitation systems (Javid, 2019). It is

a well-established fact that public infrastructure availability has a vital role to play in bringing down the poverty levels and supporting economic growth. It has become a significant reason for governments of developing countries, including Namibia, to consider infrastructure development as priority in their policy making agenda. From a Namibian context, insufficient Public Financing for the infrastructure is well understood and documented; it backdates to 1990 as the Namibian government experienced high prevalence of unemployment and poverty, calling significant levels of spending on social and economic development programmes which has caused more expenditures over revenues, consequently, budget deficits and build-ups of debt (Iiyambo, 2018).

On the contrary, Ngulu (2017) deliberations acknowledge the Namibian government that the African Development Bank ranked Namibia in third position after Botswana and South Africa in terms of Africa Regional Integration Index on infrastructure development. An empirical study by Iiyambo (2018) about the investigation of the relationship between public debt, government expenditure and revenue in Namibia reveals that since 1992, expenditure has exceeded income and the government had to borrow to finance budget deficits, revenue contracted afterwards due to a decrease in the Southern African Customs Union (SACU) revenue while expenditure as a percentage of GDP increased from 32.6% to around 36% in 1995. Recent statistics shows that Government Debt to GDP in Namibia increased to 69.60 percent in 2020 from 54.80 percent in 2019 (Bank of Namibia, 2020). The issue of how the Namibian Government is getting money to finance infrastructure comes into the picture. It is against this background to investigate the relationship between public infrastructure

investment and fiscal sustainability in Namibia and the topic of Infrastructure financing attains prominence.

The concept of Infrastructure financing refers to the financing of an infrastructure project (Lamont & Yong, 2017). The seminal issue relates to how the Namibian government embarks on public financial management and business environment reforms to address emerging challenges in line with long term financing for investment and, in particular, public infrastructure investment and the fiscal sustainability from sustainable financing options. Over the past few years, there have been positive characteristics of public infrastructure investment and Fiscal policies in Namibia so that the objective to minimize the cost of government borrowing, consistent with an acceptable degree of risk would strengthen public financial management and public sector efficiency, while laying a solid foundation for industrialisation. Namibia developed its first Sovereign Debt Management Strategy (SDMS) with an ever-increasing interest in this topic of Infrastructure Financing based on appreciating the point that removing infrastructure blockage is vital for achieving a robust, sustainable, and balanced growth.

For many economies, current and future infrastructure requirements are believed to be posing a problem for governments as they are unable to finance these needs given the fiscal constraints prevalent across developing world. This leads us to whether the private sector financing can play a more significant role or not. Public Infrastructure can be funded by different Infrastructure financing options which have been discussed as below.

#### 2.3.2.1 Financing Options

It is a recognised fact that financing enormous sum cost of building infrastructure and the subsequent payments for services conferred by infrastructure can gross great forms. Contrary, there follows public procurement (in which the government finances and owns the asset) and private infrastructure investment (where the private sector finances and owns the asset). Among the two, there is something called a Public Private Partnership (PPP) agreement in which the risk is shared between the public and private parties.

### 2.3.3. Public Financing

Public sector's role in infrastructure investment has been recognised for years now. Public service provision is amongst the 'three duties' which Adam Smith accredited to a precise government. Public financing can take place in different forms like general budget appropriations for infrastructure projects which are financed through tax revenues collected through the Namibia Inland Revenue Authority or government debt, revenue bonds attached to specific infrastructure projects such as Nampower bonds, or infrastructure investment by public enterprises (which were known as state owned Enterprises in Namibia) including Development Bank of Namibia (DBN). It is imperative to point out that Development Bank of Namibia is a distinctive form of Public Institution in the finance sector to offer credit and other financial services to those sectors of the economy that are considered by private financial institutions as under-servicing.

Namibia has the privilege of getting access to concessional and non-concessional financing from International Financial Institutions such as the World Bank, African Development Bank, and the International Monetary Fund (IMF). Like any other developed countries, Namibia's public financing of infrastructure through budget appropriation has received a reasonable share with high level of transparency and public scrutiny in compared to other government financing methods.

Given the lower cost of government debt in relation with private sector debt, it can also prove to be a cost-effective way of financing infrastructure. On the other side, there are possibilities of certain constraints from budgetary processes like fiscal rules (debt or deficit limits), impacting public infrastructure investment. Also, sometimes there can be political pressure to take on particular investments without doing cost-benefit analysis. Hence, in this direction the option of privatisation of existing assets has also been exploited to probe into new possibilities of public financing for impending public infrastructure projects like the Mass Housing Project (Zaaruka, Ndove & Tjipe, 2004).

### 2.3.4. Private Financing

Private financing is principally carried out through by the private sector where infrastructure projects backed can be further classified into two groups which are; those which are fully owned and operated by private sector, for example, private satellite networks such as Multi Choice Namibia, private telecommunication systems (Mobile and Telecommunication Ltd and Paratus Ltd), among others. There are also those private infrastructures which are commissioned by the government but partially

financed by private sector. Those projects which fall under the second group are named as Public Private Partnerships. There is not much to discuss about PPPs in this section as we emphasised on the Private financing mode.

The Private financing can be done through debt or equity. Debt forms a prime part of infrastructure financing, depending on the stability and certainty of income flows. Debt funding has been considered around 90 per cent of total funding for PPP social infrastructure projects where in the payments made by the government for the infrastructure services are stable and expected (Ke, Wang, Chan, & Lam, 2010). Debt financing is generally constituted by loans from banks, although some private projects can be funded by issuing bonds in the capital market. Contrary, equity financing is constituted by investors who can be grouped as primary or secondary investors. Primary investors are directly involved in decisions regarding building the infrastructure asset. Certain projects also have the option of raising equity on financial markets via an initial public offering (IPO). Elyasi and Rahimi (2012) found out that headway was made in the context of equity financing; it has been the superposition of large pension or superannuation funds, some of which have been devoted directly in an equity stake at the early stage of the project.

Once the projects start operating with established revenues, it is often observed that equity is sold in the secondary market to investors with a minor wish for risk. The infrastructure funds and pension funds usually favour investing at this project stage. By disposing off these established assets, primary equity investors get the chance to free up capital so that they can invest in new infrastructure projects.

#### 2.3.4.1 Promotion of Public Investment in Namibia's Infrastructure

Investing heavily in public infrastructure comes at a cost of interest payments and expenses due to exchange rate fluctuations. The expected return from the investment can justify the charges, but some projects may not yield the expected return due to substantial cost overruns and delays in their completion. Njavera (2020) referred to public infrastructure investment as one of the main strategies recommended by the government administration to revive the economy from the shocks of Covid 19 pandemic. He adds that there are much needed jobs created in Namibia in significant public infrastructure development projects like dualisation of Windhoek – Okahandja and Hosea Kutako international airport carriage roads.

However, as noted by MOF (2017), the Namibian economy had experienced economic shocks to balance infrastructure development expenditure and fiscal sustainability since the 2016 fiscal year, public debt increase was supplementary to higher public infrastructure investment the government of Namibia commenced as a fiscal policy to respond to economic growth. In a nutshell, Carranza, et al., (2017) says fiscal adjustment loans are associated with lower levels of public investment in infrastructure, and this is the case in Namibia. The relationship between public infrastructure investment and fiscal sustainability is discussed in the following section.

### 2.3.5. Infrastructure investment and fiscal sustainability

While the critical relationship between Public Infrastructure Investment and Fiscal sustainability is being discoursed, the issue of debt sustainability and eventually fiscal

sustainability must be considered. Suppose the amount of debt taken by a nation goes into alarming zones. In that case, it may have a detrimental effect on the economy's economic growth, and that is when this issue of fiscal sustainability gains importance. As per the discussion above, there are evidence of an optimal value of debt above which public debt becomes negatively correlated with economic growth. The logic behind achieving an optimal value of debt is to ensure that fiscal sustainability of an economy is maintained. This viewpoint is discussed in the next section.

Conventional indicators of fiscal activity like public debt or annual public deficit were not successful enough to gauge the sustainability of government's policies (Straub, 2011). These traditional indicators only captured the short-term effects of current political decisions, the fiscal sustainability issue which considers the long-term effects of the fiscal policy, became an important field in the economic literature. Sustainability is a term which that is used quite often in the economics literature. But each time is used, and then its contextual meaning is viewed with different connotations under different circumstances (Straub, 2011). Suppose we relate the concept of sustainability with debt. In that case, we can broadly say that a sustainable level of debt refers to the story which can be serviced through potential revenue expected in the future without hampering the productivity and solvency of the government. An apparent dissimilarity needs to be concluded between the term sustainability with solvency. As defined by Straub (2011), sustainability means having the ability to maintain or support government programmes in the future. In contrast, solvency refers to ability of a borrower to make required debt payments. When a country is faced with an economic situation involving fiscal deficit, then the government must understand that a surplus

of government expenditure over government revenue exists. The accrued value of this deficit is referred to as the public debt. Therefore, deficit is a flow and debt are a stock.

Mounting fiscal deficits obstruct the budget in various ways. From the context of developing like Namibia, fiscal deficit is typically high as public expenditure is often wasteful being poorly besieged, along with the fact that good number of subsidies are given on food, health, education to promote socioeconomic development among poor Namibian communities. A high fiscal deficit may increase interest rates, thereby enhancing debt service payments, and worsening the economic condition. Higher debt service charges compel the amount of investment for the public sector, thus finally depressing the potential economic growth that could be attained. Hence, it can be hypothesised that if an economy is fiscally sustainable, then automatically its debt is also under control. Therefore, by achieving debt sustainability, the aim is to achieve fiscal sustainability. The appropriate level of debt that should be maintained leads policymakers to a stable fiscal position.

Contrary, empirical studies by Cottarelli and Schaechter, (2010); Ghartey (2010) and Chibi, Chekouri, and Benbouziane, (2019); about effective debt sustainability and fiscal sustainability concluded that both debt and fiscal sustainability can be sensitised by paying attention to warning effects of increasing debt. It is then up to policymakers to swiftly decrease debt to a sustainable level.

Different types of approaches can be employed to analyse the debt sustainability issue. Major ones include Do mar debt sustainability condition, sustainability indicators analysis and present value budget constraint approach. However, there is no

simple method or rule which tells how to measure and assess fiscal sustainability. Chalk and Hemming (2000) provided an overview of various approaches used in the literature to evaluate fiscal sustainability. Apergisa and Coorayb (2015) used a simple VAR forecasting model to perform forecast tests and standardise the coming trails of the public debt variable up to 2020. The results from this study suggested that only a restrictive fiscal policy can allow the country to achieve debt sustainability and that debt sustainability could be achieved faster when tax revenue policies were intensified. The study results revealed meaningful inferences for policymakers in scheming effective macroeconomic policy to achieve sustainable levels of public debt.

Another commonly used approach to assess the sustainability of the fiscal policy for a nation is to observe if it has a stable public debt to GDP ratio (Ghartey, 2010). The Namibian government has successful assessed the optimal value of debt to GDP ratio to which fiscal sustainability is favourable. Therefore, the above discussion recommends that under the debt growth dynamics for Namibia an investigation of the relationship between public infrastructure investment and fiscal sustainability must be carried out.

There have been very few studies that have measured the fiscal sustainability of the Namibia as most studies failed to provide literature on how to estimate a threshold value of debt/GDP ratio which can be assumed that the fiscal stance becomes unsustainable for a state economy if exceeded. This forms the bottom-line for the second research objective of this study.

Sherbourne, Nampila and du Preez (2002), stated that, unsustainable fiscal policies have caused many states to run into severe economic problems and depend on the International Monetary Fund (IMF) or the World Bank for loans to achieve macroeconomic stabilisation or structural adjustment. These loans are generally conditional on painful economic reforms, often associated with political upheaval. Some states from the developing world can find it difficult to solicit funds from International Monetary Fund (IMF) and the World Bank to secure money for the public infrastructure investment. Likewise, the same countries have their government revenues more than sufficient to provide for public infrastructure investment with little concerns to borrow public debts. In contrast, in other countries like Namibia, there is an external surplus and a public sector deficit that needs direct external financing. Therefore, public infrastructure investment must discourse the dual vital issues surrounding the fiscal sustainability for sources of the funds to meet public expenditures, which are the adequacy of financing to provide for sufficient public expenditures to meet desired social and economic investments, and the adequacy of long-term funding to allow economies to grow and develop to their full potential.

Ultimately, fiscal sustainability depends heavily on policy frameworks. Public infrastructure development outcomes that public expenditures and investments seek to produce can be enhanced when operational policies are implemented. So, any financing conversation is incomplete without a realistic assessment of the potential for policy reform that promotes understanding of projected revenues with projected expenditures without threatening the government's solvency or defaulting on some of the government's liabilities or promised costs. In the real policy environment, more financing can help accelerate development. According to Varun (2017) about ‘Public

Infrastructure Investment Economic Growth and Fiscal Sustainability in India' agrees that if the amount of debt taken by a nation goes into alarming zones, then it may have a detrimental effect on the economic growth of the economy and that is when the issue of fiscal sustainability gains importance. Santos (2018) pointed out that Namibia's public debt sustainability and outlook remain below the distress threshold of 60%, which can be concluded that public infrastructure development was funded mainly by external debt, which is not sustainable in the long run as such loans caused projects overruns.

## 2.4. Empirical Review

Various studies have been conducted on public infrastructure investment and fiscal sustainability. Carranza, et al. (2011) employed panel data to examine the relation between public infrastructure investment and fiscal sustainability in seven of the Latin America countries has indicated that there are links between fiscal sustainability and public investment in infrastructure. An evaluation of public investment scaling-up strategies in Sierra Leone paper by Berg, Patillo, Portillo and Zanna (2012) using the dynamic general equilibrium model for Low Income Countries found that a significant increase in public investment would have positive macroeconomic effects in the medium term.

Vuran (2017) agreed that a positive relationship between public infrastructure investment, fiscal sustainability and economic growth exists in India as his findings suggested that economic policies should address each of the interlinked sectors of

infrastructure simultaneously, with investment being the uppermost concern to accomplish higher economic development in India.

Shastri, Giri and Mohapatra (2017) study about an empirical assessment of fiscal sustainability for selected Southern Asian countries tested the fiscal sustainability using model-based approach by applying a cointegration regression equation to link government revenue to Government expenditure. It was stressed that weak fiscal sustainability implies that government expenditures are systematically higher than government revenues.

A conclusion that there was a long run relationship between government revenue and government expenditure was reached; ARDL estimates of fiscal reaction function indicated a positive long-run response of primary balance to rising public debt ratio in case of India, Bangladesh, Pakistan, and Sri Lanka; therefore, the fiscal rule that relates the primary surplus and debt had a significant influence for these countries.

Another study about fiscal sustainability in the Caribbean by Khadan (2019) suggested that unbalanced fiscal sustainability is reached when rising debt ratios followed by indebtedness as downward pressure on economic growth combines low government revenues, rising government expenditures, poor credit ratings and increases in long-term interest rates and payments for sovereign bonds. A Present Value Borrowing Constraints (PVBC) equation was employed to test fiscal sustainability. A panel cointegration analysis was used to test existence of unit roots between government debts and budget deficits. It was concluded that extended fiscal reaction functions showed evidence that there is some degree of procyclical fiscal policy, and national

elections tend to worsen fiscal positions in the Caribbean. Nyambe and Kaulihowa (2020) concluded that there is no sufficient budget surplus exists or somewhat too little to offset the accumulated debt in the period studied, debt unsustainability was strong even after employing the fiscal reaction functions.

On the other note, Muzenda (2014) investigated whether the South African Government has maintained its public debt on sustainable level between 1990 and 2013. It was concluded that the fiscal policy remains an integral instrument in achieving broad economic objectives. However, Nyambe and Kaulihowa applied notion; their conclusion was clear about eliminating scepticism on Namibia's public infrastructure investment to support productive sectors such as agriculture, tourism, and mining with a multiplier effect on the economy and recommends that these sectors should thus receive support despite growing concerns on fiscal unsustainability.

## 2.5 Conclusion

This chapter substantiated the relationship between public infrastructure investment and fiscal sustainability in Namibia. It also examined the long-run relationship and the direction of causality between public infrastructure investment and fiscal sustainability in Namibia.

# CHAPTER 3

# RESEARCH METHODS

## 3.1 Introduction

This chapter discussed the methodology that provides a detailed direction about the researcher's study methods. The chapter identified the procedures and techniques employed in the collecting, processing, and analysing data. The content of this chapter has been presented in the following manner. Firstly, the research design that informed the study, the description of data source, model specification, data analysis plan and ethical considerations.

## 3.2 Research design

The study employed a quantitative research design of time series analysis. This design was appropriate to quantify the relationship between the public infrastructure investment and fiscal sustainability through a multiple regression analysis. To determine the causality between variables, the Granger causality testing was used. The quantitative design was the most appropriate because it allowed the researcher to assess the impact of the underlying relationship and the causal directions.

## 3.3 Data sources

In examining the relationship between the variables, the study used secondary annual time series data from 1990 to 2019. The data on public infrastructure investment were

sourced from both National Planning Commission and Ministry of Finance. The public infrastructure investment (PII) data was only available from 1994 to 2019, resulting in 25 observations. The data on the other variables such as total public debt, domestic debt, foreign debt, government revenue and expenditure were sourced from Ministry of Finance. The budget balance or deficit was calculated from the difference between government revenue and government expenditure. The data on GDP were obtained from Namibia Statistic Agency (NSA) online database, while data on the interest rates were obtained from International Monitory Fund (IMF) data portal.

### 3.4 Model specification

The study sought to test the relationship between public infrastructure investment and fiscal sustainability (public debts and budget deficit) in Namibia. The study used econometric techniques to explore the variable transformations aligned with the literature to determine the relationship between the variables. Checherita, Hughes and Rother (2014) identified nonlinear relationships between an economy's debt burden and the rate of GDP growth. This relationship also influences the modelling of public infrastructure investment and fiscal sustainability variables which are endogenous and dependent on both GDP growth and public debt burden. As a result, the basic model of this study takes the form:

$$PII_t = F\ (GovRev_t,\ GovExp_t,\ PubDebt_t,\ DD_t,\ FD_t,\ IntRate_t,\ GDP_t,\ BudBal_t) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ (1)$$

Where:

PII: is the public infrastructure investment,

GovRev: is the government revenue in the current year,

GovExp: is the government expenditure in the current year,

BudBal: is the difference between the budgeted revenue and expenditure,

DD: the Domestic debt or public debt from local lenders,

FD: the foreign debt or public debt from international lenders,

IntRate: is the average interest rate paid on total public debt in the current year,

GDP: is the GDP growth rate in the current year, and

PubDebt: is the change in public debt in the current period,

t: is the time

To determine the relationship between the variables, the multiple regression model is expressed below:

$$PII_t = \beta_0 + \beta_1 GovRev_t + \beta_2 GovExp_t + \beta_3 PubDebt_t + \beta_4 DD_t + \beta_5 FD_t + \beta_6 IntRate_t + \beta_7 GDP_t + \beta_8 BudBal_t + \varepsilon_t \quad \ldots\ldots (2)$$

In the model above, PII is the dependent variable whereas GovRev, GovExp, PubDebt, DD, FD, IntRate, GDP and BudBal are the independent variables. $\beta_1 \ldots\ldots \beta_8$ are regression parameters. $\beta_0$ is the constant while $\varepsilon$ is the error term. Each $\beta$'s indicates how on average, a unit change in the independent variable affects the dependent variable.

Checherita et al. (2014) proposed an optimal level for public fiscal investment that is influenced by growth-maximizing public debt. However, the model assumptions were

purely empirical, thus we have little idea what that optimal level of debt depends on, nor how to set an optimal level of debt in a particular fiscal regime and create a safe zone so that budget deficits can remain sustainable in the face of unexpected shocks and political uncertainty. Accordingly, the study adopted and modified Checherita et al.'s (2014) fiscal sustainability function by incorporating public infrastructure investment as a ratio of GDP and treating all variables as ratios of GDP.

The raw data was converted into logarithms forms to solve the problem of autocorrelation. As a result, equation 2 is expressed in natural logarithms in equation 3 as follows:

$$LnPII_t = \beta_0 + \beta_1 LnRev_t + \beta_2 LnExp_t + \beta_3 LnPubDebt_t + \beta_4 LnDD_t + \beta_5 LnFD_t + \beta_6 LnIntRate_t + \beta_7 LnGDP_t + \beta_8 LnBudBal_t + \varepsilon_t \ldots\ldots (3)$$

Where: $PII_t$ explains the change in Public Infrastructure Investment at time t, while $\beta_0$ is a constant coefficient. $\beta_1 LnRev_t$ is change in government revenue at time t while $\beta_1$ is the government revenue coefficient, $\beta_2 LnExp_t$ denotes change in government expenditure at time t while $\beta_2$ government expenditure coefficient, $\beta_3 LnPubDebt_t$ is change in public debt at time t while $\beta_3$ is the public debt coefficient, $\beta_4 LnDD_t$ denotes change in domestic debt at time t while $\beta_4$ is the domestic debt coefficient, $\beta_5 LnFD_t$ is change in foreign debts at time t while $\beta_5$ is the foreign debt coefficient, $\beta_6 LnIntRate_t$ is change in interest rate at time t while $\beta_6$ is the Interest Rate coefficient, $\beta_7 LnGDP_t$ is change in gross domestic product at time t while $\beta_7$ is the GDP coefficient, $\beta_8 LnBudBal_t$ is change in budget balance at time t while $\beta_8$ is the

budget balance coefficient. $\varepsilon_t$ explains the error term or the summation of all other significant variables that are not captured by the model at time t.

In addition, the study, specified two additional models in line with the endogenous nature of the variables and the study's objective of establishing the nature of the causal relationship between public infrastructure investment and fiscal sustainability, in the presence of the determinants such as public debt. As such, Equation 4 is derived from directly substitution of PII in Equation 3, with Fiscal Sustainability, proxied as Budget Balance, in order to establish the determinants. The equation is specified as follows:

$$BudBal_t = \beta_0 + \beta_1 Ln Rev_t + \beta_2 Ln Exp_t + \beta_3 Ln PubDebt_t + \beta_4 Ln DD_t + \beta_5 LnFD_t + \beta_6 Ln IntRate_t + \beta_7 Ln GDP_t + \beta_8 Ln\ PII_t + \varepsilon_t \quad (4)$$

Where: The BudBal explains the change in Fiscal Sustainability at time t, while $\beta_8$ becomes the $PII_t$ coefficient. Similarly, Public debt is replacing the BudBal variable, as the dependent variable in the equation to come up with equation 5, which is specified as follows:

$$Ln\ PubDebt_t = \beta_0 + \beta_1 Ln Rev_t + \beta_2 Ln Exp_t + \beta_3 Ln BudBal_t + \beta_4 Ln DD_t + \beta_5 LnFD_t + \beta_6 Ln IntRate_t + \beta_7 LnGDP_t + \beta_8 Ln PII_t + \varepsilon_t \quad (5).$$

Overall, the study specified five models on the relation between public infrastructure investment (PII) and fiscal sustainability indicators in Namibia.

### 3.5 Data Description

Fiscal sustainability is delineated as the capability of a government to preserve public finances at a credible and serviceable position over the long term (Organisation for Economic Cooperation and Development, 2013). Benz and Fetzer (2006) suggested that indicators for measuring fiscal sustainability are based on infinite time horizon indicators (sustainability gap, annual consolidation, and soft transition) and finite time horizon indicators (debt quota, deficit quota and ratio of primary deficits to revenues). A Debt quota limits money borrowed by a government, corporation, or private household from another country, while deficit quota is the excess of government expenditures over government receipts acceptable for national accounts (Javid, 2019). Moreover, Fiscal sustainability can be defined as the public sector's ability to promptly fulfil its financial obligations (Quintos, 1995; Bohn, 2005). It means that the public sector satisfies the intertemporal budget constraint, according to which the current value of the expected primary surpluses equals the present public debt.

**Table 3.1 Description of Variables**

| **Variable** | **Description** | **Sources** |
|---|---|---|
| Public Infrastructure Investment | Annual development budget allocation as a share of total budget | Ministry of Finance and National Planning Commission |
| Government revenue | Tax revenue, non-tax revenue and grants in Namibian dollars (N$) | Ministry of Finance |

| | | |
|---|---|---|
| Government expenditure | Total operational and development expenditure in Namibian dollars (N$) | Ministry of Finance |
| Public debts | Total domestic and external debt as a percentage of GDP | Ministry of Finance |
| Domestic Debt | Domestic debt as a percentage of GDP | Ministry of Finance |
| Foreign Debt | External debt as a percentage of GDP | Ministry of Finance |
| Budget balance | Total difference between government revenue and expenditure as a percentage of GDP | Ministry of Finance |
| Interest rate | Real interest rate on public debts as a percentage of GDP | IMF data portal |
| GDP growth rate | Gross domestic product annual growth rate | NSA online database |

**Source: Author**

### 3.6 Data analysis

Ader, Mellenbergh and Hand (2008:22) described data analysis as gathering, modelling, and transforming data in the form of highlighting information. In simple terms data analysis is the process of classifying, ordering, evaluating, and decoding data. It involves breaking data into meaningful and understandable units. The purpose of this study is to investigate the relationship between public infrastructure investment

and fiscal sustainability in Namibia. The E-views “Econometric views” statistical software package, version 10 was used to analyse the data and estimate the model.

To find the best-fitting model, the data's time series properties (unit root and cointegration) were assessed. Pre-estimation tests, such as descriptive statistics and correlation matrices, which are important in determining the nature of the data, were also evaluated. In comparison, the determination of the most suitable econometric estimating technique was guided by the stationarity or unit root test and the cointegration test results. In addition, post-estimation diagnostic tests were performed to validate the model's appropriateness and fitness. Furthermore, the Granger causality test was employed to examine the direction of causality between public infrastructure investment and fiscal sustainability indicators.

### 3.6.1 Unit Root

Granger and Newbold (1974) articulate that when non-stationary data is encapsulated in data examination, it will probably yield spurious results. They enunciate that the sequences in the data leads to fictitious ties that imply a correlation between the data when in practical use and when no correlation exists. The data is thus gauged for stationarity, using a unit root test. The study used Augmented Dickey-Fuller (ADF) to test the nature of time series data whether it is stationery or non-stationary.

### 3.6.2 Cointegration

Cointegration is an econometric conceptualisation which simulates the prevalence of a long-run equilibrium among economic time series. Cointegration is said to exist when the time series variables are non-stationary, but their linear combination exhibits a long-run relationship, then they are said to be cointegrated (Wagner & Lakiwa, 2014). The study also employed a cointegration test to identify long run relationships between the variables. Later, the direction of causality was estimated to establish whether causal relationship exists between public infrastructure investment and fiscal sustainability indicators.

Although various cointegration tests exist such as the Engle and Granger (1987) and Watson and Johansen (1988), This study adopted a research method of Autoregressive Distributed Lag (ARDL) model by Gujarati (2009), who states that the method is applied to deduce the impact of the lag of independent variables and dependent variable that are included in the model. ARDL models are linear time series models in which both the dependent and independent variables are correlated not only contemporaneously but also across historical (lagged) values. The study's objective is to establish whether there is a relationship between public infrastructure investment and fiscal sustainability in Namibia using an Autoregressive Distributed Lag (ARDL) model.

#### 3.6.2.1 Bounds Test for Cointegration

The study uses ARDL Bounds testing approach to cointegration suggested by Pesaran et al. (2001)'s technique, to see if there was any cointegration. The ARDL Bounds F-statistic derived from the equation estimates were then compared to a computed F-critical value. The null hypothesis of the Bounds test is that there are no long-run relationships among the investigated variables. If the computed F-statistics is less than the lower bound value, the null hypothesis is not rejected. In comparison, the alternative view suggests a long-run relationship between the investigated variables. Consequently, if the estimated F-statistics are between the lower and upper bounds, the long-run relationship between the variables is uncertain.

### 3.6.3 Diagnostic Tests

The diagnostic tests are then carried out to test for the goodness of fit of the estimated model. The diagnostic checks carried out include the residual test is to detect whether serial correlation, heteroscedasticity, test for misspecification of the model and normality tests which affect the model assumptions (error normality, error non-heteroskedasticity, error non-autocorrelation).

#### 3.6.3.1. Durbin Watson Statistic for Autocorrelation

The Durbin Watson (DW) statistic tests for autocorrelation in the residuals from a statistical model or regression analysis. The Durbin–Watson statistic is a test statistic deployed to detect the presence of autocorrelation at lag 1 in the residuals (prediction

errors) from regression analysis (UCLA, 2019). The DW test's null hypothesis is that the residuals from an ordinary least-squares regression are not autocorrelated against the option that the residuals follow an AR1 process. The Durbin-Watson statistic ranges in value from 0 to 4. With, values from 0 to less than 2 points to positive autocorrelation, and values from 2 to 4 means negative autocorrelation (Wooldridge, 2016).

#### 3.6.3.2 The Breusch–Godfrey serial correlation LM test

The term "serial correlation" refers to the notion that the present value of a variable is influenced by all or part of its prior values (Adeleye, 2018). As a result, the study used the Lagrange Multiplier (LM) test, commonly known as the Breusch-Godfrey test, to assess autocorrelation (Wooldridge, 2016). The Autocorrelation Lagrange Multiplier (LM) test presents multivariable LM test results for residual serial correlation up to the specified lag order h, with the null hypothesis of no serial autocorrelation and an alternative hypothesis of autocorrelation's presence (Das, 2019).

#### 3.6.3.3 Harvey test for Heteroskedasticity

When the variation of the residuals is unequal over a range of measured values, this is referred to as heteroscedasticity. When executing a regression analysis heteroscedasticity causes an unequal scatter of residuals (also known as the error term) (UCLA, 2019). Regression disturbances with non-constant variances across observations are referred to as heteroscedastic in model estimation (Hill, et al., 2018). Heteroscedasticity causes broader confidence intervals, which leads to mistakes in the

t–test and F–test results, as well as the acceptance of non-significant coefficients (Das, 2019). For heteroscedasticity, the Harvey (1976) test for heteroscedasticity, which is like the Breusch-Pagan-Godfrey test was used. Harvey, on the other hand, tests the null hypothesis of no heteroskedasticity against heteroskedasticity in the form of, where is a vector of independent variables.

## 3.7 Research Ethics

As per the University of Namibia standards, all sources cited in the study were acknowledged using Harvard referencing style. It was done to avoid plagiarism and to enable the reader to trace the origins used in the study. Further, although the study employed secondary data, a letter granting the researcher to conduct the study was obtained from the Department of Economics and presented to Ministry of Finance and the National Planning Commission from where the data relating to the variables were obtained to acknowledge informed consent.

## 3.8 Conclusion

This chapter has presented the research methodology of this study. Firstly, the research design was discussed, followed by a discussion on the data sources, model specification, data description and data analysis, and lastly the research ethics.

# CHAPTER 4

# RESULTS, ANALYSIS, AND INTERPRETATION

## 4.1 Introduction

This chapter presents and discusses the analysis and findings of the study as per the method highlighted in the preceding chapter. The section presents the analysis and interpretation of the findings. The chapter consists of the five main sections, with the first section covering the descriptive statistics, followed by Unit root tests. The third section presents the findings from the ARDL Bounds testing approach to cointegration. The fourth section provides empirical results of the ARDL models specified in Chapter 3. While the fifth section interprets the estimation results and discusses the findings in relation to the research hypothesis supported by Granger Causality tests.

## 4.2 Descriptive Statistics

The table below shows the descriptive statistics for significant variables used in the study. The summary of descriptive statistic includes the mean, standard deviation, minimum and the maximum value of the variables. Descriptive statistics is the steps that describe the essential features of data collection. The fundamental element includes variables' mean, maximum value, minimum value, and standard deviation. The results are presented in Table 4.1.

**Table 4.1 Summary Statistics**

| Variable | Description | Mean | MED | MAX | MIN | Std. Dev. |
|---|---|---|---|---|---|---|
| BUDBAL | Budget Balance as % of GDP | -3.01 | -3.62 | 5.19 | -7.02 | 3.18 |
| LNDD | Log of Domestic Debt as % GDP | 2.47 | 2.68 | 3.40 | 1.18 | 0.78 |
| LNEXP | Log of Expenditure as % of GDP | 3.49 | 3.47 | 3.67 | 3.31 | 0.11 |
| LNFD | Log of Foreign Debt as % of GDP | 2.36 | 2.67 | 3.30 | 1.20 | 0.71 |
| LNGDP | Log of GDP in NAD | 10.99 | 11.00 | 12.21 | 9.61 | 0.83 |
| LNPII | Log of PII as % of GDP | 2.56 | 2.53 | 3.08 | 2.21 | 0.22 |
| LNREV | Log of Revenue as % of GDP | 3.40 | 3.39 | 3.53 | 3.23 | 0.08 |
| LNTD | Log of Public Debt as % GDP | 3.27 | 3.22 | 4.03 | 2.71 | 0.33 |
| GDPGROWTH | GDP growth as % | 3.40 | 3.55 | 6.70 | -1.60 | 2.28 |
| INTRATE | Interest rates on Public Debt | 5.60 | 4.41 | 13.26 | 0.10 | 3.89 |
| PII | Public Infrastructure Investment as % of GDP | 13.30 | 12.54 | 21.68 | 9.13 | 3.20 |

| Variable | Description | SKEW | KURT | Jarque-Bera | Prob. | Obs. |
|---|---|---|---|---|---|---|
| BUDBAL | Budget Balance as % of GDP | 1.19 | 3.82 | 6.36 | 0.04 | 25 |
| LNDD | Log of Domestic Debt as % GDP | -0.45 | 1.65 | 2.63 | 0.27 | 25 |
| LNEXP | Log of Expenditure as % of GDP | 0.19 | 2.22 | 0.74 | 0.69 | 25 |
| LNFD | Log of Foreign Debt as % of GDP | -0.29 | 1.49 | 2.63 | 0.27 | 25 |
| LNGDP | Log of GDP in NAD | -0.04 | 1.73 | 1.62 | 0.44 | 25 |
| LNPII | Log of PII as % of GDP | 0.64 | 2.50 | 1.91 | 0.38 | 25 |
| LNREV | Log of Revenue as % of GDP | -0.18 | 2.09 | 0.96 | 0.62 | 25 |
| LNTD | Log of Public Debt as % GDP | 0.53 | 2.85 | 1.13 | 0.57 | 25 |
| GDPGROWTH | GDP growth as % | -0.64 | 2.73 | 1.69 | 0.43 | 25 |
| INTRATE | Interest rates on Public Debt | 0.62 | 2.15 | 2.25 | 0.32 | 25 |
| PII | Public Infrastructure Investment as % of GDP | 1.00 | 3.16 | 4.06 | 0.13 | 25 |

**Source: Author**

The data sample of 25 annual observations spanning 25 years, from 1994 to 2019, as these are the only years in which reliable data on PII in Namibia has been tracked. This lack of data on the PII before 1994, restricted the study to a shorter time series. Table

4.1 results indicates that on average the budget balance over the period 1994 to 2019, shows an average deficit of -3.01%, with minimum of - 7.02% experienced at the height of the global financial crisis in 2011. While budget surpluses were evident in prior to the beginning of the Global crisis in 2008, with a budget balance maximum of 5.19% in 2007.

The findings also show that the maximum growth of 6.70% was in 2002 and 2004, while the lowest growth was experienced in the period 2016 to 2019 giving recessive GDP growth of -1.6%. Overall, the Namibian economy has grown at an average of 3.40% in the period 1994 to 2019. The public infrastructure investment (PII) has averaged at 13.30%, with a maximum investment of 21.68% of GDP in 2011, which aligned with the lowest budget deficit of -7.02%.

Additionally, the findings indicated the variables that were transformed using logarithm to ensure uniform variance. The values of the natural logarithm of the variables, thus show the standard deviation values ranging from 0.08 for the Log of Revenue as % of GDP to 0.83 for Log of GDP in NAD. The Jarque-Bera, Skewness and Kurtosis statistics indicated that the variables met the normality assumptions for all the variables. The next section presents the stationarity tests of the natural logarithm variables transformed in line with model specification, discussed in section 3.4.

### 4.3 Unit root tests

To estimate the models specified, the study uses the ARDL model of Shin et al. (2014) which requires that all the variables should be integrated order zero (I (0)) or one (I

(1)). Additionally, the stationarity tests were used to verify that none of the variables were integrated of order 2. In determining the stationary properties of the variables, the unit root test was carried out using three methods, namely the Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), and Kwiatkowski, Philips, Schmidt & Shin (KPSS). The standard unit root test results are shown in Table 4.2 and indicate the results for the test undertaken with none, constant, and constant & trend.

**Table 4.2: Augmented-Dick Fuller (ADF) Unit Root Tests**

| Variable | Type | ADF | | PP | | KPSS | | Integration Order |
|---|---|---|---|---|---|---|---|---|
| | | **Level** | **1st Diff** | **Level** | **1st Diff** | **Level** | **1st Diff** | |
| **PII** | None | 0.133 | **-6.913*** ** | 0.017 | **-6.663*** ** | | | |
| | Constant | -1.832 | **-6.776*** ** | -1.926 | **-6.545*** ** | 0.209 | 0.121 | **I(1)** |
| | Constant & Trend | -3.139 | **-6.644*** ** | -1.954 | **-6.431*** ** | 0.101 | 0.114 | |
| **LNTD** | None | -1.57 | **-4.757*** ** | -1.57 | **-4.755*** ** | | | |
| | Constant | -0.796 | **-4.986*** ** | -0.804 | **-4.986*** ** | 0.322 | 0.176 | **I(1)** |
| | Constant & Trend | -1.202 | **-4.981*** ** | -1.232 | **-4.981*** ** | **0.123*** | **0.141*** | |
| **INTRATE** | None | **-1.985** ** | **-5.021*** ** | **-1.938*** | **-11.781*** ** | | | |
| | Constant | **-4.288*** ** | **-4.905*** ** | **-4.354*** ** | **-11.403*** ** | 0.289 | 0.01 | **I(0)** |
| | Constant & Trend | **-5.245*** ** | **-4.327** ** | **-5.413*** ** | **-11.625*** ** | 0.074 | 0.093 | |
| **GDP growth** | None | -1.434 | **-7.265*** ** | -1.434 | **-7.265*** ** | | | |
| | Constant | -2.363 | **-7.186*** ** | -2.394 | **-7.214*** ** | 0.235 | 0.209 | **I(1)** |
| | Constant & Trend | -2.678 | **-7.259*** ** | -2.685 | **-7.486*** ** | **0.127*** | 0.102 | |
| **Budget Balance** | None | -1.65* | **-3.35*** ** | -1.25 | **-5.208*** ** | | | |
| | Constant | -2.709* | **-3.33** ** | -2.070 | **-5.10*** ** | 0.173 | 0.055 | **I(1)** |
| | Constant & Trend | -2.846 | **-3.35*** | -2.424 | **-5.00*** ** | **0.126*** | 0.052 | |
| **LNDD** | None | 0.694 | **-2.709*** ** | 1.178 | **-5.011*** ** | | | **I(1)** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Constant | -1.627 | **-2.969**** | -1.061 | **-4.872***** | **0.962****** | 0.104 | |
| | Constant & Trend | -2.489 | -2.977 | -1.926 | **-4.825***** | 0.137* | 0.103 | |
| **LNFD** | None | -0.104 | **-1.989**** | 0.134 | **-4.697***** | | | **I(1)** |
| | Constant | -1.302 | -1.982 | -1.204 | **-4.691***** | 0.264 | 0.191 | |
| | Constant & Trend | -0.969 | -2.403 | -1.065 | **-4.621***** | **0.239****** | 0.104 | |
| **LNREV** | None | 0.327 | -3.019*** | 0.096 | **-4.988***** | | | **I(1)** |
| | Constant | -2.395 | -3.027** | -1.92 | **-4.941***** | 0.674** | 0.071 | |
| | Constant & Trend | -3.154 | -3.071 | -1.5 | **-4.927***** | 0.077 | 0.051 | |
| **LNEXP** | None | -0.193 | -1.996 | 0.413 | -5.457*** | | | **I(1)** |
| | Constant | -1.987 | -1.914 | -1.66 | -5.380*** | 0.637** | 0.107 | |
| | Constant & Trend | -2.583 | -1.903 | -1.61 | -5.430*** | 0.161** | 0.099 | |

***, ** and * represents stationary at 1%, 5% and 10% level of significance respectively

**Source: Author's compilations**

The unit root tests for ADF, PP and KPSS are presented in Table 4.2. The null hypothesis is that the data are non-stationary or contain unit root, while the alternative hypothesis is that they are stationary or do not contain unit root. The asymptotic probability values in bold with stars reflect the choice to reject the null hypothesis of a unit root. The ADF results indicated that all variables, except for interest rates were non-stationary at level, when the ADF test was done.

The study also utilized the non-parametric PP test for comparison, which uses the same estimating scheme as the ADF test. The results of the PP tests are based on the significance threshold of 0.05 and the p-value of the PP test, the findings were consistent with the ADF test indicating that all variables were stationary at first difference I (1), except for Interest rates that is stationary at levels, I(0). The KPSS test, whose null and alternate hypotheses are the polar opposites of the ADF and PP

test, was also used to verify the stationarity of the study variables. The KPSS test presented evidence for rejecting the null hypothesis in favour of the alternative based on the significance level of 0.05 and the p-value of the KPSS test. As a result, only the PII results were not consistent with the other two tests.

Using these results, the interpretation for stationarity was used when all three tests had consistent results for stationarity. Consequently, all variables were non-stationary and integrated at the first order, I (1). While interest rate was the only one integrated at the order of 0. Thus, fulfilling the precondition of the ARDL model and confirms that none of the variables had an integration order of 2, I (2). In terms of lag length, the generated the ARDL model determines its own lag order during estimation and analysis.

### 4.4 Bounds Test for Cointegration

The section presents and interprets the findings from the ARDL Bounds testing approach to cointegration of the specified equations in alignment with the models in section 3.4 of Chapter 3. The F-statistics were compared to a computed F-critical value using Pesaran et al. (2001)'s technique to see if there was any cointegration. If the computed F-statistics is less than the lower bound value, the null hypothesis is not rejected; otherwise, it suggests the presence of a long-run relationship between the investigated variables. Finally, if the estimated F-statistics are between the lower and upper bounds, the long-run relationship between the variables is uncertain. Table 4.3 presents the results of the ARDL bounds test for the equations.

**Table 4.3 Bounds test for cointegration**

| **Variables** | | **F-statistic** | **K** | **Cointegration or No Cointegration** |
|---|---|---|---|---|
| F (BUDBAL/PII, GDP GROWTH, LNDD) | | 4.74*** | 3 | Cointegration |
| F (LNPII/LNREV, LNEXP, LNTD, LNFD, BUDBAL) | | 5.29*** | 5 | Cointegration |
| F (LNTD/LNDD, INTRATES, BUDBAL, PUBINFINV, LNREV) | | 3.76** | 5 | Cointegration |

| **Equation** | **Critical Value Bounds (significance)** | **Lower Bound (I (0))** | **Upper Bound (I (1))** |
|---|---|---|---|
| 2 | 5% | 3.16 | 4.194 |
| 4 | 1% | 3.06 | 4.15 |
| 5 | 2.5% | 2.7 | 3.73 |

*** denote cointegration at the 1% significance level based on Pesaran et al.'s (2001) critical bounds table.

As shown in Table 4.3, the estimated F-statistics for the three equations had values that were higher than the upper bound critical value at 1 percent and 5 percent significance level. The equations were derived using the variance inflation factors (VIF) to screen out variables that had a VIF above 10. Thus, the remaining equations were then assessed to establish the existence of unique long-run relationships between the variables in the equation and provides sufficient grounds to reject the null hypothesis of no long-run relationship at the 5% significance level. Therefore, the findings imply the existence of cointegration among the three resultant equations. Having confirmed the presence of cointegration in our variables using the Pesaran *et*

*al.* (2001) ARDL bounds test, the equations were then estimated using the ARDL Bounds Test model.

## 4.5 Empirical Results

In order to discuss whether the research problem has been answered, the presentation and interpretation of the ARDL estimation models are made against the original objectives and the research hypothesis: To achieve the objectives of this research, the following hypotheses were tested.

### 4.5.1 Results of the Determinants of Fiscal Sustainability

The ARDL model was estimated from a recursive search of the optimal number of lags through the Akaike Information Criterion (AIC), which resulted in an optimal lag of 4 for the Budget balance equation estimated as ARDL (1, 0, 2, 1). Table 4.4 presents the estimated results for equation 2: F (BUDBAL/PII, GDP GROWTH, LNDD).

**Table 4.4: Fiscal sustainability (BudBal) Model Results based on ARDL (1, 0, 2, 1)**

| **Long Run** | | | | **Short Run** | | | |
|---|---|---|---|---|---|---|---|
| **Variable** | **Coef.** | **t-Stat** | **Prob.** | **Variable** | **Coef.** | **t-Stat** | **Prob.** |
| PUBINFINV | **-1.195*** | -2.06 | 0.06 | C | 2.30 | 1.04 | 0.315 |
| GDPGROWTH | 0.58 | 0.63 | 0.54 | BUDBAL (-1) * | **-0.40 **** | -2.93 | 0.012 |
| LNDD | 2.82 | 1.55 | 0.15 | PUBINFINV** | **-0.47 ***** | -3.74 | 0.003 |
| **Error Correction Term** | | | | GDPGROWTH (-1) | 0.23 | 0.78 | 0.447 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CointEq (-1) * | **-0.434*** ** | -5.44 | **0.001** | LNDD (-1) | 1.12 | 1.76 | 0.102 |
| **Diagnostic Test** | | | | D(GDPGROWTH) | 0.22 | 1.08 | 0.302 |
| *Breusch-Godfrey Serial Correlation LM Test:* | | | | D (GDPGROWTH (-1)) | 0.18 | 0.61 | 0.552 |
| F-statistic | 0.423 | Prob. F (2,11) | 0.665 | D (GDPGROWTH (-2)) | **0.74 ** ** | 2.76 | 0.016 |
| Obs*R-squared | 1.642 | Prob. Chi-Sq (2) | 0.44 | D(LNDD) | **-3.10 ** ** | -2.55 | 0.024 |
| *Heteroskedasticity Test: Harvey* | | | | D (LNDD (-1)) | -1.96 | -1.50 | 0.158 |
| F-statistic | 1.283 | Prob. F (9,13) | 0.331 | EC = BUDBAL - (-1.1948*PUBINFINV + 0.5756*GDPGROWTH + 2.8182*LNDD + 5.7952) | | | |
| Obs*R-squared | 10.818 | Prob. Chi-Sq (9) | 0.288 | | | | |
| Durbin-Watson stat | | 1.910 | | | | | |

Note: Sample years: 1994 – 2019 (N=25); Adjusted R-square: 0.728; ***, ** and * significant at 1%, 5% and 10% respectively.

Table 4.4 results indicates the result for the variables influencing the budget balance in each quarter in the period 1994 to 2019. The three variables account for 72.8 % (Adj. R-sq. 0.728) variability in Budget balance, while the lagged error correction term (a = - 0.434) in the model explains the rest of the variation. Additionally, the model's error correction term (ECT) provides the feedback, or the speed of adjustment whereby short-run dynamics converge to the long-run equilibrium path in model. The coefficient of error correction term (lagECM) is negative and significant, as expected. The result implying that within one year it the model adjusts about 43.4% of the disequilibria, which shows that the deviation from the long run equilibrium adjusted moderately (43.4%) of the disequilibrium in each period.

Table 4.4 also presented the Durbin Watson (DW) test statistic (1.91) indicating that the model does not suffer from autocorrelation. Additionally, the Breusch-Godfrey Serial Correlation LM Test ($\chi^2_{SC}$) statistic of 0.423 ($p = 0.665 > 0.05$) is free of serial autocorrelation, which fulfils the LM serial correlation conditions with observed chi-square probability value of 0.665 is above the recommended 0.05 value for the null-hypothesis to be rejected. Thus, suggesting that the model is a good fit and satisfies the serial correlation test criteria. Similarly, the model does not suffer from heteroscedasticity problem, as indicated using Harvey's Heteroscedasticity test ($\chi^2_{HET}$) with an observed chi-square probability value [F (9,13)] of 0.331 > 0.05. These diagnostic tests indicate that the empirical results are reliable and consistent.

Table 4.4 shows the long run and short run coefficients results of the determinants of Budget Balance in Namibia. The results indicate that there is a statistically significant negative relationship between budget balance and public infrastructure investment, both in the long and short term, implying that an increase in public infrastructure investments by 1% leads to 1.2% decrease in the Budget balance, in the long run. In contrast, the same 1% increase will result in a 0.47% negative shock in the short run. Table 4.4 findings also indicated a negative short run shock relationship between Budget Balance and Domestic Debt (-3.1, $p < 0.05$), which implies a 1% increase in Domestic Debt will contribute to 3.1% influence on the budget deficits. On the contrary, the findings indicated that a 1% change in GDP growth resulting in a 0.74% increase in Budget Balance.

In support, Shastri, Giri and Mohapatra (2017) stresses that a weak fiscal sustainability implies that government expenditures are systematically higher than government revenues (Budget deficits). They similarly discovered a positive long-run response of primary balance to the rising public debt ratio. These findings support the recommendation that Namibia needs a 30% fiscal rule guided by short term GDP growth and Domestic debt ratios.

### 4.5.2 Results of the Determinants of Public Infrastructure Investment

The ARDL model was estimated from a recursive search of the optimal number of lags through the Akaike Information Criterion (AIC) which resulted in an optimal lag of 2 for the Public Infrastructure Investment equation estimated as ARDL (2, 0, 1, 0, 1, 1). Table 4.5 presents the estimated results for equation 4: F (LNPII/LNREV, LNEXP, LNTD, LNFD, BUDBAL).

**Table 4.5: Public Infrastructure Investment Model Results using ARDL (2, 0, 1, 0, 1, 1)**

| **Long Run** | | | | **Short Run** | | | |
|---|---|---|---|---|---|---|---|
| **Variable** | **Coef.** | **t-Stat** | **Prob.** | **Variable** | **Coeff** | **t-Stat** | **Prob.** |
| LNEXP | **1.176*** ** | 3.57 | 0 | D(LNFD) | **0.09** | 1.39 | 0.18 |
| LNTD | **-0.336*** ** | -3.75 | 0 | **Variance Inflation Factors (VIF)** | | | |
| LNFD | **-0.167*** ** | -3.652 | 0 | | | | |
| BUDBAL | -0.01289 | -1.088 | 0.29 | **Variable** | **Variance** | **VIF** | |
| **Diagnostic Test** | | | | LNPII(-1) | 0.03 | 2.9 | |
| | | | | LNEXP | 0.15 | 4.1 | |
| *Breusch-Godfrey Serial Correlation LM Test:* | | | | LNTD | 0.01 | 2 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | LNFD | **0** | 4.1 |
| F-statistic | 1.882 | Prob. F (2,80) | 0.188 | LNFD(-1) | 0 | 4.4 |
| Obs*R-squared | 2.491 | Prob. Chi-Sq (2) | 0.115 | BUDBAL | 0 | 2.5 |
| | | | | **Error Correction Term** | | |
| *Heteroskedasticity Test: Harvey* | | | | CointEq (-1)* | **-0.9** | -7.36 0 |
| F-statistic | 1.33 | Prob. F (18,81) | 0.29 | Selected Model: ARDL (2, 0, 1, 0, 1, 1) | | |
| Obs*R-squared | 7.68 | Prob. Chi Sq (18) | 0.26 | Durbin-Watson stat | | 2.813 |
| EC = LNPII - (1.1758*LNEXP-0.3360*LNTD-0.1670*LNFD -0.0129*BUDBAL -0.0916) | | | | | | |

Note: Sample years: 1994 – 2019 (N=25); Adjusted R-square: 0.787; ***, ** and * significant at 1%, 5% and 10% respectively.

Table 4.5 results indicate the result for the variables influencing the public infrastructure investment in each quarter in the period 1994 to 2019. The four variables account for 78.7 % (Adj. R-sq. 0.787) variability in public infrastructure investment (PII), while the lagged error correction term (a = - 0.90) in the model explains the rest of the variation. Additionally, the model's error correction term (ECT) provides the feedback, or the speed of adjustment whereby short-run dynamics converge to the long-run equilibrium path in model. The coefficient of error correction term (lagECM) is negative and significant, as expected. The result implies that within one year, the model adjusts about 90% of the disequilibria, which shows that the deviation from the long run equilibrium adjusted moderately (90%) of the disequilibrium in each period.

Table 4.5 also presented the Durbin Watson (DW) test statistic (2.813), indicating that the model does not suffer from autocorrelation. Additionally, the Breusch-Godfrey

Serial Correlation LM Test ($\chi^2_{SC}$) statistic of 1.882 ($p = 0.188 > 0.05$), which is above the recommended 0.05 value suggesting that the model is a good fit and is free from serial correlation. Additionally, the model does not suffer from heteroscedasticity problems, as indicated by an observed chi-square probability value from Harvey's Heteroscedasticity test ($\chi^2_{HET}$) of 0.29 that is above the recommended 0.05.

The findings in Table 4.5 indicates the long run relationships of the determinants of public infrastructure investment specified in equation 4. The results show statistically significant long-run negative relationship between the log of public infrastructure investment with foreign debt ($b = -0.167$, $p < 0.01$) and total public debt ($b = - 0.336$, $p < 0.01$), implying that an increase in foreign debt by 1% leads to 0.17% decrease in the public infrastructure investment in the long run. In contrast, a 1% increase in total public debt will result in 0.34% decrease in public infrastructure investment in the long run. The findings suggest that foreign debt and total debt have an inverse relationship with PII. The findings in Table 4.5 also shows the log of PII having long run positive relationship with the log of government expenditure ($b = 1.18$, $p < 0.01$). In terms of short run relationships, PII had no significant relationships. While the dynamics of the short and long run influences of the variables were adjusted by the 90% error correction term.

The findings are consistent with the study of Berg, et al. (2012), which found using the dynamic general equilibrium model for Low Income Countries that a huge increment in public investment would have positive macroeconomic impact in the medium term. Varun (2017) agrees that if the amount of debt taken by a nation goes into alarming zones, then it may have a detrimental effect on the issue of fiscal

sustainability gains importance. In the Namibian context, the study findings reveal that public infrastructure investment increases government expenditure and is negatively impacted by foreign debt.

In addition, Santos (2018) pointed out that Namibia's public debt sustainability and outlook remain below the distress threshold of 60%, which encourages public infrastructure investment through external debt. This notion is contrary to the findings which suggests that the continued funding of public infrastructure development through public foreign debt will, in the long run, discourage further infrastructure investments in the country. Thus, supporting Santos (2018) assertions that it is not sustainable as interest rates and the ability to repay the loans can be negatively impacted through project cost overruns and inefficiencies in project implementation. The next section provides insights into the factors influencing the total public debt sustainability.

### 4.5.3 Results of the Determinants of Public Debt: Autocorrelations

The ARDL model was estimated from a recursive search of the optimal number of lags through the Akaike Information Criterion (AIC) which resulted in an optimal lag of 1 for the Public Debt equation estimated as ARDL (1, 0, 0, 0, 0, 0). Table 4.6 presents the estimated results for equation 5: F (LNTD/LNDD, INTRATES, BUDBAL, PUBINFINV, LNREV).

**Table 4.6: Total Public Debt Model Results using ARDL (1, 0, 0, 0, 0,0)**

| **Long Run** | | | | **VIF** | **Short Run** | | | |
|---|---|---|---|---|---|---|---|---|
| **Variable** | **Coef.** | **t-Stat** | **Prob.** | | **Variable** | **Coeff** | **t-Stat** | **Prob.** |
| LNDD | **0.201*** | 1.92 | 0.07 | 1.93 | C | -0.93 | -0.564 | 0.580 |
| INTRATES | 0.018 | 0.66 | 0.51 | 1.95 | LNTD (-1) * | -0.386* | -2.06 | 0.053 |
| BUDBAL | **-0.120**** | -2.37 | 0.03 | 1.70 | LNDD** | 0.078 | 1.495 | 0.152 |
| PUBINFINV | **-0.064**** | -2.31 | 0.03 | 4.06 | INTRATES** | 0.007 | 0.729 | 0.475 |
| LNREV | 1.668 | 1.29 | 0.22 | 2.61 | BUDBAL** | -0.046*** | -3.947 | 0.001 |
| ***Breusch-Godfrey Serial Correlation LM Test:*** | | | | | PUBINFINV** | -0.025 | -1.384 | 0.183 |
| F-statistic | 0.170 | Prob. F (1,12) | | 0.685 | LNREV** | 0.64 | 1.202 | 0.245 |
| Obs*R-squared | 0.248 | Prob. Chi-Sq (1) | | 0.618 | ***Error Correction Term*** | | | |
| ***Heteroskedasticity Test: Harvey*** | | | | | CointEq (-1) * | -0.386*** | -5.92 | 0.00 |
| F-statistic | 1.808 | Prob. F (10,13) | | 0.154 | Selected Model: ARDL (1, 0, 0, 0, 0, 0) | | | |
| Obs*R-squared | 9.40 | Prob. Chi-Sq (10) | | 0.152 | Durbin-Watson stat | | | 2.08 |
| EC = LNTD - (0.2011*LNDD + 0.0183*INTRATES -0.1204*BUDBAL -0.0644*PUBINFINV + 1.6683*LNREV -2.4080) | | | | | | | | |

Note: Sample years: 1994 – 2019 (N=24); Adjusted R-square: 0.560; ***, ** and * significant at 1%, 5% and 10% respectively.

Table 4.6 results suggest a long relationship between public debt and its determinants, with most of the variables indicating a strong negative effect at the 5% level of significance for budget balance (-0.12) and public infrastructure investments (-0.064). Significant positive relations were observed for domestic debt in the long run.

Additionally, the model's error correction term (ECT) indicates a slow speed of adjustment for the convergence of short-run dynamics to the long-run equilibrium path in model, indicating a lagged error correction term (a = - 0.386). The post diagnostic tests for autocorrelation, serial autocorrelation and heteroscedastic were satisfied all conditions for a stable, reliable, and fitting model.

The findings are consistent with Khadan (2019) who suggested that unbalanced fiscal sustainability is reached when rising public indebtedness puts downward pressure on economic growth, thus contributing to low government revenues, rising government expenditures leading to poor credit ratings. These determinants will lead to an increase in long-term interest rates and payments for sovereign bonds. The study findings are consistent with the notion of extended fiscal reaction functions showing evidence concluded that there is no sufficient budget surplus that exists or somewhat too little to offset the accumulated debt in the period studied; debt unsustainability was strong even after employing the fiscal reaction functions. Nyambe and Kaulihowa (2020).

### 4.5.4 Casual Relationships and Testing of Research Hypothesis

The last step in the ARDL estimation approach was to represent the results against the research hypothesis. Table 4.7 presents the summary of the significant relationship and the interpretations of these findings against the research hypotheses.

**Table 4.7: Hypothesis Testing Results**

| Endogenous | Exogenous | LR | SR | Equation | Hypothesis | Conclusion |
|---|---|---|---|---|---|---|
| LNPII | LNEXP | **1.176*** ** | | 3 | 1 | BudBal, Domestic Debt, GDP and Public Debt are not significant determinants of LNPII |
| LNPII | LNTD | **-0.336*** ** | | 3 | 1 | |
| LNPII | LNFD | -0.167*** | | 3 | 1 | |
| BUDBAL | PII | -1.195* | | 4 | 2 and 3 | PII is a long run determinant of BudBal |
| BUDBAL | GDP | | 0.74** | 4 | 2 | GDP is positive short tun determinant of BudBal |
| BUDBAL | LNDD | | 3.10** | 4 | 2 | Domestic Debt is positive short run determinant of BudBal. |
| LNTD | LNDD | 0.201* | | 5 | 1 and 2 | Domestic Debt is positive long run determinant of Public Debt |
| LNTD | BUDBAL | -0.120** | | 5 | 1 and 2 | BudBal is a negative long run determinant of Public Debt |
| LNTD | PUBINFINV | -0.064** | | 5 | 1 and 2 | PII is a negative long run determinant of Public Debt |

Note: SR -Short run, LR- Long run; ***, ** and * significant at 1%, 5% and 10% respectively.

Table 4.7 shows the result for the testing of the research hypotheses. The findings are summarised in Figure 2.

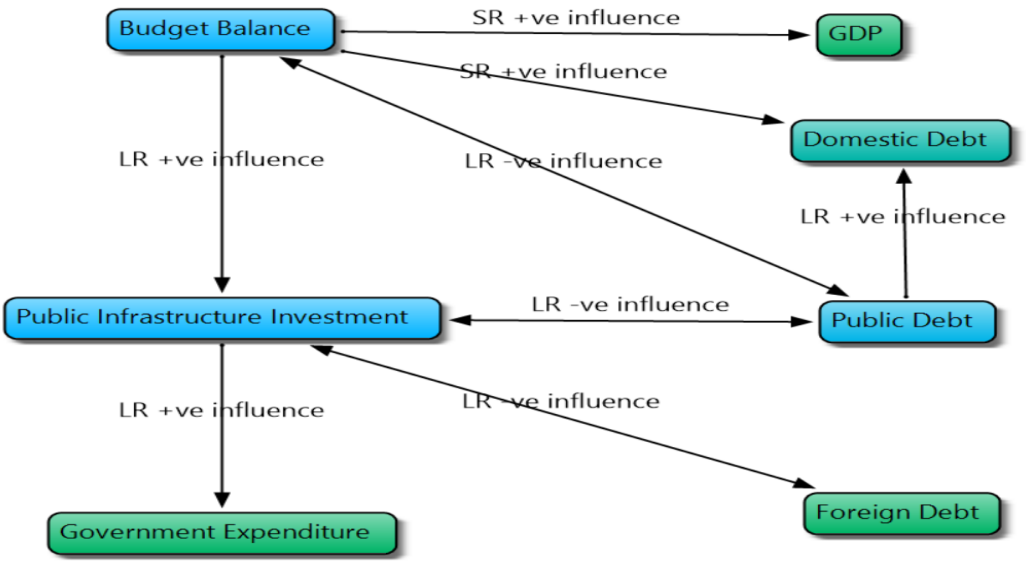



Figure 2: Casual Relationships and Testing of the Research Hypothesis

The findings in Figure 2 indicated that Fiscal Sustainability in Namibia, proxied by Budget Balance is positively influenced by GDP and Domestic debt in the short term. While in the long run, Fiscal Sustainability is influenced positively by Public Infrastructure Investments (PII) while negatively influenced by Public Debt. The findings reveal that when the increases in domestic borrowing and good economic performance tend to improve the Budget Balance (Fiscal Sustainability), compared to increasing public debt through external borrowing. The findings imply that when Namibia increases it Foreign Debt, this is an indication of poor fiscal sustainability. While increases in government expenditure and PII has positive effects on

sustainability when the Budget Balance is positive, the moment it becomes negative foreign borrowing becomes favourable but not sustainable.

## 4.6 Conclusion

The chapter empirically explored the relationship between public infrastructure investment and fiscal sustainability, using time series data from 1994 to 2019. The study applied robust linear ARDL models that estimated the linear relationships of variables in both the short and long run. After estimating the empirical model and testing for goodness of fit of the model through diagnostic tests, the testing of hypotheses was then carried out through statistical inference of the model. The objective of the study was to investigate the relationship between public infrastructure investment and fiscal sustainability in Namibia. More specifically, the study sought to establish whether or not there exists a causal relationship between public infrastructure investment and fiscal sustainability indicators like budget deficit and public debt and growth. As well as determine the direction of causality and establish if there was any long-run relationship between public infrastructure investment and the fiscal sustainability indicators, budget deficit, public debt, and growth.

The findings from the ARDL model estimation provided empirical evidence to the existence of a direct positive long-run relationship between public infrastructure investment and fiscal sustainability (budget balance and GDP growth). In contrast, a negative long-run bivariate relationship was observed between public infrastructure investment and total public debt. In the short run, the findings indicated a positive relationship with total public debt. The findings also showed that public infrastructure investment had a negative effect on budget balance in the short run.

The findings were consistent with existing literature on which the estimation equations were derived. For instance, the three fiscal sustainability indicators follow Benz and Fetzer (2006) suggestions on the indicators for measuring fiscal sustainability, in them being based on infinite time horizon indicators (budget balance, growth) and finite time horizon indicators (domestic debt, interest rates and ratio of government expenditure to revenues). Moreover, the chosen indicators of fiscal sustainability highlighted the ability of the Namibian public sector in fulfil its fiscal obligations in a timely manner. The next chapter presents the conclusion, policy implications, and areas for further study.

# CHAPTER 5

# CONCLUSIONS AND RECOMMENDATIONS

## 5.1. Introduction

After the presentation and discussion of the empirical results in the previous chapter, this chapter highlights a synopsis of the main findings of this research. It then goes further to draw policy recommendations and makes suggestions for further research.

## 5.2. Summary of Findings

The purpose of this study was to investigate whether there is a relationship between public infrastructure investment and fiscal sustainability in Namibia over the period 1990 – 2019. The data sample of 25 annual observations spanning 25 years, from 1994 to 2018, as these were the only years in which reliable data on PII in Namibia has been tracked. This lack of data on the PII before 1994, restricted the study to a shorter time series. To ensure that the findings were consistent with existing literature, the study derived estimation equations based on three fiscal sustainability indicators that follows Benz and Fetzer (2006) suggestions on the indicators for measuring fiscal sustainability. Moreover, the chosen indicators of fiscal sustainability highlighted the ability of the Namibian public sector in fulfil its financial obligations in a timely manner.

The findings from the descriptive statistics indicated that on average the budget balance over the period 1994 to 2019 had an average deficit of -3.01%, with minimum

of - 7.02% experienced at the apex of the global financial crisis in 2011. While budget surpluses were evident prior to the beginning of the Global crisis in 2008, with a budget balance maximum of 5.19% in 2007. The findings also showed a maximum growth of 7% recorded between 2002 and 2004, while the lowest growth was experienced in the period 2016 to 2019, giving recessive GDP growth of -3.55%. Overall, the Namibian economy has grown at an average of 3.40% in the period 1994 to 2019. The public infrastructure investment (PII) averaged at 13.30%, with a maximum investment of 21.68% of GDP in 2011, aligning with the lowest budget deficit of -7.02%. Additionally, the variables were transformed using natural logarithm to ensure uniform variance.

In estimating the models specified as equation, the study used the ARDL model of Shin et al. (2014), which required that all the variables be integrated order zero (I (0)) or one (I (1)). Stationarity tests were used in determining the stationary properties of the variables and verifying that none of the variables were integrated of order 2. Using the three different unit root test results, the interpretation for stationarity confirmed, with all variables being non-stationary and integrated at the first order, I (1). At the same time, Interest rate was the only one integrated at the order of 0. As a result, the ARDL model's prerequisite was met. To determine whether there was any cointegration, the ARDL Bounds test for cointegration of the given equations of the models in section 3.4 of Chapter 3 was used. The results revealed that each of the three stated equations had a distinct long-run relationship between the variables. The equations were approximated using the ARDL Bounds Test model after the presence of cointegration in our variables had been validated using the Pesaran et al. (2001) ARDL bounds test.

To assess the linear relationships of variables in the short and long term, the study used robust linear ARDL modelling. Following the estimation of the empirical model, diagnostic tests for autocorrelation, serial correlation, and heteroscedastic were performed to ensure that the models were stable and dependable. Following the presentation of the estimating models, hypothesis testing was conducted using statistical inference to test the models and the study hypothesis. The assessment and inference aimed to determine whether there is a causal relationship between public infrastructure investment and fiscal sustainability indicators such as budget deficit, public debt, and growth, and to determine the direction of causality and see if there is a long-term link between public infrastructure investment and fiscal sustainability indicators such as budget deficits, public debt, and growth.

The results of the ARDL model estimation offered empirical data to demonstrate that public infrastructure investment and fiscal sustainability (budget balance and GDP growth) are linked in the long run. Public infrastructure investment and total public debt, on the other hand, have a negative long run bivariate relationship. The data also suggested a negative association with total public debt in the short term. The findings further showed that public infrastructure investment had a negative effect on budget balance in the short run.

The results were also consistent with many empirical studies that reported on the relationship between public infrastructure investment and fiscal sustainability. Investing extensively in public infrastructure comes with a price tag that includes interest payments and currency rate changes. The expenses can be justified by the planned return on investment; however due to significant cost overruns and delays in

completion, some projects may fail to deliver the expected return. Njavera (2020) referred to public infrastructure investment as one of the main strategies recommended by the government administration to revive the economy from the shocks of Covid 19 pandemic, as it creates the much-needed jobs created in Namibia, for instance, major public infrastructure development projects like dualisation of Windhoek – Okahandja and Hosea Kutako international airport carriage roads. However, as noted by MOF (2017), the Namibian economy experienced economic shocks to balance infrastructure development expenditure and fiscal sustainability since 2016 fiscal year, public debt increase was supplementary to higher public infrastructure investment the government of Namibia. While, Carranza, et al., (2017) notes that fiscal adjustment loans are associated with lower levels of public investment in infrastructure.

### 5.3. Policy Recommendations

In concluding, the study presents the conclusion against the against the original objectives and the research hypothesis: To attain the objectives of this research, the concludes as follows:

The findings showed evidence to suggests that we reject the null hypothesis for hypothesis 1, which implies a 98% confidence that there is a causal relationship between public infrastructure investment and fiscal sustainability indicators of hypothesis 1a: Budget Balance, hypothesis 1b: Public Debt and hypothesis 1c: Growth. Therefore, the study concludes that a causal relationship exists between public infrastructure investment and fiscal sustainability. The fiscal sustainability was

represented through three proxy indicators which includes Public Debt, Budget Balance, and GDP Growth.

In addition, the results for Hypothesis 2 indicated the significance of the causal relationships in the long run. The findings showed public infrastructure investment (PII) having significant unidirectional positive relationship with GDP growth (hypothesis 2c) and budget balance (hypothesis 2a). While total public debt had a bidirectional negative relationship with PII (hypothesis 2b) in the long run. The study concludes that a long run relationship exists between public infrastructure investment and fiscal sustainability (public debt, budget balance and GDP growth).

With regards, to hypothesis 3 on the short run relationships, the findings indicated a short run unidirectional positive relationship between public infrastructure and fiscal sustainability, as the third lag of total public debt. As well as a negative short run relationship with budget balance, Therefore, the study concludes that public infrastructure investment has a mixed short run relationships with fiscal sustainability.

In support, Shastri, Giri and Mohapatra (2017) stresses that a weak fiscal sustainability implies that government expenditures are systematically higher than government revenues. The study further recommends the need to set up fiscal rules guided by the findings in this study; for instance, there is need for a 30% fiscal rule for Namibia that relates the primary surplus to revenue, and deficits to expenditure. The findings indicated that public infrastructure investment in Namibia is mainly finance through foreign debt and often leads to high budget deficits. As such, the study recommends that Namibia's public infrastructure investment should be directed towards productive

sectors such as agriculture, tourism and mining that have a multiplier effect on the economy and recommends that these sectors should thus receive support despite growing concerns on fiscal unsustainability.

Lastly, fiscal sustainability in Namibia, proxied by Budget Balance is positively influenced by GDP and Domestic debt in the short term. While, in the long run Fiscal Sustainability is influenced positively by Public Infrastructure Investments (PII), and negatively influenced by Public Debt. The study noted that when there are increases in domestic borrowing and good economic performance, this is good as it improves the Budget Balance (Fiscal Sustainability), compared to increasing public debt through external borrowing. However, increases in government expenditure and PII has positive effects on sustainability only when the Budget Balance is positive, the moment it becomes negative, then foreign borrowing becomes favourable, even though it is not sustainable. Therefore, the study concludes that when Namibia increases its Foreign Debt, this will lead to poor fiscal sustainability, through reductions in public infrastructure investments in the long run.

### 5.4. Areas of Further Research

There have been very few studies which have measured the fiscal sustainability of the Namibia as most studies failed to provide literature on how to estimate a threshold value of debt/GDP ratio which can be assumed that the fiscal stance becomes unsustainable for a state's economy if exceeded. There is need for further research in this line, the current study established the existence of causality relationships, as well

as their magnitudes and direction. Future research should focus on modelling thresholds that will guide decision making for planning and resource mobilisation.

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# APPENDICES

## 1. Ethical Clearance Certificate

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☎ +264 61 206 3111, URL : http//www.unam.edu.na

UNAM
UNIVERSITY OF NAMIBIA

31 May 2021

**Bank of Namibia**

**Research project**: Anna Niita Etuna Nahambelelwe Shatika

I write this letter to confirm that Anna Shatika is a registered student Masters in Development Finance program at the University of Namibia (student number: 200744291 ) and is required to submit a research project in the final year of study at the Department of Economics. Her chosen topic for the research project is "An investigation of the relationship between Public Infrastructure Investments and Fiscal Sustainability in Namibia."

In order to complete this project, she requires certain information from the Bank of Namibia. The study will be conducted in an ethical way and the data that will be used solely for academic purposes.

Please do not hesitate to contact me if you need any more information.

Yours sincerely

Dr. J.A. de Beer
Lecturer and course coordinator : MSC in Développent Finance
Department of Economics
University of Namibia

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UNAM
UNIVERSITY OF NAMIBIA

31 May 2021

Ministry of Finance

**Research project**: Anna Shatika

**To whom it may concern**

I write this letter to confirm that Anna Shatika is a registered student Masters in Development Finance program at the University of Namibia (student number : 200744291 ) and is required to submit a research project in the final year of study at the Department of Economics. Her chosen topic for the research project is "An investigation of the relationship between Public Infrastructure Investments and Fiscal Sustainability in Namibia."

In order to complete this project, she requires certain information from Ministry of Finance The study will be conducted in an ethical way and the data that will be used solely for academic purposes.

Please do not hesitate to contact me if you need any more information.

Yours sincerely

Dr. J.A. de Beer
Lecturer and course coordinator : MSC in Développent Finance
Department of Economics
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UNAM
UNIVERSITY OF NAMIBIA

31 May

**National Planning Commission**

**Research project: Anna Niita Etuna Nahambelelwe Shatika**

I write this letter to confirm that Anna Shatika is a registered student Masters in Development Finance program at the University of Namibia (student number : 200744291 ) and is required to submit a research project in the final year of study at the Department of Economics. Her chosen topic for the research project is "An investigation of the relationship between Public Infrastructure Investments and Fiscal Sustainability in Namibia."

In order to complete this project, she requires certain information from the National Planning Commission The study will be conducted in an ethical way and the data that will be used solely for academic purposes.

Please do not hesitate to contact me if you need any more information.

Yours sincerely

Dr. J.A. de Beer
Lecturer and course coordinator : MSC in Développent Finance
Department of Economics
University of Namibia

jdebeer@unam.na

## 2. Raw Annual Data

| Time | PII | GovRev (in mil. N$) | GovExp (in mil. N$) | PubDebt | IntRate | GDP | BudBal |
|---|---|---|---|---|---|---|---|
| **1990/1991** | | 2,032 | 2,103 | 6.66% | | 2.0 | -0.95% |
| **1991/1992** | | 2,674 | 2,863 | 9.04% | 16.39 | 5.3 | -2.17% |
| **1992/1993** | | 2,945 | 3,380 | 12.49% | 9.02 | 9.3 | -4.35% |
| **1993/1994** | | 3,106 | 3,439 | 12.37% | 6.94 | -1.6 | -3.00% |
| **1994/1995** | 13.2 | 3,661 | 3,857 | 15.37% | -2.83 | 3 | -1.47% |
| **1995/1996** | 13.49 | 4,081 | 4,557 | 17.69% | 11.09 | 4.1 | -3.18% |
| **1996/1997** | 14.22 | 4,676 | 5,567 | 20.62% | 3.46 | 3.2 | -5.11% |
| **1997/1998** | 12.5 | 5,690 | 6,129 | 22.67% | 12.20 | 4.2 | -2.26% |
| **1998/1999** | 11.13 | 6,186 | 6,936 | 24.96% | 11.50 | 3.3 | -3.40% |
| **1999/2000** | 11.53 | 7,272 | 7,953 | 24.19% | 10.96 | 3.4 | -2.81% |
| **2000/2001** | 10.37 | 8,200 | 8,708 | 26.97% | 3.59 | 3.5 | -1.82% |
| **2001/2002** | 10.35 | 9,098 | 10,302 | 32.12% | 2.99 | 2.4 | -3.79% |
| **2002/2003** | 10.69 | 10,562 | 11,399 | 25.03% | 3.49 | 6.7 | -2.33% |
| **2003/2004** | 10.06 | 9,768 | 12,245 | 31.56% | 13.26 | 3.5 | -6.41% |
| **2004/2005** | 12.57 | 11,425 | 12,771 | 28.01% | 9.16 | 6.6 | -3.09% |
| **2005/2006** | 9.13 | 13,108 | 13,193 | 26.63% | 4.75 | 4.7 | -0.18% |
| **2006/2007** | 12.74 | 17,593 | 15,279 | 24.30% | 1.62 | 3.9 | 4.14% |
| **2007/2008** | 11.63 | 20,688 | 17,382 | 19.16% | 3.29 | 3.6 | 5.19% |
| **2008/2009** | 13.03 | 23,447 | 21,946 | 18.76% | 2.50 | 2.7 | 2.10% |
| **2009/2010** | 17.86 | 24,047 | 24,914 | 15.06% | 3.90 | 0.3 | -1.13% |
| **2010/2011** | 18.07 | 23,377 | 27,253 | 16.09% | 5.78 | 6 | -4.63% |
| **2011/2012** | 21.68 | 29,922 | 36,611 | 25.46% | 4.73 | 5.1 | -7.02% |
| **2012/2013** | 16.72 | 37,997 | 38,112 | 24.22% | -2.34 | 5.1 | -0.10% |
| **2013/2014** | 17.97 | 41,910 | 46,751 | 24.27% | 4.08 | 5.6 | -3.83% |
| **2014/2015** | 16.64 | 49,960 | 58,769 | 21.87% | 0.43 | 6.1 | -5.37% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2015/2016** | 16.54 | 52,363 | 62,540 | 34.85% | 5.26 | 4.3 | -5.95% |
| **2016/2017** | 13.27 | 50,865 | 62,228 | 39.69% | 1.74 | 0 | -6.45% |
| **2017/2018** | 10.71 | 58,659 | 67,523 | 40.58% | 0.10 | -1 | -4.83% |
| **2018/2019** | 11.4 | 55,882 | 65,108 | 49.12% | 5.53 | 1.1 | -5.18% |
| **2019/2020** | 11.6 | 58,425 | 67,343 | 56.11% | 8.91 | -1.6 | -4.98% |

### 3. Public Infrastructure Investment Equation Results

**ARDL Long Run Form and Bounds Test**
Dependent Variable: D(LNPII)
Selected Model: ARDL (1, 1, 2, 2, 2, 2)
Case 2: Restricted Constant and No Trend
Date: 11/30/21 Time: 15:00
Sample: 1994 2019
Included observations: 24

Conditional Error Correction Regression

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 9.749238 | 2.43831 | 3.998358 | 0.004 |
| LNPII (-1) * | -1.720946 | 0.218284 | -7.883978 | 0 |
| LNEXP (-1) | -2.26291 | 0.907322 | -2.494055 | 0.0373 |
| LNTD (-1) | -2.270818 | 0.428203 | -5.303136 | 0.0007 |
| LNFD (-1) | 0.351538 | 0.141802 | 2.479085 | 0.0382 |
| LNGDP (-1) | 0.781153 | 0.167838 | 4.654221 | 0.0016 |
| BUDBAL (-1) | -0.092307 | 0.025741 | -3.58592 | 0.0071 |
| D(LNEXP) | -0.92527 | 0.476562 | -1.941552 | 0.0881 |
| D(LNTD) | -0.664445 | 0.202741 | -3.277313 | 0.0112 |
| D (LNTD (-1)) | 1.000731 | 0.189095 | 5.292212 | 0.0007 |
| D(LNFD) | 0.078857 | 0.053569 | 1.472055 | 0.1792 |
| D (LNFD (-1)) | -0.201504 | 0.094347 | -2.135782 | 0.0652 |
| D(LNGDP) | 1.561597 | 0.550111 | 2.838695 | 0.0219 |
| D (LNGDP (-1)) | 1.014165 | 0.577953 | 1.754755 | 0.1174 |
| D(BUDBAL) | -0.019617 | 0.012239 | -1.602852 | 0.1476 |
| D(BUDBAL (-1)) | 0.038751 | 0.011927 | 3.248945 | 0.0117 |

* p-value incompatible with t-Bounds distribution.

Levels Equation
Case 2: Restricted Constant and No Trend

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| LNEXP | -1.314922 | 0.609773 | -2.156412 | 0.0631 |
| LNTD | -1.319517 | 0.200695 | -6.574733 | 0.0002 |
| LNFD | 0.20427 | 0.081374 | 2.510262 | 0.0364 |
| LNGDP | 0.453909 | 0.100308 | 4.52516 | 0.0019 |

| | | | | |
|---|---|---|---|---|
| BUDBAL | -0.053637 | 0.010471 | -5.122338 | 0.0009 |
| C | 5.665046 | 1.402643 | 4.038837 | 0.0037 |

**EC = LNPII - (-1.3149*LNEXP -1.3195*LNTD + 0.2043*LNFD + 0.4539 *LNGDP -0.0536*BUDBAL + 5.6650**

**F-Bounds Test** Null Hypothesis: No levels relationship

| Test Statistic | Value | Signif. | I (0) | I (1) |
|---|---|---|---|---|
| | | | Asymptotic: n=1000 | |
| F-statistic | 12.54025 | 10% | 2.08 | 3 |
| k | 5 | 5% | 2.39 | 3.38 |
| | | 2.50% | 2.7 | 3.73 |
| | | 1% | 3.06 | 4.15 |
| Actual Sample Size | 24 | | Finite Sample: n=35 | |
| | | 10% | 2.331 | 3.417 |
| | | 5% | 2.804 | 4.013 |
| | | 1% | 3.9 | 5.419 |
| | | | Finite Sample: n=30 | |
| | | 10% | 2.407 | 3.517 |
| | | 5% | 2.91 | 4.193 |
| | | 1% | 4.134 | 5.761 |

**Breusch-Godfrey Serial Correlation LM Test:**

| | | | |
|---|---|---|---|
| F-statistic | 0.51409 | Prob. F (2,6) | 0.6222 |
| Obs*R-squared | 3.511055 | Prob. Chi-Square (2) | 0.1728 |

**Heteroskedasticity Test: Harvey**

| | | | |
|---|---|---|---|
| F-statistic | 0.612773 | Prob. F (15,8) | 0.8031 |
| Obs*R-squared | 12.83175 | Prob. Chi-Square (15) | 0.6153 |
| Scaled explained SS | 10.71909 | Prob. Chi-Square (15) | 0.7722 |

## 4. Budget Balance Equation Results

**ARDL Long Run Form and Bounds Test**
Dependent Variable: D(BUDBAL)
Selected Model: ARDL (1, 0, 3, 2)
Case 2: Restricted Constant and No Trend
Date: 11/30/21 Time: 11:49
Sample: 1994 2019
Included observations: 23

Conditional Error Correction Regression

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 2.303468 | 2.204847 | 1.044729 | 0.3152 |
| BUDBAL (-1) * | -0.397476 | 0.135681 | -2.929492 | 0.0117 |
| PUBINFINV** | -0.474889 | 0.126893 | -3.742442 | 0.0025 |
| GDPGROWTH (-1) | 0.2288 | 0.292016 | 0.783518 | 0.4474 |
| LNDD (-1) | 1.120166 | 0.636281 | 1.760489 | 0.1018 |
| D(GDPGROWTH) | 0.215902 | 0.20077 | 1.075371 | 0.3018 |
| D (GDPGROWTH (-1)) | 0.177287 | 0.290611 | 0.61005 | 0.5523 |
| D (GDPGROWTH (-2)) | 0.737042 | 0.266836 | 2.762148 | 0.0162 |
| D(LNDD) | -3.095353 | 1.215572 | -2.546417 | 0.0244 |
| D (LNDD (-1)) | -1.959861 | 1.306463 | -1.500128 | 0.1575 |

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z (-1) + D(Z).

Levels Equation
Case 2: Restricted Constant and No Trend

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| PUBINFINV | -1.194762 | 0.580656 | -2.057606 | 0.0603 |
| GDPGROWTH | 0.575632 | 0.919125 | 0.626283 | 0.542 |
| LNDD | 2.818196 | 1.823364 | 1.545603 | 0.1462 |
| C | 5.795234 | 7.858131 | 0.737483 | 0.4739 |

**EC = BUDBAL - (-1.1948*PUBINFINV + 0.5756*GDPGROWTH + 2.8182 *LNDD + 5.7952)**

**F-Bounds Test** Null Hypothesis: No levels relationship

| Test Statistic | Value | Signif. | I (0) | I (1) |
|---|---|---|---|---|
| | | | Asymptotic: n=1000 | |
| F-statistic | 4.735494 | 10% | 2.37 | 3.2 |
| k | 3 | 5% | 2.79 | 3.67 |
| | | 2.50% | 3.15 | 4.08 |
| | | 1% | 3.65 | 4.66 |
| | | | Finite Sample: n=35 | |
| Actual Sample Size | 23 | | | |
| | | 10% | 2.618 | 3.532 |
| | | 5% | 3.164 | 4.194 |
| | | 1% | 4.428 | 5.816 |
| | | | Finite Sample: n=30 | |
| | | 10% | 2.676 | 3.586 |
| | | 5% | 3.272 | 4.306 |
| | | 1% | 4.614 | 5.966 |

**Heteroskedasticity Test: Harvey**

| | | | |
|---|---|---|---|
| F-statistic | 1.282747 | Prob. F (9,13) | 0.3311 |
| Obs*R-squared | 10.81816 | Prob. Chi-Square(9) | 0.2884 |
| Scaled explained SS | 6.491372 | Prob. Chi-Square(9) | 0.6899 |

**Variance Inflation Factors**
Date: 11/30/21 Time: 11:53
Sample: 1994 2019
Included observations: 23

| Variable | Coefficient Variance | Uncentered VIF | Centered VIF |
|---|---|---|---|
| BUDBAL (-1) | 0.012419 | 9.448856 | 5.558799 |

| | | | |
|---|---|---|---|
| PUBINFINV | 0.015108 | 184.135 | 9.626338 |
| GDPGROWTH | 0.016539 | 15.7242 | 3.051958 |
| GDPGROWTH (-1) | 0.063376 | 83.78054 | 10.47011 |
| GDPGROWTH (-2) | 0.039361 | 42.85094 | 3.210063 |
| GDPGROWTH (-3) | 0.095764 | 87.25618 | 2.749629 |
| LNDD | 0.969922 | 544.2911 | 7.478075 |
| LNDD (-1) | 1.478704 | 532.2289 | 18.00038 |
| LNDD (-2) | 0.687805 | 199.8656 | 9.130583 |
| C | 7.981094 | 576.2506 | NA |

## 5. Public Debt Equation Results

**ARDL Long Run Form and Bounds Test**
Dependent Variable: D(LNTD)
Selected Model: ARDL (1, 0, 2, 1, 2, 2)
Case 2: Restricted Constant and No Trend
Date: 11/30/21 Time: 12:23
Sample: 1994 2019
Included observations: 24

**Conditional Error Correction Regression**

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 9.138093 | 4.082603 | 2.238301 | 0.0491 |
| LNTD (-1) * | -1.119775 | 0.262644 | -4.263472 | 0.0017 |
| INTRATES** | -0.001864 | 0.007703 | -0.24201 | 0.8137 |
| BUDBAL (-1) | -1.218141 | 0.340664 | -3.575785 | 0.005 |
| PUBINFINV(-1) | -0.054789 | 0.017777 | -3.081912 | 0.0116 |
| LNREV (-1) | 34.13332 | 9.731509 | 3.507506 | 0.0057 |
| LNEXP (-1) | -35.59845 | 10.69329 | -3.329047 | 0.0076 |
| D(BUDBAL) | -0.307697 | 0.158848 | -1.937059 | 0.0815 |
| D (BUDBAL (-1)) | 0.315905 | 0.185179 | 1.705944 | 0.1188 |
| D(PUBINFINV) | -0.016693 | 0.018507 | -0.901983 | 0.3883 |
| D(LNREV) | 8.2179 | 4.514691 | 1.820258 | 0.0987 |
| D (LNREV (-1)) | -9.251599 | 5.563148 | -1.663015 | 0.1273 |
| D(LNEXP) | -9.474647 | 4.996469 | -1.896269 | 0.0872 |
| D(LNEXP (-1)) | 8.450988 | 6.076527 | 1.390759 | 0.1945 |

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z (-1) + D(Z).

Levels Equation
Case 2: Restricted Constant and No Trend

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| INTRATES | -0.001665 | 0.006827 | -0.243876 | 0.8123 |
| BUDBAL | -1.087845 | 0.331178 | -3.284775 | 0.0082 |
| PUBINFINV | -0.048928 | 0.00942 | -5.193983 | 0.0004 |
| LNREV | 30.48231 | 9.011621 | 3.382556 | 0.007 |
| LNEXP | -31.79072 | 10.1954 | -3.118142 | 0.0109 |

| | | | | |
|---|---|---|---|---|
| C | 8.160652 | 4.328343 | 1.885399 | 0.0887 |

**EC = LNTD - (-0.0017*INTRATES -1.0878*BUDBAL -0.0489*PUBINFINV + 30.4823*LNREV -31.7907*LNEXP + 8.1607)**

| **F-Bounds Test** | | Null Hypothesis: No levels relationship | | |
|---|---|---|---|---|
| Test Statistic | Value | Signif. | I (0) | I (1) |
| | | | Asymptotic: n=1000 | |
| F-statistic | 6.899606 | 10% | 2.08 | 3 |
| k | 5 | 5% | 2.39 | 3.38 |
| | | 2.50% | 2.7 | 3.73 |
| | | 1% | 3.06 | 4.15 |
| Actual Sample Size | 24 | | Finite Sample: n=35 | |
| | | 10% | 2.331 | 3.417 |
| | | 5% | 2.804 | 4.013 |
| | | 1% | 3.9 | 5.419 |
| | | | Finite Sample: n=30 | |
| | | 10% | 2.407 | 3.517 |
| | | 5% | 2.91 | 4.193 |
| | | 1% | 4.134 | 5.761 |

| **Breusch-Godfrey Serial Correlation LM Test:** | | | |
|---|---|---|---|
| F-statistic | 0.550796 | Prob. F (2,8) | 0.5969 |
| Obs*R-squared | 2.904788 | Prob. Chi-Square (2) | 0.234 |

| **Heteroskedasticity Test: Harvey** | | | |
|---|---|---|---|
| F-statistic | 0.787885 | Prob. F (13,10) | 0.6627 |
| Obs*R-squared | 12.14376 | Prob. Chi-Square (13) | 0.5159 |
| Scaled explained SS | 5.765329 | Prob. Chi-Square (13) | 0.9543 |
| | | | |
| R-squared | 0.869031 | Mean dependent var | 0.04808 |
| Adjusted R-squared | 0.811732 | S.D. dependent var | 0.1856 |
| S.E. of regression | 0.080529 | Akaike info criterion | -1.9392 |
| Sum squared resid. | 0.10376 | Schwarz criterion | -1.5465 |
| Log likelihood | 31.27025 | Hannan-Quinn criter. | -1.835 |
| Durbin-Watson stat | 2.086983 | | |

## 6. Literature Schema

| Author(s)/Article Bibliographic details | What was done and why? | Relevance to my work | How it was done - model | Variables used | What were the findings | Scope, limitations, conclusion, and the recommendations |
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| Varun, C. (2017). Public Infrastructure Investment, Economic Growth and Fiscal Sustainability in India: An Empirical Analysis. Birla Institute of Technology & Science Pilani (Rajasthan) | The interlinked aspects of Public Infrastructure Investment, Economic Growth and Fiscal Sustainability have been of great importance in terms of the proper functioning of any developing economy, like India. They noted that very few studies analyzing the | Infrastructure investment has been identified as a key to economic growth in many countries and this is not exception for Namibia. | *Sectoral analysis was performed to capture the essence of the critical relationship between public infrastructure investment and economic growth. *Time series econometric techniques such as | GDP per Capita; Public investment for different areas e.g., Education, transport); Total Receipts (Capital and operational receipts); Debt/GDP ratio; fiscal deficit as a ratio of GDP; growth rate | *The presence of cointegration was confirmed and hence long-run equilibrium relationship existed among the seven variables used for studying this objective. Various causal relationships were also inferred among these seven | *The findings from the panel data analysis of Indian states suggest that economic policies should address each of the cointegrated/interlinked sectors of Infrastructure simultaneously with investment. *Certain aspects which impact the quality of infrastructure sectors across Indian states, such as the identity of operators, the nature of the regulatory |

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| | relationship between Public Infrastructure Investment and economic growth, particularly from a state level point of view had been conducted in India. It was also noted that there was insufficiency of research works which had explored and suggested the best mode of infrastructure financing for India's major Infrastructure sectors, and also, the | Although public infrastructure is needed, there is also a need to consider fiscal sustainability since public infrastructure projects are typically large, long-lived and are usually | Im, Pesaran and Shin (IPS) (2003) panel unit root test and Westerlund (2007) panel cointegration were employed in order to examine this panel data. *Structural Vector Autoregression (SVAR) model was used to estimate the preferred mode of financing in terms | (GDP%); interest rate on debt | variables of our study. *Private mode of infrastructure financing was seen to be the most preferred one for sectors such as roads, telecommunication, and energy while Public Private Partnership (PPP) mode was preferred for the Seaports sector. *It was concluded that the major | framework and the nature of the political economy and ultimately drive the Public Infrastructure Investment can be considered for future scope of work. *One avenue for further research would be to impose sign restriction Vector Autoregression (VAR) and carry out the analysis on estimating the impact of different modes of infrastructure financing on economic growth. |

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| | aspect of determining the major determinants of attracting any Public Private Partnership (PPP) in India was largely untouched. Lastly, the vital relationship between debt and economic growth needed evaluation, particularly from an Indian context. Also, measurement of fiscal sustainability and estimation of a threshold value of debt/GDP ratio | financed with debt. It was noted that no study conducted to analyse the relationship between Public Infrastructure Investment and Fiscal Sustainability in Namibia, hence the scope of this | of having the maximum positive impact on India's economic growth. *Poisson regression, Negative Binomial regression and Tobit regression techniques were used to test and estimate the possible determinants of PPPs in infrastructure in | | determinants of a successful PPP in India are hard government constraints, market conditions, political factors, and institutional quality. *It was concluded that public debt makes a significant positive contribution to economic growth directly as well as indirectly via investment. | *More number of variables and improving the model specifications by incorporating dummy variables for global crisis or decomposing the analysis for specific sectors of infrastructure, are some attempts that could be done to extend the analysis pertaining to estimation of determinants of PPPs in India. *Further research can be focused on terms of establishing a causal link between public debt and economic growth, via the use of an instrumental |

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| | for Indian states still remained relatively unexplored and required its due attention. Therefore, the study was conducted to understanding the relationship between Public Infrastructure Investment and Economic growth for India, Issues pertaining to Infrastructure Financing, and finally the interlinkages between debt, economic | study to investigate the relationship between public infrastructure investment and fiscal sustainability in Namibia. | India, *fiscal sustainability index was calculated to examine the dynamic relationship between debt and economic growth. *Pareto principle and decision tree algorithm were used to calculate an optimal value of debt/GDP ratio. | | *An increase in level of public debt, all else being equal, would appear to stimulate the rate of investment over the course of time and, in turn, indirectly increase economic growth, hence supporting the argument that public debt has an indirect effect on economic growth through its beneficial impact on investment. | variable which will have a direct impact on debt but no direct effect on economic growth. *Further research could be performed in terms of finding ways to bridge the gap between economics and machine learning and find out interesting relationships. *From policy recommendation point of view, this empirical framework can help to estimate the short- and long-run elasticities of Public Investment in these major Infrastructure |

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| | growth, and fiscal sustainability issue for Indian economy. | | | | *Findings concluded with the condition that if fiscal deficit crosses -3.62 and debt-GDP ratio is more than 69.45% then the economy becomes fiscally unsustainable. If fiscal deficit does not cross -3.62, and debt-GDP ratio is also less than 69.45%, then the economy remains fiscally sustainable. *Findings it was concluded that if fiscal | sectors, so as to calibrate the developed models and generate scenarios telling how openness policies might stimulate businesses to adopt different types of investment options (like PPPs etc.) so as to maximize growth prospects. *The historical trend analysis for the last twenty years concludes with Private mode of infrastructure financing coming as the most preferred one for sectors – Roads, Telecom and Energy while PPP mode is the most preferred one for Seaports |

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| | | | | | deficit of a particular Indian state does not cross -3.62 with its debt-GDP ratio being less than 69.45% and growth rate greater than 13.48%, then the state economy remains fiscally sustainable. | sector,<br>*Based on the findings of examining which mode of infrastructure financing has a maximum positive impact on the overall GDP of our nation, it is concluded that Private mode of investment in Roads, Energy, Telecom while PPP mode for Seaports are observed to have maximum positive impact on GDP.<br>*The results indicate that public debt makes a significant positive contribution course of time and, in turn, indirectly |

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| | | | | | | increase economic growth, hence supporting the argument that public debt has an indirect effect on economic growth through its beneficial impact on investment. *Depending on the feasibility and importance in terms of the objective of the study, more number of Infrastructure sectors can be included so as to make the analysis more comprehensive and exhaustive.<br>*The analysis carried out for estimating the impact of different modes of financing on |

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| | | | | | | economic growth was limited to annual time series data for twenty years from 1995 to 2014 due to lack of data for the years before 1995.<br>*In the specification of the Structural Vector Autoregression (SVAR) model, dummy<br>variables were not used to account for major structural changes to the economy.<br>*Also, the analysis on examining and estimating the determinants of PPPs in India has limitations in terms of the |

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| | | | | | | considered time span and model specifications.<br>*For the empirical analysis on constructing the measure of fiscal sustainability and then estimating the threshold value of debt, validation measures to corroborate the calculation and estimation could not be carried out. |
| Carranza, L., Daude, C., & Melguizo, A. (2011). Public infrastructure investment and fiscal sustainability in Latin | The authors examine in detail trends in public and total infrastructure investment in six large Latin American economies, and their | It is relevant in the essence that it examines the trend in public | The study employed panel data to examine the relation between public infrastructure | Capital expenditure; Current expenditure; public debt; fiscal balance, gross capital formation; | The study concluded, there are links between fiscal sustainability and public investment in infrastructure. | *Fiscal exit strategies already debated and in many cases under implementation, should incorporate not only a sizable fiscal retrenchment, but also a fiscal framework favourable to |

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| America: Incompatible goals? OECD Development Centre. Working Paper No.301. | relationship with fiscal policies since the early eighties. They argue that post-crisis fiscal frameworks, notably fiscal rules, increasingly popular in the region, should not only consolidate the recent progress towards fiscal sustainability, but also create the fiscal space required to close the infrastructure gaps. They illustrate the importance of these | infrastructure investment in relation to the fiscal policy, to device fiscal strategies to maintain public investment in infrastructure, maintain public debts, and create more fiscal space, which | investment and fiscal sustainability | consumption expenditure | | public infrastructure investment.<br>*The analysis focused on fiscal rules, but the effectiveness of fiscal consolidation would be eased by a combination of rules, institutions (from fiscal councils to independent fiscal agencies), and better budgetary procedures.<br>*A disaggregated analysis of the different types of infrastructure may shed some light on their relationship with budget balance developments.<br>*Depending on data |

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| | arguments with a detailed account of recent developments in the fiscal framework and public investment in some of the main economies in Latin America, which could represent good practices for the region and for other developing economies. | is the significancy of this study. | | | | availability, it would be interesting to include more years and more countries. *The descriptive analysis could be complemented by a simple modelling of the trade-offs between public deficits to close infrastructure gaps, and higher interest expenses with imperfect capital markets which would allow understanding the optimal path to close the infrastructure gaps. |
| Hyeong Seok, JO. (2020) n the Relationship between | Given that social expenditure is a main part of mandatory | The study is relevant to my study in the | Hybrid panel data model, linear fixed effect equation, | Social Expenditure, Aging, Unemployment rate, | Research result portraits that organization capacity | The research empirically identified the causal relationship between SOCX and |

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| SOCX and Financial Sustainability Comparing OECD 19 Countries: Study of Using Hybrid panel data method and Granger Causality Test and implication for Korea fiscal policy. | spending of fiscal balance, it brings the concern of fiscal sustainability. The aim of this research is to investigate the relations between social expenditure and fiscal sustainability in 19 OECD countries from 2000 to 2018. | essence that it investigates the investment in social issues in relation to the fiscal sustainability, while this study is looking into the infrastructure investment in relation to | Granger causality test, Augmented Dickey-Fuller test, Phillips-Perron test, IPS unit root test | GDP growth rate, General government debt, National burden, General government Fiscal balance, Pension wealth, Financial power, Organization capacity, Budget institution | is significant to explain the change of social expenditure at the 0.1 level of significance, holding other factors are constant. Granger causality test is rendered social expenditure and fiscal sustainability variables are granger caused each other for the last 18 years in most case. | fiscal sustainability variables. Limitation noted in the study was on variables and short time series. |

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| | | fiscal sustainability. | | | | |
| Khadan, J. (2019). Fiscal Sustainability in the Caribbean: An Econometric Analysis. IDB Working Paper Series, 1014. | Most countries have been grappling with persistent fiscal imbalances and rising debt levels. debt levels have reached levels that have raised concerns among policymakers. The study e examines the issue of fiscal sustainability for a group of 10 Caribbean countries over the period 1991–2017. | Infrastructure projects normally requires large sums of funds or debt to finance it. Namibia debt level has raised concern as well, hence this study is investigating | Intertemporal budget constraint framework and panel data econometric estimators | stock of public debt, government revenue, primary government expenditure (government expenditure excluding interest payments), real interest rate payable on public debt, real GDP growth rate, the nominal GDP, debt-to-GDP ratio | The evidence from panel cointegration models of government revenue and expenditure shows that past fiscal behavior is “weakly” sustainable. The “weak sustainability” finding is reinforced by evidence from an extended fiscal reaction function which showed that the | The study suggests that countries need to be cautious about continuing past fiscal policies into the future and should seek to enact measures to ensure that they can adequately respond to fiscal-related shocks. |

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| | | the relationship between infrastructure investment and fiscal sustainability. | | | primary balance improves by about 0.02 for a one percentage point increase in the debt ratio. | |
| Lora, E. (2007). Public Investment in Infrastructure in Latin America: Is Debt the Culprit? *Inter-American Development Bank*, Washington DC. | The study used panel data to assess how public debt affects public infrastructure investment with econometric evidence for seven Latin American countries | Infrastructure projects normally requires large sums of funds or debt to finance it. Namibia debt level has | Econometric model: Unit Root Test (Dickey Fuller), Pairwise Correlations | Total Investment in Infrastructure, Public Investment in Infrastructure, Private Investment in Infrastructure, Log GDP per capita, Public Debt, Fiscal Balance, Debt | Debt increases are associated with higher public infrastructure investment, The study also finds some evidence of complementarity between public and private | Due to time sample limitations of some of the explanatory variables described below; the panel is unbalanced. The central conclusion of this paper is that (exogenous) debt increases (or declines) are associated with increases (or declines) in public infrastructure investment, r, it is |

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| | | raised concern as well, hence this study is investigating the relationship between infrastructure investment and fiscal sustainability. | | Service, Primary Expenditure, Real Exchange Rate, Inflation | investment and of the negative effect of IMF adjustment loans on infrastructure expenditures. No evidence is found that debt defaults affect public investment in infrastructure. | not robust to the breakdown of the fiscal balance between primary balance and interest payments because PII is strongly and positively associated with debt interest payments, PII is also strongly and positively associated with total primary expenditures. |
| Muzenda, A. (2014). An Empirical Assessment of Fiscal Sustainability in South | The aim of this study was to empirically analyse whether the government maintained | My study is also using time series data | Vector Error Correction Model (VECM) was used in E-views, ADF | primary balance-to-GDP ratio, debt-to-GDP ratio, | The computed results confirm that the government maintained a | Fiscal policy needs to be formulated and implemented in such a way that it eloquently promotes inclusive growth and |

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| Africa. Journal of Economics and Sustainable Development. 23, 2014. | its public debt position on a sustainable path during the period 1990-2013. A fiscal reaction function was estimated to examine whether the government's fiscal policies were consistent with the intertemporal government budget constraint, following diagnostic evaluation of unit root and cointegration properties of the time series data. | | approach was used to perform unit root tests, Johansen cointegration, | | sustainable fiscal policy during the period under review by adjusting the primary deficit or surplus in response to variations in its debt positions. | equitable income distribution. From the domestic economy viewpoint, the government total debt in relation to the domestic bond market remains high. Rising public D/Y ratios entail the risk of increasing pressure on sovereign financing capacity, creditworthiness, and country ratings. Fiscal consolidation is required in the future coming years to put public debt on a declining path and keep the path stable in both the medium term and long run periods. |

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| Shastri, S., Giri, A. K., & Mohapatra, G. (2017). An empirical assessment of fiscal sustainability for selected South Asian economies. Theoretical and Applied Economics Vol. 25, 163-178 | The study examines sustainability of public finances for five major South Asian economies namely to assess whether there is a long-run relationship between the government revenues and expenditures. Second, we investigate if the fiscal rule that relates the primary surplus and debt holds for the countries. | It is relevant in the essence that it examines the relationship between public infrastructure investment, that is dependent on government revenue and fiscal sustainability, as well the | cointegrating regression, Augmented Dickey- Fuller (ADF) and Phillips-Perron (PP), Gregory-Hansen and Carrion-i-Silvestre and Sanso test, Dynamic Ordinary Least Squares (DOLS), unrestricted error correction model | government revenue and expenditures, | The presence of long-run relationship between government revenue and expenditure for all the countries was found. An indication of a positive long-run response of primary balance to rising public debt ratio. | The results thus establish that South Asian countries have adhered to their intertemporal budget constraints in the post reform period. However, in view of the weakly sustainable fiscal stance, except in case of Bangladesh, the countries still need to reinforce their commitments to long-term fiscal discipline. |

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| | | long-run relationship between the variables. | (UECM) of ARDL model, | | | |
| Nxumalo, W.N. & Hlophe, N.F., 2018, 'Assessing fiscal sustainability in Swaziland', South African Journal of Economic and Management Sciences 21(1), a1821. https://doi.org/10.4102/ sajems. v21i1.1821 | Understanding and assessing fiscal sustainability is essential in ensuring financial and macro-economic stability. Fiscal sustainability has emerged as an important subject for Swaziland given the increasingly volatile government revenues especially | | The study employs a broad approach to assessing fiscal sustainability in Swaziland covering both deterministic and stochastic analysis. ADF and Philips Perron (PP), dynamic ordinary least squares | Primary balance, government expenditures, revenues and interest payments, GDP, debt | Fiscal sustainability indicators reflected that the country is on an unsustainable path with a primary gap and tax-gap of about 7% of gross domestic product (GDP) that has to be corrected. The econometric results also portray evidence of 'weak- | The study recommends corrective measures (mainly cuts in government expenditure) for fiscal policy to be brought back into a sustainable path without which a fiscal crisis is imminent. The recommendations are mainly based on the fiscal sustainability indicators as they are more forward looking for the short to medium term. The article |

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| | those coming through the South African Customs Union (SACU), which threw the country into a severe fiscal crisis between 2010 and 2012, as well as the pressures on increased government spending in the post-fiscal crisis era. The study focuses on studying whether Swaziland's fiscal policy remains on a sustainable path or | | (DOLS), Engle-Granger and JJ co-integration tests, VECM | | form' sustainability in the long-run. The econometric results also suggest a tax-spend hypothesis in the long-run, while short-run developments point to a spend-tax hypothesis. In both instances the correction measure is cutting expenditure, mainly recurrent expenditure | suggests fiscal rules based on these indicators. |

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| | whether corrective measures would be required. | | | | | |
| Rudi, K. (2012) Sustainability of Fiscal Policy and Government Revenue-Expenditure Nexus: The Experience of Indonesia. Online at https://mpra.ub.uni-muenchen.de/65883/ MPRA Paper No. 65883, posted 02 Aug 2015 16:05 UTC | Diagnosing the Indonesia's public finance by analysing the evolution of key fiscal indicators—debt, budget deficit, revenue, and expenditure—over time, to examines the issue of fiscal policy sustainability. The fiscal sustainability was tested based on the government | | Augmented Dickey-Fuller (ADF) test, the Phillips-Perron (PP) test, and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS), Zivot-Andrews (1992) unit root test (ZA test). Granger causality test involves | Government debt stock, government expenditure, government revenue, and government budget deficit. All variables are scaled to GDP | It is found that the fiscal policy in Indonesia has been responsible and conservative. The budget deficit has been maintained below 3 percent of GDP with a decreasing trend in public debt-to-GDP ratio since 2001 to present. All the | In controlling budget deficit and sustaining fiscal sustainability, the fiscal authorities in Indonesia should pursue robust fiscal policy aimed at raising revenue and controlling expenditure. |

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| | intertemporal budget constraint (IBC) framework using the data set covering the period of 1982 – 2010. | | estimating the vector autoregression (VAR) | | variables of interest are stationary, which favoring a conclusion that fiscal policy in Indonesia has been sustainable during the sample period. That government revenue Granger causes government expenditure positively. Also find that a shock in expenditure lead to a worsening budget deficit | |

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| Nyambe, J. M., & Kaulihowa, T. (2020). Public debt dynamics and fiscal sustainability in Namibia: An intertemporal budget constraint analysis. Journal of Economics and Business, 3(3), 1095-1104. | The paper examines Namibia's salient issues of public debt-dynamics and fiscal sustainability from 1980 to 2018. Time series data for the same study period was used. Of interest is the aspect of demystifying the dearth surrounding the trend of increasing public debt in Namibia when it is economically concerning that the existing capacity to | The paper is relevant as investigates public debt, which is one of the main variables of fiscal sustainability which the study would like to investigate in relation to public | The inter-temporal budget constraints model was used to examine the various fiscal reaction functions, debt dynamics and fiscal policy adjustment to debt | Government spending, revenue, debts, GDP, money supply, interest rates and consumption expenditure | The study found that the intertemporal budget constraint does not hold for Namibia for the period under review, confirming that no surplus exists or somewhat too little to offset the accumulated debt from the previous period. The fiscal reaction functions are consistent with the intertemporal budget constraint with | The government can address debt and fiscal sustainability issues by adjusting its expenditure through resources-wise matching. While government expenditure containment amidst a global downturn could be complicated there is scope to design workable approaches for generating needed revenues while seeking to balance up expenditure concerns. |

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| | mobilize needed resources is inadequate. | infrastructure investment. | | | resounding results for both fiscal reaction and extended fiscal reaction functions. The debt dynamics function exposition is that in the short-run, Namibia's public debt is unsustainable. | |
| Camarero, M., Carrion-i-Silvestre, J. L., & Tamarit, C. (2013). The relationship between debt level and fiscal | The financial and economic crisis of 2008-09 has raised serious concerns about the long-term fiscal sustainability of the Euro area countries. The paper | | | | The results obtained point to weak fiscal sustainability as well as to the existence of cointegration between deficit and debt confirming the | |

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| sustainability in OECD countries | integrated the traditional approaches to testing fiscal sustainability considering the stock-flow system that fiscal variables compose. The researcher's approach encompasses previous ways of testing sustainability. | | | | relevance of the stock-flow approach. | |
| Marini, G. & Piergallini, A. (2007) Indicators and Tests of Fiscal Sustainability: An Integrated Approach. | The evolution of public debt in OECD countries requires some form of monitoring. To demonstrate that indicators and tests for | | Intertemporal budget constraint, Primary gap, tax gap, Dynamic Error Correction Model (ECM), | Budget deficits, primary surpluses, and public debt. All variables are scaled by GDP | The paper has proposed a simple strategy that enables one to integrate the use of indicators and tests of fiscal | Our integrated approach allows to test the consistency of fiscal plans over the relevant sample period. Fiscal indicators derived from the present value budget constraint should also be |

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| JEL Classification: C12; C22; E60; H60 | fiscal sustainability may usefully be integrated. We show that the simultaneous use of indicators and tests provides additional information on the issue of government solvency. | | | | sustainability. Indicators are forward looking, in the sense that they are based on published forecasts, thereby reacting to a set of current and expected future conditions in fiscal policy. Tests, on the other hand, are backward looking, in the sense that they are based on a sample of past data. | calculated. Their interpretation, however, must be made contingent on results by tests, that is, according to whether or not there is a genuine sustainability problem |