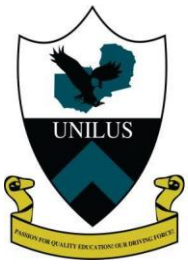

UNIVERSITY OF LUSAKA

SCHOOL OF POSTGRADUATE STUDIES

AN ASSESSMENT OF THE IMPACT OF DEBT FINANCING ON INFRASTRUCTURE DEVELOPMENT IN ZAMBIA FROM 1990 TO 2023

A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, UNIVERSITY OF LUSAKA IN PARTIAL FULFILMENT OF THE AWARD OF THE MASTER OF SCIENCE IN ECONOMICS AND FINANCE.

BY

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DECLARATION

Dissertation Author:

I, **Zambwe Shingwele**, declare that the dissertation, which I hereby submit for the Master of Science in Economics and Finance at the University of Lusaka is my own work and to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

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SIGNATURE : 

DATE : 20th January, 2025

DEDICATION

I dedicate my dissertation work to my loved ones.

My mother, Lydia, and my sister, Lungowe, have shown me immense love and support which has enabled me to reach this far. I am particularly appreciative of their words of encouragement ability to see greatness in me, even when I fail to see it in myself sometimes.

To my best friend Kay, we've grown together and seen many versions of each other. Here's to a new version of myself to evolve with.

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Above all, I want to start by expressing my gratitude to God for the divine love, grace, and provision He has shown me. This has not been an easy journey but I have found favour in unlikely places up until the completion of my dissertation.

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ACRONYMS

ADF	Augmented Dickey-Fuller
AfDB	African Development Bank
AIDI	Africa Infrastructure Development Index
ARDL	Auto Regressive Distributed Lag Model
COMESA	Common Market for Eastern and Southern Africa
DBS	Direct Budget Support
DSR	Debt Service Ratio
EIB	European Investment Bank
EU	European Union
GRZ	Government of the Republic of Zambia
HIPC	Highly Indebted Poor Countries
ICT	Information and Communication Technologies
IMF	International Monetary Fund
MDBs	Multilateral Development Banks
PPPs	Public-Private Partnerships
SADC	Southern African Development Community
SBS	Sector Budget Support
SGR	Standard Gauge Railway
TEN-T	Trans-European Transport Network
UNDP	United Nations Development Program
VECM	Vector Error Correction Model

ABSTRACT

The study empirically examined the impact of debt financing on infrastructure development in Zambia for the period of 1990 to 2023 using an Auto Regressive Distributed Lag Model (ARDL). In order to conduct the analysis, Infrastructure Development Index, Total Debt Servicing, Government Expenditure and Domestic Tax time series data were used. The ARDL Model was employed because the variables in the study had a mixed order of integration, and the ARDL bounds test was conducted to determine the long-run relationship among the variables of interest respectively. There was found to be one co-integrating equation, therefore establishing that there exists a long-run relationship. Consequently, the empirical findings of the study provide evidence that there exists a negative significant long-run relationship between debt financing and infrastructure development in Zambia, owing to the fact that a high level of public debt can have adverse effects on the macroeconomic stability, discouraging capital inflows, while favouring capital flight. The government expenditure and government domestic tax revenue were found to have a positive and significant effect on infrastructure development in Zambia, in the long-run. Therefore, policymakers should prioritise strengthening governance structures to ensure that infrastructure projects are executed efficiently and sustainably. Additionally, a robust tax system would provide the government with the financial resources needed for long-term infrastructure projects.

Keywords: *Debt Financing, Infrastructure Development index, Total Debt Servicing, Government Expenditure, Domestic Taxes, Autoregressive Distributed Lag Model (ARDL).*

CHAPTER ONE

1.0 Introduction

The Government of the Republic of Zambia (GRZ) continues to rely on both domestic and foreign borrowing as a key method for mobilizing resources to address the financing gap in the national budget (GRZ, 2020). The government obtains funds from both internal and external sources to finance capital projects and various budgetary programs, including Direct Budget Support (DBS) and Sector Budget Support (SBS).

Infrastructure is one of the significant economic development and societal growth drivers, especially in developing nations like Zambia. Proper and maintained infrastructure like transportation networks facilitate the easy movement of goods, services, and persons; hence, these underpin most sectors of the economy (Foster & Dominguez-Torres, 2010). Unfortunately, financing for this infrastructure is usually a challenge and most countries, including Zambia, resort to heavy borrowing for such investments (Badu et al., 2013).

Dissecting debt-financed infrastructure development is therefore significant for Zambia, whose government has ventured in projects that target construction and rehabilitation of roads, bridges, railways, and aerodromes as part of the country's transport network (GRZ, 2017). While there are positive outcomes associated with these endeavours, such as economic growth and improved connectivity, over reliance on debt financing without caution poses risks related to the long-term sustainability of this financing strategy and the country's fiscal stability.

Since its independence in 1964, Zambia's infrastructure has seen a dramatic transformation. Most recently, there have been targeted interventions by the Zambian government relating to the improvement of the transport infrastructure since 2011 (ZDA, 2015). Some of these include obtaining Eurobonds in 2012 and 2015 in which approximately 91% and 34% of the debt respectively where slated for infrastructure development (World Bank, 2017). This development is especially important because Zambia, being a landlocked country, relies heavily on a good transport system to facilitate its imports and exports Therefore, it is imperative that the country registers significant improvements in its transportation infrastructure. The steps to ensuring that this is achieved is evidenced by the Link Zambia 8000 project (Accelerated National

Roads Construction Programme) that the government embarked on in 2011 which is aimed at building 8000km of high quality single and dual lane roads throughout the country (ZDA, 2015).

Additionally, this rapid improvement in infrastructure development programs may be attributed to the fact that it was a priority in the Sixth National Development Plan (2011 to 2015) and Seventh National Development Plan (7NDP). One of the outcomes specified in the 7NDP (2017-2021), is to contribute towards the achievement of improved transport and infrastructure systems by 2021. However, the World Bank (2017), stated that the five-year Link Zambia 8000 Project, from 2011-2016, was overly ambitious and was not well planned as it lacked a detailed implementation framework. When the available resources required for implementation of the Link Zambia 8000 Project became lower than US$6 billion, the process of selecting roads became random and lacked the evidence of social and economic returns.

Despite the inconsistencies in infrastructure development, the Bank of Zambia (BOZ) in its 2014 report showed that growth in the construction sector was strong at 8.5% compared to 11.4% in 2013. This infrastructure development included public infrastructure such as residential housing and shopping malls (BOZ, 2014). The 2015 BOZ annual report showed that road infrastructure was over budget by 34.4%. This can be attributed to the fact that according to the 2009 Auditor General report cited in the World Bank Report (2017), the cost of construction of roads in Zambia has been very high in comparison to other countries in the region. These much higher costs increase opportunities for corruption in the transport and storage sector. Therefore, in 2015, the construction sector only grew by 1.4% (BOZ, 2015). The construction sector further recorded a slower growth in 2016, falling from 18.0% in 2015 to 4.5%. The decline was attributed to the reduced implementation of various public infrastructure development projects and coincidentally an early election took place due to the demise of the president at the time. The infrastructure expenditure particularly on roads was below target by 56.5% (BOZ, 2016). This was quite disappointing considering the Zambian government borrowed heavily for supposed infrastructure development.

1.1 Background of the Study

Globally, debt financing has been instrumental in advancing major infrastructure projects. For example, China's Belt and Road Initiative (BRI) has funded transportation infrastructure throughout Asia, Europe, and Africa via loans, promoting enhanced connectivity and trade networks. This initiative, backed by institutions like the Asian Infrastructure Investment Bank (AIIB), has led to the development of extensive road and rail networks (Hillman, 2020). However, the reliance on debt for infrastructure has sparked concerns about debt sustainability, particularly among developing countries, where the repayment burden may be high (Hurley et al., 2018). The European Union (EU) has also embraced debt financing for transportation projects through mechanisms like the European Investment Bank (EIB) loans. These loans have supported projects such as the Trans-European Transport Network (TEN-T), which aims to improve connectivity across EU member states (EIB, 2019). For example, the infrastructure investment need in Asia was estimated to be US$2 trillion between 2016 and 2030 (UN ESCAP, 2019). Neither the governments, multilateral development banks (MDBs) nor the banking sector can provide financing in such quantum, making bond markets both local and international a crucial source to close the financing gap.

In Africa, debt financing has similarly been vital for transport infrastructure. Countries like Kenya, Nigeria, and Ethiopia have leveraged loans to build key infrastructure projects. For example, Kenya's Standard Gauge Railway (SGR) was financed through a US$3.2 billion loan from the Export-Import Bank of China. The SGR has significantly reduced travel time between the port of Mombasa and Nairobi, enhancing trade and transport efficiency (Mugambi, 2017). African countries have increasingly relied on external borrowing from China, multilateral institutions like the African Development Bank (AfDB), and international capital markets to finance transport infrastructure. However, as alluded to earlier, the increasing debt burden poses risks to fiscal stability. Zambia, for instance, experienced significant debt distress, partly due to large-scale infrastructure investments financed through loans (IMF, 2021).

In recent years, Africa has made strides in improving its infrastructure. According to the Africa Infrastructure Development Index (AIDI), low-income countries have shown rapid progress, while fragile states continue to struggle, with advancements primarily in Information and Communication Technologies (ICT) and, to a lesser degree, in

access to Water and Sanitation (WSS). Meanwhile, electricity production has stagnated, and transportation development has seen limited progress, though some notable efforts have been made (Tumbare 2015, Laborda and Sotelsek 2019). The infrastructure achievements of countries like Kenya, Ghana, and Senegal are particularly notable, largely due to their strong performance in the ICT sector. However, some countries, such as Madagascar, Niger, and Chad, are still behind in infrastructure development, though improvements are beginning to be felt (IMF 2014). Further, in 2009, Botswana secured a loan from the World Bank to support the Integrated Transport Project, which aimed to enhance road safety and improve transport efficiency across the country. The project involved upgrading critical road infrastructure and modernising the transport sector's regulatory framework (World Bank, 2009). This funding was crucial in improving road safety and reducing travel times, which have been key factors in boosting Botswana's economic competitiveness.

Similarly, the AfDB has been a key partner in financing Botswana's transport infrastructure. In 2017, the bank approved a US$137 million loan for the Kazungula Bridge project, which links Botswana and Zambia. This bridge is a vital transport corridor for the Southern African Development Community (SADC) region and is expected to enhance trade and logistics between the two countries (AfDB, 2017). Moreover, PPPs have emerged as a critical approach to mitigate the risks of over-reliance on debt. South Africa's Gautrain project, a rapid rail link connecting Johannesburg and Pretoria, was financed through a combination of debt and private investment, providing a model for sustainable infrastructure development without overburdening public debt (Arimoro, 2019).

Transport infrastructure development in Zambia has come a long way with well-known reference to the construction of the "Cape to Cairo" railway line in the colonial era which connected the country to the continental transportation network (Phiri, 2018). Post colonisation, transport infrastructure development has continued to take precedence for successive Zambian governments in their quest to diversify the economy, foster trade, and enhance social integration. This is evidenced by the heavy investment in the expansion and modernisation of the Zambian road network.

Once hailed as the best alternative financing solution for infrastructure development, the increasing dependence on debt financing, especially external debt, has led to Zambia's rising debt burden. According to the IMF (2021), Zambia's debt-to-GDP ratio increased from 35.2% in 2014 to 105.9% in 2020. This rapid accumulation of debt has exerted pressure on Zambia's fiscal space as the increased debt servicing costs have reduced government's ability to allocate resources to other pertinent sectors such as health, education and social protection. This has also not been helped by Zambia's subsequent vulnerability to currency fluctuations and economic shocks.

In 2014, according to the Bank of Zambia (2014) annual report, the total stock of outstanding external debt for the country rose by 35.3% to US$4,751.9 million at end-December 2014 from the US$3,548.0 million recorded at end-December 2013. The increase was predominantly as a consequence of the US $1.0 billion Euro bond issued on the international capital market during the year. In the same year the, the Government external debt service amounted to US $265.0 million, representing an increase of 4.1% from US $238.6 million in 2013. The stock of external debt continued to rise in 2015 as it increased by 39.6% of which 66.7% of this increase was as a result of the third US$1,250 million Eurobond issued by end of December of the same year. In 2016, a 3.8% increase in the stock of external debt in 2016 was recorded and as at December of the same year the debt was sitting at US$6,850.9 million. Similarly, the external debt service has been increasing exponentially. In 2016, external debt service was at US$ 585.0 million which represents a 53.3% increase from 2015 which also increased by 53.6% from 2014 figure (BOZ, 2016).

Further, concerns have been noted that in Zambia's transport sector, infrastructure financing has not always been transparent and the procurement process not efficient either (Bwalya & Mwaba, 2019). This has led to increased calls for an overall assessment of the financing strategies being used and their effects on the country's development.

To this effect, the government has made use of various financing strategies over the years and these include:

- **Government Budgetary Allocations:** Each year, the government allocates a varied portion of its annual budget to the development of transport infrastructure

(Mwale, 2020). This funding has been instrumental for the construction, maintenance and upgrading of infrastructure.

- **Debt Financing:** To address its fiscal deficit, Zambia has relied on both domestic and external debt financing more and more (Mwanawina, 2018). This has been achieved through measures such as the issuance of government bonds and the procurement of loans from international financial institutions.
- **Donor Funding:** International development agencies such as the World Bank and the AfDB have supported Zambia's transport infrastructure projects through the provision of financial assistance (Sikazwe, 2019). These donor funds have been fundamental to financing large-scale initiatives such as the construction of major highways and the rehabilitation of railway lines.

Zambia became the first African nation, post-COVID-19, to default on its Eurobond debt, as announced on 13th November 2020 (Mbewe et al., 2024). By the end of 2021, Zambia's multilateral debt stood at an average of 15% of total external debt; the bilateral debt averaged 32%, and the government issued three Eurobonds in 2012, 2014, and 2015, amounting to US$750 million, US$1 billion, and US$1.25 billion, respectively. Together, these bonds made up more than 50% of the total external debt (GRZ, 2021).

Confronting these challenges, the options being pursued by Zambia entail the use of Public-Private Partnerships (PPPs) and investments in the private sector as alternatives to financing modalities that rely on traditional debt financing (Bwembya & Chileshe, 2019). PPP arrangements with private sector entities have financed and managed some transport projects, such as toll roads, built and operated by the private sector (Kabinga, 2021). However, their implementation has not been without their challenges such as issues of risk allocation, inadequate legal and regulatory frameworks, and limited coordination between the public and private sectors.

1.2 Statement of the Problem

Some studies in the literature have analysed the relationship between debt and economic growth (Arsène et al. 2013, Chongo, 2013, Prabir, 2012, Reinhart,2010, Roodman, 2009). There is hardly any literature that has focused on the impact of debt financing on the disaggregated component of economic growth, such as infrastructure

development, for Zambia. This study will analyse the impact of debt financing on infrastructure development alone as a component of economic growth in Zambia. The study uses secondary data on infrastructure Development Index, Debt to Gross Domestic Product Ratio, Governance Expenditure and Domestic Tax for the period 1990 to 2023. For the analysis of the data, the study applies the Auto Regressive Distributed Lag (ARDL) model and it is anticipated that the results of the study will enhance the understanding of the impact of debt financing on infrastructure development in Zambia. The study will also contribute to the body of literature and narrow the gaps that have been observed in literature.

1.3 Research Objectives

1.3.1 General Objective

To analyse the impact of debt financing on infrastructure development in Zambia from 1990 to 2023.

1.3.2 Specific Objectives

i. To analyse the impact of debt financing on infrastructure development in Zambia from 1990 to 2023.
ii. To establish the impact of government expenditure on infrastructure development in Zambia from 1990 to 2023.
iii. To analyse the impact of domestic taxes on infrastructure development in Zambia from 1990 to 2023.

1.4 Research Questions

i. What is the impact of debt to gross domestic product on infrastructure development in Zambia from 1990 to 2023?
ii. What is the effect of government expenditure on infrastructure development in Zambia from 1990 to 2023?
iii. What is the impact of domestic tax on infrastructure development in Zambia from 1990 to 2023?

1.5 Research Hypotheses

i. H_0: Debt financing has no impact on infrastructure development in Zambia from 1990 to 2023.
ii. H_1: Debt financing has an impact on infrastructure development in Zambia from 1990 to 2023.

1.6 Significance of the Study

As alluded to earlier, the research will interrogate the financing strategies used in Zambia's infrastructure development over the years, exploring their advantages, limitations and overall impact on the country's economic growth and development. Dynamics, such as debt management, resource allocation and the general economic and political environment, influencing the sustainability of the financing strategies Zambia employs will as well be examined, as noted by Mulenga (2020). Additionally, this research is significant as it will contribute to the existing literature on debt financing and its impact on infrastructure development and will be useful to scholars who would like to research on a similar subject.

Furthermore, the research findings will give an in-depth insight into the challenges and the trade-offs which are associated with the debt financing in Zambia, and at the same time, inform policymakers and stakeholders on the most effective and sustainable ways of investing in the infrastructure development of the country.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

The chapter will review the literature on the theoretical and empirical research on the impact of debt financing on infrastructure development. It will give the theoretical framework of the study and also discuss the conceptual frame on which the study will depend.

2.1 Empirical Literature review

Zambia has over the last few years issued three major bonds which include; the US $750 million Eurobond and US $1.25 billion in 2012 and 2015 respectively. The Zambian government issued these bonds to finance the various infrastructure projects that the government is undertaking across the country, in the transport, energy and social sectors (Yambe, 2015). While government borrowing is not inherently bad, growing debt and large expenditure on debt servicing costs are a severe burden to developmental expenditure (Sanderatne, 2011).

Debt contraction in most developing countries has been seen as a source of economic problems and Zambia is not exempt from challenges stemming from excessive borrowing. Nkonde (2015), writing in the Lusaka Times Newspaper adds that, excessive borrowing is associated with several risks and Zambia is at the brink of falling into the debt trap. This is because since its independence in 1964, the country has never accumulated this high level of debt. It is feared that this high level of debt and subsequent debt service charges negatively impact infrastructure spending.

To further understand the infrastructure spending deficit, an African Infrastructure Country Diagnostic Country Report prepared by Foster and Dominguez (2010) showed that the funding gap in Zambia's infrastructure spending was at 0.5 billion United States Dollars (US$) per year. The Zambia Development Agency (ZDA) stated that the Country's infrastructure deficit was due to the fact that the Government of the republic of Zambia had limited resources to invest in infrastructure. The collection of revenue by government through taxes and/or levies was not sufficient to meet the increasing demand for public infrastructure facilities. Additionally, there had been a reduction in the budget support received from cooperating partners from 2014 onwards, forcing Government to consider alternative sources of funding to sustain the

budget. In 2014, the Country's external debt was about US$3.2billion and US$1.852 million accounted for internal debt. With the proposal to finance 24.6% of the 2014 budget using debt, the governments' capacity to contract more debt for infrastructure development drastically declined (ZDA, 2014).

There have been varying reports about what the real debt figures are in Zambia. For example, contrary to the ZDA (2014) report, the Debt Sustainability Analysis (DSA) conducted by the Zambia Institute for Policy Analysis and Research (ZIPAR), in the same year, revealed that Zambia's total public debt was estimated at around US$8.8 billion, with external debt standing at US$4.8 billion. However, with the government's issuance of a US$1.25 billion Eurobond in July 2015, the country's external debt stock was pushed to over US$6 billion and has since continued to rise. Most recently, the external debt stock as at May of 2017 was US$ 7.2billion and US$3.86 million domestic debt (The World Bank, 2017). The IMF suggests that the Zambian government slows down the rate of debt contraction to ensure sustainability of debt. It was also recommended that the selection, monitoring and procurement process of infrastructure projects should be done to in a transparent manner so as to ensure these projects deliver value for money (IMF and IDA, 2017).

On the issue of debt-financed transport infrastructure development, Estache and Fay (2007) looked at the relationship between public investment in infrastructure and economic growth in developing countries. The findings revealed that although investing in transport infrastructure had a positive impact on economic growth, the long-term success of these investments was dependent on effective financing strategies. Debt-financed projects, if not well managed, would lead to debt sustainability problems and possibly negatively affect the long-term benefits of the investment in infrastructure.

Briceño-Garmendia et al. (2008) discussed the problems of infrastructure financing in the African region, including the role of debt. They concluded that debt financing should be balanced with other sources of finance, such as private investment and public-private partnerships, to ensure the sustainability of infrastructure development. Additionally, in order to mitigate risks associated with debt-financed infrastructure projects, the study recommends prudent project selection, cautious debt management and diverse financing sources and strategies. Similarly, Gwilliam et al. (2008)

considered transport infrastructure challenges in Africa, Zambia inclusive. According to the study, it was discovered that Zambia's transport sector was heavily financed by debt causing high debt servicing costs and limited resources for infrastructure construction and maintenance.

On the specific context of Zambia, Mwale and Mulenga's 2019 study was aimed at establishing the impacts of Chinese-funded infrastructure projects on the transport sector of Zambia. Using a mixed-methods approach, the researchers coupled quantitative analysis of project data with stakeholder interviews. The findings demonstrate that Chinese-funded projects have contributed to the expansion and modernisation of the country's transport infrastructure, although there are questions about the sustainability of such infrastructure financed through a debt-driven model. The findings of the study imply that the Zambian government should look with a critical eye at the terms and conditions under which the loans were taken out to ensure that they do not translate into an unattainable debt burden in the long term (Mwale & Mulenga, 2019). The empirical literature reviewed in the preceding section has further emphasised why financing challenges in the development of transport infrastructure in Zambia must be addressed. This is especially regarding the reliance on debt as a means of financing capital-intensive infrastructure projects. While debt is a useful tool for investment in infrastructure, the literature supports the need for a more balanced and sustainable approach.

Gohar et al. (2012) used the least square multiple regression method to investigate the impact of external debt servicing on the growth of low-income countries using annual panel data of thirty-six (36) low-income countries taken from 1990-2008. The study finds that the impact of external debt servicing is quite adverse on economic growth and it was concluded that low-income countries should go for the option of debt forgiveness, invite regulated foreign direct investment (FDI) and encourage exports.

A study undertaken to assess the influence of public indebtedness on public investment in infrastructure (PII) in the period 1987- 2001 for seven (7) Latin American countries finds that exogenous debt (exogenous in this context is defined as debt changes that are not the result of PII decisions) increases do not reduce PII. On the contrary, the study finds that the more a country plunges further into debt, the more

PII increases (Lora, Eduardo, 2007). However, there have not been many studies of this nature to compare to the findings of this report.

Fosu (2009) studied the impact of external debt service payments on public expenditure composition in thirty-five (35) Sub-Saharan African countries over 1975-1994, a period preceding the Highly Indebted Poor Countries (HIPC) initiatives and found out that debt servicing shifts spending away from social sector, health and education. Therefore, as the debt servicing grows there is reduced funding going to the social and health sector in these countries.

Using an estimated Model for Pakistan Aggregate Investment from 1978-2009, Kazim et al. (2009), show that debt service payments affect investments. However, the intensity of the effects differs in nature depending on the crediting institute. It is evident from the results that debt services to Multilateral Creditors and other Private Creditors have a negative impact on Pakistan's Gross Private Capital Investment. Debt from Bilateral Creditors contributes positively for aggregate investment.

Elmendorf and Mankiw (1999) discovered that public debt accumulation can influence growth primarily through long-term interest rates. As government budget deficits are financed by more debt, long-term interest rates rise, which crowds out private investment and slows potential output growth. This means that the higher interest rates needed to repay public sector debt could prompt more funds to flow from the private sector to the public sector, as private sector interest rates also increase. Furthermore, this rise in private sector interest rates results in reduced private sector spending.

Drehmann and Juselius (2012) investigate whether or not debt service costs affect macroeconomic and financial stability. The study comprised twenty-seven (27) countries and debt service ratios (DSR) as an estimation method. The findings show that DSR produces a very reliable early warning signal ahead of financial crises which implies that the DSR can serve as a useful supplementary indicator for the build-up of vulnerabilities in the real economy and financial sector. The study found that the purpose for which external debt is acquired, which is to fund development, is depressed by debt service payments because it takes up the bulk of the resources as opposed to advancing the development agenda.

As highlighted previously, the study has shown that the debt in Zambia has been growing exponentially over the last decade or so, therefore the literature further highlights the impact of growing debt on a country's economy and at what point debt accumulation may pose serious challenges to a country's economy as studied by various scholars. A debt sustainability report done by the IMF and IDA (2017) on Zambia, showed that the country was headed towards a debt crisis. The report attributes this to the fact that the public and publicly guaranteed external debt present value (PV) breached the 40 percent of GDP threshold (Ibid). This is owed to the fact that the rate at which the country has accumulated debt has been considerably high. The study suggests that the country should strengthen the investment process, including the selection, procurement, and monitoring of infrastructure projects, to ensure that public investment projects meet their expected standards in relation to their costs.

In a study by Ejigayehu and Persson (2013), which examined the impact of external debt on economic growth in eight heavily indebted African countries from 1991 to 2010 using a random effect estimation model, it was found that debt impacts economic growth primarily through the debt crowding-out effect rather than the debt overhang effect. They define the debt crowding out effect as a situation when income from export is used to pay the accumulated debt.

The impact of governance on infrastructure development has been pointed out in some past research (Dixit, 2009; Kaufmann et al., 2004, 2010). Depending on the level of governance, infrastructure can be enhanced through various approaches and channels, including production facilitation, trade mobilisation that promotes more competitiveness, more job provision, and a decrease in trade logistics and other supply chain costs (Dixit, 2009; Kenny, 2007, 2009). Inadequate infrastructure may be a stumbling block to prosperity and poverty alleviation despite its positive impact on economic development (Appiah et al., 2020; Malah Kuete & Asongu, 2022; Onifade et al., 2020), and the lack of well-developed infrastructure has been identified as a clog in the wheel of development as worsening poverty in SSA countries (Kodongo & Ojah, 2016; Çevik et al., 2020).

A study was conducted by the European Union Central Bank to assess the impact of high and growing government debt on economic growth in the euro area. Using data

in a panel of twelve (12) euro countries over a period of forty (40) years starting in 1970, the study finds a highly statistically significant non-linear relationship between the government debt ratio and per capita GDP growth for the twelve (12) pooled euro area countries sampled. The study concludes that public debt on average would only have a negative effect on economic growth when it exceeds 90-100% of GDP threshold (European Union, 2010). Kontbay (2013) studied the thresholds of public debt-to-GDP and total external debt-to-GDP ratios above which economic growth is impaired. The second objective was to examine the effects of debt overhang on the sources of growth. The study used large panel data set of developed and developing countries from 1970-2009. Findings showed that for high income OECD countries, the level of public debt above which the growth becomes a burden is 69 percent, while it is forty-seven (47) percent and thirty (30) percent for middle and low-income countries respectively. For external debt the thresholds are eighty (80) percent, fifty (50) percent and seventy (70) percent for high, middle and low-income OECD countries respectively. However, despite these thresholds the study finds that the growth is in no way affected negatively by an increase in external debt, the negative relationship between debt and growth can be attributed to the decrease in capital stock accumulation for high debt levels. However, Chudik et al. (2015), conducted an empirical study using data of forty (40) countries (grouped into developing and advanced) over a period from 1965-2010 find that a universally applicable threshold effect in the relationship between public debt and economic growth, does not exist once the impact of global factors and their spillover effects are accounted for. The study does however find that there are significant negative long-run effects on output growth as a result of a build-up of external debt. Another study Pescatori et al. (2014) found that there is no evidence of any debt threshold above which growth prospects are compromised in the medium-term.

Oshikoya (2004) investigated the macroeconomic determinants of private investment in some African countries for which adequate statistics were readily available. Raheem (2000) acknowledged the fact that debt management has to be conceived within a comprehensive and macro-policy framework that emphasises the need to enhance domestic saving rate, generate current account surplus, and improve the efficiency of resource allocation. Raheem (2000) came up with an econometric-based debt management model to determine the levels of debt and balance of payments, as well

as their impact on the entire economy. Essien and Onwiodukokit (2008) suggested that the government should embark on appropriate debt management strategies with feasibility study of projects such as loan acquisition and deployment. The author further stated that project should be financial with feasibility study of projects such as loan acquisition and deployment. The author further stated that projects should be financed with external loans since the potential of economic growth in the country can be improved through external resources invested on viable ventures. Ndekwu (2003), Pearson (2003), Symonds (2000), Lewis (2006), Singer (2009), Kaldor (1995), and Berger (2005) came to the conclusion that foreign resources transferred to less developed countries will help improve the economies that have low growth rate to grow into economies capable of adequate and sustainable growth. Ndekwu (1996), Wijeweera (2005) found out that international financial institutions and international creditor countries should cooperate and make the various debt management strategies to function effectively.

Aladejana, Okeowo, Oluwalana and Alabi (2021) investigated debt burden and infrastructural development in Nigeria. Annual time-series data from the CBN statistical bulletin for the period 1986-2019 were used in the study. A multiple regression analysis based on ordinary least squares (OLS) was conducted to test the hypotheses at a 5% significance level. The study's findings indicated that both current and lagged domestic debt had a positive and significant relationship with infrastructure development. In contrast, current and lagged external debt showed a negative relationship with infrastructure development and was not statistically significant during the study period. The results suggest that an increase in domestic debt leads to short-term improvements in infrastructure development, whereas external debt did not contribute to better infrastructure development in Nigeria during the study period.Good governance is critical to sustainable development. Economic, corporate, international, regional, national, and local governance are examples of governance (Dixit, 2009). For effective governance, a proper institutional and policy framework is required. As Dixit (2009) points out, good economic governance is required to ensure three essential prerequisites: (i) collective action, (ii) contract enforcement, and (iii) property rights security. It ensures that corruption is minimised, minorities' opinions are heard, and the voices of societies' most vulnerable are heard in decision-making. The United Nations has made it a strategic priority to assist developing countries in improving their

governance. The African Union respects the region's diversity of political systems and institutional cultures. Nonetheless, it identifies four criteria of good governance that all governments should consider. (i) Accountability: Officials should be accountable to the entity that gave them authority, work should be carried out according to agreed-upon rules and standards, and data should be reported relatively and adequately. (ii) Participation: Citizens, particularly the impoverished, are empowered through advancing their rights to access and secure control over essential entitlements that enable them to earn a living. (iii) Predictability: Laws and policies are implemented consistently and fairly (iv) Transparency: Citizens are given access to low-cost, easily understandable, and relevant information to promote effective accountability and clarity about laws, regulations, and policies. Participatory, consensus-oriented, accountable, transparent, responsive, effective, efficient, equitable and inclusive, and cognisant of the rule of law are the eight major characteristics of good governance. The infrastructure network of an area, in basic terms, is the socio-economic atmosphere formed by the institutions that function as trade and investment conduits. Some of these establishments are public, while others are private. In either scenario, their contributions to integration are transformative, assisting in converting resources into outputs or facilitating trade by reducing barriers. As a result, improving regional infrastructure is one of the most important aspects determining a region's long-term growth and infrastructure.

Governance is crucial in laying the groundwork for creating resilient critical infrastructure (Murdock et al., 2018). According to Vallejo and Mullan (2017), sectoral regulation should ensure the implementation of appropriate risk and resilience standards by using both financial incentives (such as compensation for end users) and non-financial incentives (like transparency requirements). For example, requiring end-user compensation in a service disruption can encourage operators to invest appropriately in resilience while allowing them to choose. On the other hand, transparency standards may cause operators to be concerned about their reputation in the event of a service failure. Some scholars link the concept of reflexive governance with the idea of resilience, which is described as the capacity to adapt and prosper in the face of shocks by developing new strategies (Boin & McConnell, 2007; Crichton et al., 2009).However, in the context of sustainability, reflexive governance is commonly used to address socio-ecological vulnerabilities, and it has been noted that this

dynamic and polycentric governance paradigm may lead to more effective and long-term public service delivery (Appiah, Onifade, & Gyamfi, 2022).

The relationship between institutions and organisations shapes an economy's (or region's) institutional evolution. Institutional quality and good governance are comparable to trade tariff liberalisation. Both improve regional and national integration, economic growth, and infrastructure. According to the empirical evidence from Barro (1999), good governance and growth are positively connected. Furthermore, the quality of institutions and good policies matter for long-term economic progress (Knack & Keefer, 1995; Lee & Kim, 2009). Good regional governance has a direct and positive impact on the local governance of each country in the region, and it has been noted that a lack of sufficient regulation and institutions leads to poor regional infrastructural provision (OECD, 2016). As a result, excellent institutional governance is critical for attaining integrated infrastructure. The public sector regulates and supplies most of the national and regional infrastructure. Hence, regional public policy is more significant.

2.2 Theoretical Framework

2.2.1 Debt Overhang Theory

The Debt Overhang Theory, as proposed by Sachs (1989), suggests that when a country’s debt burden reaches unsustainable levels, it deters investment and slows economic growth. This occurs because both domestic and foreign investors anticipate that a significant portion of future revenues will be used to service debt, rather than being reinvested in productive sectors. As a result, they become reluctant to commit capital, leading to reduced economic expansion and lower levels of infrastructure development. The theory further posits that excessive debt creates a vicious cycle, where governments must divert resources away from essential public investments, such as transport, energy, and social services, to meet debt obligations, thereby exacerbating economic stagnation (Borenzstein, 2000).

One of the key mechanisms through which debt overhang affects economic growth is fiscal crowding out. When a country accumulates high levels of external debt, it faces rising debt-servicing costs, which consume a large share of government revenues. Consequently, fewer resources are available for infrastructure expansion, education,

healthcare, and other critical public services (Kamin et al., 1989). In extreme cases, excessive debt may also undermine investor confidence, as market participants fear potential defaults, fiscal instability, and unpredictable policy measures. Krugman (1988) argues that when a country's future debt obligations increase relative to its output, investors may assume that the government will impose higher taxes or other distortionary policies to meet its obligations, which in turn discourages private sector participation and reduces overall investment levels.

Empirical studies support the debt overhang hypothesis, particularly in developing economies. Elbadawi, Ndulu, and Ndung'u (1997) found that high external debt levels in Sub-Saharan Africa significantly reduced private investment and constrained long-term economic growth. Similarly, Fosu (1996) demonstrated that excessive public debt in low-income countries negatively impacted GDP growth by diverting resources away from productive investment. In the case of Latin America, Chowdhury (2001) found that countries with high debt burdens faced stagnant infrastructure development and lower levels of foreign direct investment (FDI) due to investor concerns over long-term economic stability.

In Zambia, the effects of debt overhang on infrastructure development are increasingly evident. While external borrowing has facilitated major transport and energy sector investments, the rapid accumulation of debt has constrained fiscal space for further public investment. According to Bova et al. (2016), Zambia's rising debt service obligations have limited the government's ability to allocate resources to other critical sectors, such as education, healthcare, and social development.

Additionally, Zambia's creditworthiness and investor confidence have been negatively impacted by its increasing debt levels. The country has faced credit rating downgrades, which have made it more expensive to secure new financing for infrastructure projects. The debt overhang effect is particularly pronounced in Zambia's transport sector, where despite initial investments in road networks, fiscal constraints have delayed project completion and maintenance efforts.

2.2.2 Keynesian Theory of Public Debt

The Keynesian Theory of Public Debt, as postulated by Keynes (1936), argues that government borrowing can be a strategic tool for stimulating economic growth, particularly when private sector investment and consumer spending are insufficient to drive expansion. The theory asserts that public sector investment in infrastructure can have a multiplier effect, generating economic activity, creating employment, and fostering long-term productivity gains. Infrastructure projects, such as transport networks, energy systems, and public utilities, can enhance economic efficiency, improve connectivity, and attract further investment.

In the context of developing economies, several empirical studies support this view. Calderón and Servén (2010) examined infrastructure development in Africa and found that increased public investment in transport, energy, and communication infrastructure significantly contributed to economic growth by enhancing productivity and reducing transaction costs. Similarly, Aschauer (1989) demonstrated that public capital investment, particularly in infrastructure, positively affects private sector productivity and economic output. In Zambia, infrastructure development has been a key policy priority, with large-scale investments in roads, railways, and energy projects aimed at unlocking economic potential and improving regional trade integration (World Bank, 2021).

The Keynesian perspective assumes that government borrowing for infrastructure will eventually yield returns that outweigh the cost of debt, provided investments are well-targeted and efficiently managed. Countries such as China and South Korea have successfully applied Keynesian principles, using state-led investment in infrastructure as a catalyst for rapid industrialisation and economic transformation (Eichengreen et al., 2015). However, empirical evidence also suggests that the effectiveness of debt-financed infrastructure largely depends on the quality of governance, efficiency in public investment, and the sustainability of debt management (Adam & Bevan, 2005). In cases where debt is mismanaged, the benefits of infrastructure investment may be eroded by excessive debt servicing costs, inefficient project execution, and economic distortions.

For Zambia, the application of Keynesian debt-financed infrastructure development is evident in various transport corridor expansions, which have been funded through external borrowing. While these investments have enhanced the country's transport infrastructure, the rapid accumulation of public debt raises concerns about long-term sustainability and fiscal strain (Bova et al., 2016). The challenge lies in ensuring that borrowing remains within sustainable limits while maximising the economic benefits of infrastructure investments.

The Keynesian Theory of Public Debt is particularly relevant to this study as it provides a foundational explanation for Zambia's reliance on debt-financed infrastructure development. The study seeks to assess whether debt financing has effectively contributed to infrastructure expansion or whether the rising debt burden has outweighed its benefits. By analysing the impact of debt on infrastructure development, this research critically evaluates whether Zambia's borrowing strategy aligns with Keynesian principles or whether it is veering towards unsustainable debt accumulation, as highlighted in debt overhang literature.

Furthermore, this study contributes to the ongoing debate on the trade-off between infrastructure expansion and debt sustainability. While Keynesian economics supports borrowing as a means to stimulate development, the effectiveness of this approach depends on governance, fiscal discipline, and economic conditions. This research will therefore provide valuable insights into whether Zambia's infrastructure financing strategy is yielding the intended economic benefits or exacerbating fiscal vulnerabilities.

2.2.3 Crowding Out Hypothesis

The Crowding Out Theory suggests that excessive government borrowing can negatively impact private sector investment by increasing interest rates, reducing credit availability, and creating fiscal instability (Elmendorf & Mankiw, 1999). The theory postulates that when a government finances its budget deficit through public debt, it absorbs a substantial portion of available savings in the financial markets. This results in higher interest rates, which in turn discourage private investment in key sectors, including infrastructure development (Panizza et al., 2013).

A primary argument advanced by Elmendorf and Mankiw (1999) is that sustained budget deficits lead to a reduction in national savings. As government borrowing increases, financial institutions respond by raising interest rates to attract sufficient capital, making borrowing more expensive for private investors. This creates a chain reaction: higher interest rates reduce investments in physical capital, such as machinery and infrastructure, which subsequently lowers future economic growth rates. Aschauer (1989) provides empirical evidence demonstrating that large fiscal deficits directly contribute to the reduction of private-sector investments, reinforcing the notion that government borrowing can crowd out productive private expenditure.

Empirical studies from both developed and developing economies support this hypothesis. Rangarajan & Srivastava (2005) found that rising interest rates due to increased public borrowing significantly reduced private sector participation in infrastructure development in India. Similarly, in Ghana and other Sub-Saharan African economies, public sector debt accumulation has been linked to constrained private investment, particularly in capital-intensive industries (Were, 2001). Loayza et al. (2007) further demonstrate that, in countries with weak financial markets, the crowding-out effect is more pronounced, as private firms struggle to access credit when governments dominate borrowing channels.

Zambia's infrastructure development strategy has been heavily reliant on debt financing. While these investments have expanded the country's physical infrastructure, the rising public debt burden raises concerns about potential crowding-out effects on private sector investment. High government borrowing, coupled with limited domestic savings, has contributed to rising interest rates and restricted access to credit for private enterprises (Bova et al., 2016). This has implications for infrastructure development, as private-sector involvement in large-scale infrastructure projects is often essential for long-term sustainability.

This study seeks to assess the impact of debt financing on infrastructure development, and the Crowding Out Theory provides a critical lens through which to examine the unintended consequences of Zambia's borrowing strategy. While public investment in infrastructure is necessary for economic development, excessive government borrowing may hinder private sector participation, increase financing costs, and limit long-term infrastructure expansion.

The relevance of this theory to the study lies in its ability to explain the potential trade-offs between public and private sector investment in Zambia. If government borrowing leads to significantly higher interest rates, private investors may be discouraged from funding infrastructure projects, resulting in slower development despite high public investment. Therefore, policymakers must strike a balance between leveraging public debt for infrastructure and ensuring that private sector investment remains viable.

Moreover, Zambia's fiscal challenges have led to periodic liquidity constraints, reducing the government's ability to finance additional infrastructure without further borrowing. The crowding-out hypothesis suggests that if Zambia's debt trajectory continues, interest rate pressures could stifle private investment in complementary sectors, such as manufacturing and construction, ultimately slowing economic growth.

2.3 Conceptual Framework

This study seeks to examine the impact of debt financing on infrastructure development in Zambia by employing carefully selected economic and fiscal indicators covering the period 1990 to 2023. The Infrastructure Development Index (IDI) serves as the dependent variable, while Total Debt Servicing (TDS), Government Expenditure (GOVE), and Domestic Tax (TAX) are the independent variables. The selection of these variables is based on both theoretical foundations and empirical evidence, ensuring a comprehensive framework for analysing the relationship between debt financing and infrastructure development.

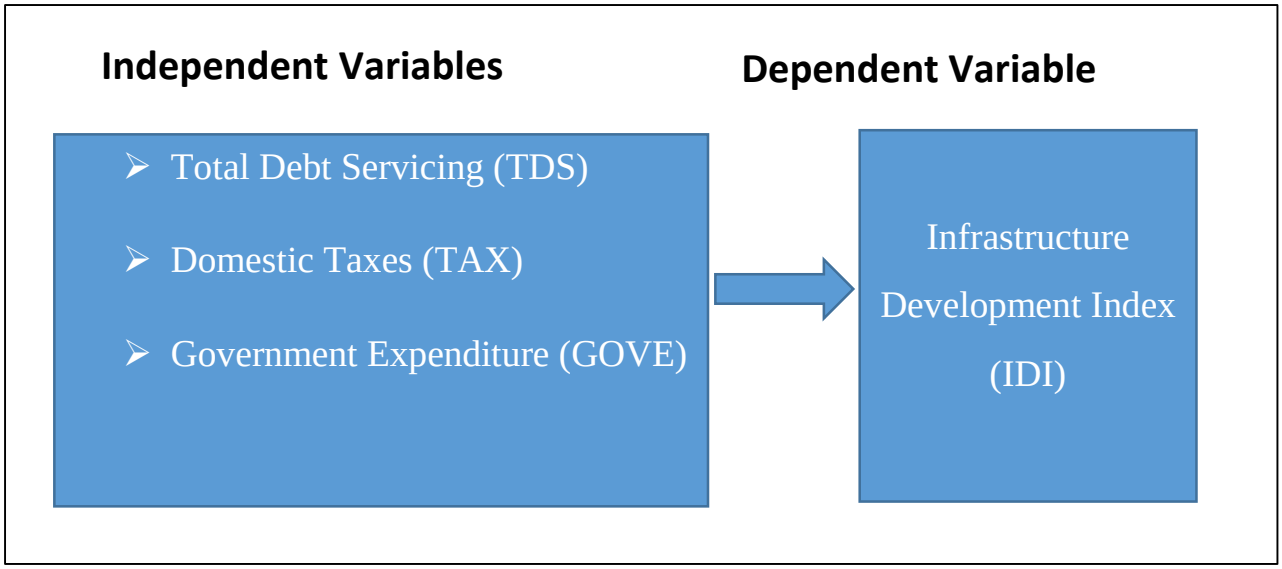
The Infrastructure Development Index (IDI) is chosen as the dependent variable because it is a widely used measure of infrastructure progress, capturing key aspects such as transport networks and public utilities. The Keynesian Theory of Public Debt (Keynes, 1936) supports the idea that public investment in infrastructure, often financed through borrowing, can stimulate economic growth and improve development outcomes. Empirical studies, such as those by Calderón and Servén (2010), have demonstrated a strong correlation between infrastructure development and economic growth, highlighting the role of public financing in shaping infrastructure outcomes. The IDI data will be obtained from Index Mundi, a reputable online database providing detailed country-level infrastructure statistics.

Total Debt Servicing (TDS) is included as an independent variable to assess the extent to which Zambia's debt obligations impact infrastructure financing. According to the Debt Overhang Theory (Sachs, 1989; Krugman, 1988), excessive debt servicing can divert resources away from productive investments, leading to infrastructure stagnation. Empirical evidence from Bova et al. (2016) and Elbadawi, Ndulu, and Ndung'u (1997) supports this argument, showing that high debt-servicing costs constrain government expenditure on infrastructure projects. The TDS data will be sourced from the Bank of Zambia (BOZ).

Government Expenditure (GOVE) is another crucial independent variable, as public spending plays a fundamental role in infrastructure development. The Keynesian economic framework suggests that increased government expenditure can stimulate economic growth, particularly when allocated to infrastructure projects. Empirical studies by Aschauer (1989) and Adam & Bevan (2005) confirm that higher public investment in infrastructure enhances economic productivity and fosters long-term development. By including government expenditure in this study, we aim to determine whether Zambia's spending patterns align with these theoretical and empirical findings. The data will be obtained from the World Development Indicators (WDI) database of the World Bank.

Domestic Tax (TAX) is selected as an independent variable due to its role in funding public investment. While higher tax revenues provide the government with the financial capacity to invest in infrastructure, excessive taxation may reduce private sector growth and investment, as suggested by the Crowding Out Theory (Elmendorf & Mankiw, 1999). Empirical research by Rangarajan & Srivastava (2005) in India and Were (2001) in Sub-Saharan Africa has shown that rising tax burdens can limit private sector participation in infrastructure development. The TAX data will be obtained from the Zambia Revenue Authority (ZRA) to assess how taxation influences infrastructure financing in Zambia.

Figure 1: Conceptual framework



Source: Author's own construction

2.4 Literature Critique

Many of the empirical studies reviewed dealt largely on effect of tax revenue on economic growth, very few studies reviewed the impact of tax revenue on infrastructural development. None of the studies included Custom and Excise Duties in the types of tax revenue that were reviewed. Further, literature showed that infrastructure investment contributes positively to the economic growth of a country. Since literature on the impact of debt financing on public expenditure particularly infrastructure is limited, the research mostly considered literature that shows the impact of public debt and/or debt service on economic growth. Literature does not show explicitly if there is a negative relation between debt financing and infrastructure development as data is very limited.

Literature review also shows that the determinants of public expenditure cannot be generalised, whether using country specific or cross-country analysis. Results of studies reviewed in this research on the determinants of public expenditure also vary depending on the methodology, approach or proxies used. In conclusion, coupled with the fact that there is very limited literature on this subject, there are very few common grounds identified as potential determinants of public expenditure. The study reviewed literature to establish what the acceptable limits of public debt are to establish what

some of the policy implications of exceeding this threshold may be. The findings show mixed reviews most of which show that an increase in the public debt does not necessarily translate into a negative economic growth. What is observed in most studies is that an excessive accumulation of debt in the country leads to a decrease in capital stock accumulation.

CHAPTER THREE: METHODOLOGY

3.0 Introduction

This chapter focuses on discussing the methodology used in the study. It highlights the research design, research approach, data sources, data analysis, model specification, pre-estimation tests and post-estimation tests.

3.1 Research Design

This study employed an empirical research design based on observation and experimentation, using real-world data and evidence to reach conclusions. This approach is well-suited for the research as it facilitates the collection and analysis of quantitative data, allowing for hypothesis testing and offering valuable insights into the relationship between debt financing and infrastructure development in Zambia.

3.2 Research Approach

The study used a descriptive survey to identify the characteristic behaviour of one variable in relation to another, focusing on understanding the what, where, and how of a phenomenon (Jupp, 2006). This approach is suitable as the study aims to gain a deeper understanding of the impact of debt financing on infrastructure development in Zambia.

3.3 Data Sources, Sample Size and Data Type

This study utilised time series data, with the Infrastructure Development Index (IDI) sourced from Index Mundi, a website offering detailed country statistics. The Government Expenditure (GOVE) data were obtained from the World Development Indicators (WDI), a database provided by the World Bank, while the Total Debt Service (TDS) data were extracted from the Bank of Zambia (BOZ); and the Domestic Tax (TAX) data were obtained from the Zambia Revenue Authority (ZRA). The study covered the period from 1990 to 2023, with annual data frequency.

3.4 Data Analysis

The data were analysed using Eviews 10.0, applying both descriptive and inferential statistics to present clear, organised, and coherent results that align with the research objectives. Figures and tables were employed to display the analysed data in a way that facilitates easy understanding.

3.5 Theoretical model

This study employed an ARDL model. The model is represented as follows:

$$X_t = \beta_0 + \beta_1 log\, Y_{t-1} + \cdots . \beta_p Y_{t-p} + \beta_2 log Z_{t-1} \ldots . + \cdots . \beta_p Z_{t-1} + \mu_t \ldots . . eqn\,(1)$$

Where: $X_t$is the dependent variable, Y and Z represent the independent variables, β_0 is the intercept of the model and $\beta_1, \beta_2, \beta_p$ are elasticity coefficients of the variables. μ_t is the error or disturbance term. The assumptions of the model are that the error term should have the constant variance, the variables should be linear in parameters as well as normality (Gujarati, 2009).

3.6 Model Specification

The variables of interest for the study are the Infrastructure Development Index, Total Debt Servicing, Government Expenditure, and Domestic Tax in a single multivariate framework. The model for the study is shown in the following equation:

$$\Delta logIDI_t = \beta_0 + \sum \beta_1 \Delta \log TDS_{t-k} + \sum \beta_2 \Delta\, logGOVE_{t-k} + \sum \beta_3 \Delta logTAX_{t-k} + \varepsilon t \ldots eqn(2)$$

Where Δ is difference, $\beta 1, \beta 2, \beta 3$ are parameters of government expenditure (GOVE), total debt service (TDS) and domestic tax (TAX) respectively. The null hypothesis based on the F- statistic for joint significance of the parameters $\mu\ is$ ($H0: \mu 1 = \mu 2 = \mu 3 = 0$ against $H1: \mu 1 \neq \mu 2 \neq \mu 3 \neq 0$).

3.6.1 Assumptions

The model has the following assumptions:

3.6.1.1 Error Terms are Statistically Independent

The independence assumption requires observations to be independent of each other (Nimon, 2012). Violation of this assumption often occurs in time series regression

models. In essence, serial correlation (autocorrelation) is the result of time series data that are influenced by past values (Marno Verbeek, 2013). A violation of statistical independence indicates that the model could be improved. In extreme cases, this violation signals that the model is mis-specified. In non–time series models, a violation of statistical independence can be present if the model systematically underpredicts or overpredicts the coefficient estimates (Nau, 2018).

3.6.1.2 Error Terms Have Constant Variance (Homoscedasticity)

Nonconstant variances (heteroscedasticity) can originate from violations of the other assumptions. Given all other assumptions are met, coefficients from heteroscedastic regression results are not BLUE (best linear unbiased estimators) under OLS (Marno Verbeek, 2013). When heteroscedasticity is present, OLS gives equal weight to all observations regardless of the magnitude of the variance. The standard errors in the presence of heteroscedasticity are biased, which leads to biased test statistic and confidence intervals (Williams, 2015). Slight violations of the homoscedasticity assumption are generally acceptable, but violations to the assumption can result in an increased risk of Type I error (Osborne & Waters, 2002).

3.6.1.3 Error Terms are Normally Distributed

Park (2008) describes normality testing and provides the associated codes in SAS, Stata, and SPSS. A common misconception is that the variables should be normally distributed (Osborne & Waters, 2002); however, the correct assumption is that the error terms are normally distributed. This assumption needs to be met for the p-values of the t-tests to be valid (Chen, Ender, Mitchell, & Wells, 2003a; 2003b; 2003c). According to Nau (2018), a violation of normality can distort confidence intervals for forecasts and cause difficulties in determining the significance of model coefficients. A violation of normally distributed error terms can signal the existence of unusual data points or that the model can be improved.

3.7 Pre-Estimation Tests

3.7.1 Unit Root Test

Before exploring long-term relationships or cointegration among variables, it is essential to analyse the integration order of all variables. The commonly used augmented Dickey-Fuller test helps determine whether basic time series are representing fundamental stochastic processes. Therefore, stationarity tests are necessary to identify the unit root issue in empirical analysis.

The hypotheses are;

$\mathrm{H0}: \delta = 0$ (Either there is a unit root or the time series is non-stationary)

$\mathrm{H1}: \delta \neq 0$ (The time series is static or there is no root for the unit)

The model below is used to estimate the general version of ADF, where the term t is a random term. $Yt = \gamma Yt - 1 + \varepsilon t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots eqn\ (3)$

The preceding equation transforms into a non-stationary random walk process if γ=1. This often leads to what is known as a unit root problem, which indicates that the series is non-stationarity. On the other hand, the series is stationary if γ<1.

3.8 Post-Estimation Tests

To test the robustness of the model, post diagnostic tests are conducted. These include the following.

3.8.1 Normality Test

The assumption of normality is very important because the diagnostic tests depended on it. There are several ways of testing for normality in literature which includes the histogram of residuals, normal probability plot (NPP), a graphical residual and the Jarque-Bera test (Gujarati, 2004). To test for normality, the Jarque-Bera method was used in this study.

3.8.2 Test for Multicollinearity

Multicollinearity occurs when there is a linear relationship between or among the explanatory variables; the main area of concern is that as multicollinearity increases, the standard errors for the coefficients can get inflated because their regression model estimates become unstable (Ibid). This implies that in a collinear model, significant variables might appear insignificant. This implies that in a collinear model, significant variables might appear insignificant. To test for the presence of multicollinearity, the Klien's thumb rule and the pair-wise coefficients are the two methods which were employed in this study if multicollinearity were present.

3.8.3 Heteroscedasticity

Testing for Heteroscedasticity in the model was important because if the usual testing procedures were used despite heteroscedasticity, whatever inferences that may have been made may have been very misleading. Heteroscedasticity occurs when the variance of the error terms or residual is either increasing or decreasing (not constant); and the presence of Heteroscedasticity leads to inefficiency estimators despite being linear, unbiased and consistent estimators (Gujarati, 2004). The white general heteroscedasticity test was used in this study as the sample size is large.

3.8.4 Serial Correlation Test

It is cardinal to test for serial correlation in a model so as to establish whether the errors in the model are independently distributed. If they are not independently distributed, it means that an error occurring at period may be carried over to the next period and the estimates won't be consistent. Durbin's alternative test for autocorrelation is used to check if there is correlation between members of the series or data in time series ordered in the time space; thus, autocorrelation is said to be present if the successive error terms are inter-dependent (Marno Verbeek, 2013). The null hypothesis implies that there is no serial correlation, and no serial correlation means that the errors associated with one observation are not correlated with the errors of any other observation.

3.8.5 Autoregressive Distributed Lag Model (ARDL) Bounds Test

After determining the level of integration of the variables, the next step is to examine the cointegration among the variables by using ARDL bound test. ARDL Model is used when there is mixed cointegrated levels in the series (Persaran et al, 2001). The ARDL has several advantages over other techniques of cointegration. First, it can be applied irrespective of whether the underlying variables are I (0), I (1) or a combination of both.

3.8.5.1 Advantages of ARDL Approach

A linear econometric model, using the Auto Regressive Distributed Lags method was used in this study. The model included all the variables used in the study. The ARDL technique has certain advantages in comparison to other single equation estimation techniques such as General to Specific (GETS), Engle and Granger (EG) and Phillip Hansen's Fully Modified Ordinary Least Squares (FMOLS): when compared to GETS and EG, ARDL reduces the endogeneity problems since all the variables stand as a single equation and all variables are assumed to be endogenous (Nkoro & Uko, 2016). Secondly, problems associated with autocorrelation and omitted variables are excluded because the long-run and short-run variables are estimated simultaneously. Thirdly, ARDL does not require the knowledge of the order of integration of variables, which is necessary in the Engle and Granger (1987) and conventional Granger (1981) (Nkoro & Uko, 2016). While these techniques require that the variables have the same order of integration; ARDL does not require the classification of variables into different order of integration (I (0) or I (1) (Pesaran, 1997). The ARDL approach yields consistent estimates irrespective of the orders of integration of the underlying regressors (Pesaran, 1997). For the reasons above, the ARDL technique was used to examine the effect of Debt servicing on Infrastructure spending.

CHAPTER FOUR: PRESENTATION AND INTERPRETATION OF RESULTS

4.0 Introduction

This chapter gives a detailed analysis of the study and presents the data collected from the study. The ADF test for unit root, correlation, cointegration test with long-run relationship, error correction model and the diagnostic test for model validity were the types of tests used in this study. Additionally, post estimation diagnostic tests were conducted to test the validity of the model; and these included model specification, heteroscedasticity, autocorrelation, goodness of fit, normality tests as well as model significance. In this study, estimations were made using the Eviews 10.0 software package.

4.1 Descriptive Statistics

Table 1: Descriptive statistics

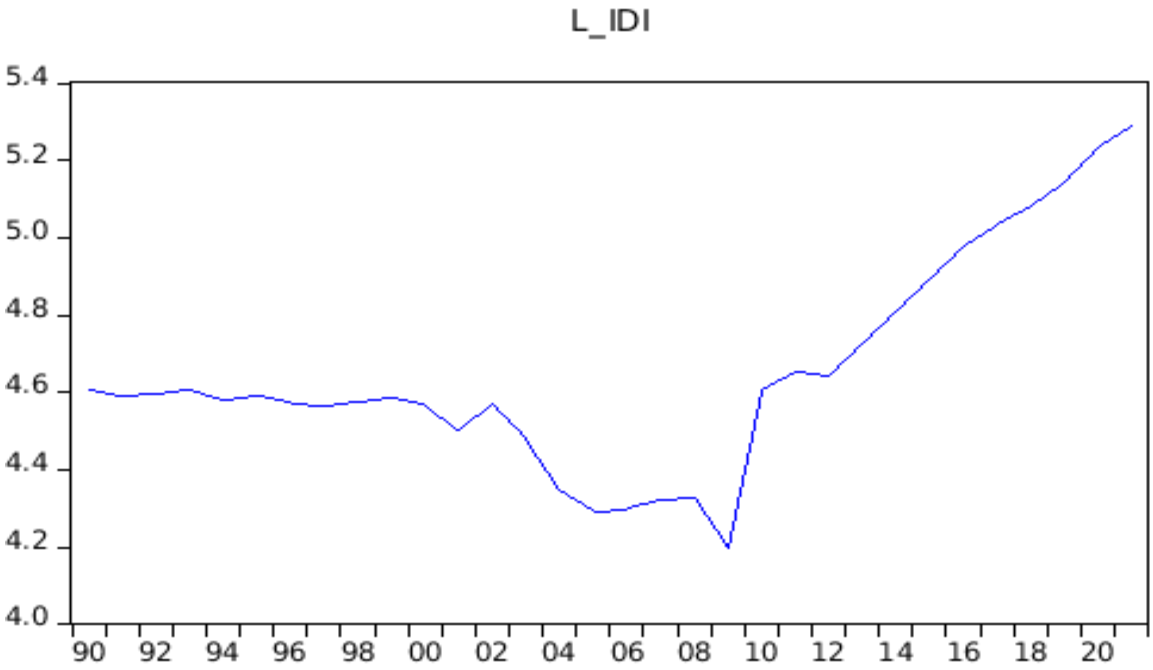
	L_IDI	L_GOVE	L_TDS	L_TAX
Mean	4.593075	18.62644	4.215836	4.386625
Median	4.585987	18.61953	4.218036	4.453387
Maximum	5.082646	21.00090	4.387760	4.763436
Minimum	4.197202	16.66042	4.027492	3.709185
Std. Dev.	0.215717	1.120762	0.114405	0.312907
Skewness	0.465710	0.219128	-0.066165	-1.101184
Kurtosis	3.101048	2.267764	1.753944	3.187365
Jarque-Bera	1.060617	0.879954	1.897286	5.903350
Probability	0.588423	0.644051	0.387266	0.052252
Sum	133.1992	540.1667	122.2593	127.2121
Sum Sq. Dev.	1.302944	35.17103	0.366476	2.741504
Observations	33	33	33	33

The averages (means) for the variables indicate how each variable increased per year. That is, infrastructure development index (IDI) increased by 4.59 percent, Debt

Servicing (TDS) increased by 4.22 percent, Government Expenditure (GOVE) reduced by 18.62 percent and Tax increased by 15.44 respectively. The standard deviation values simply show how much variation or dispersion of the data points from their means; the interpretation is that low standard deviation shows that the data points are very close to the mean but a high standard deviation shows that the data are spread out over a large array of values (Gujarati, 2004).

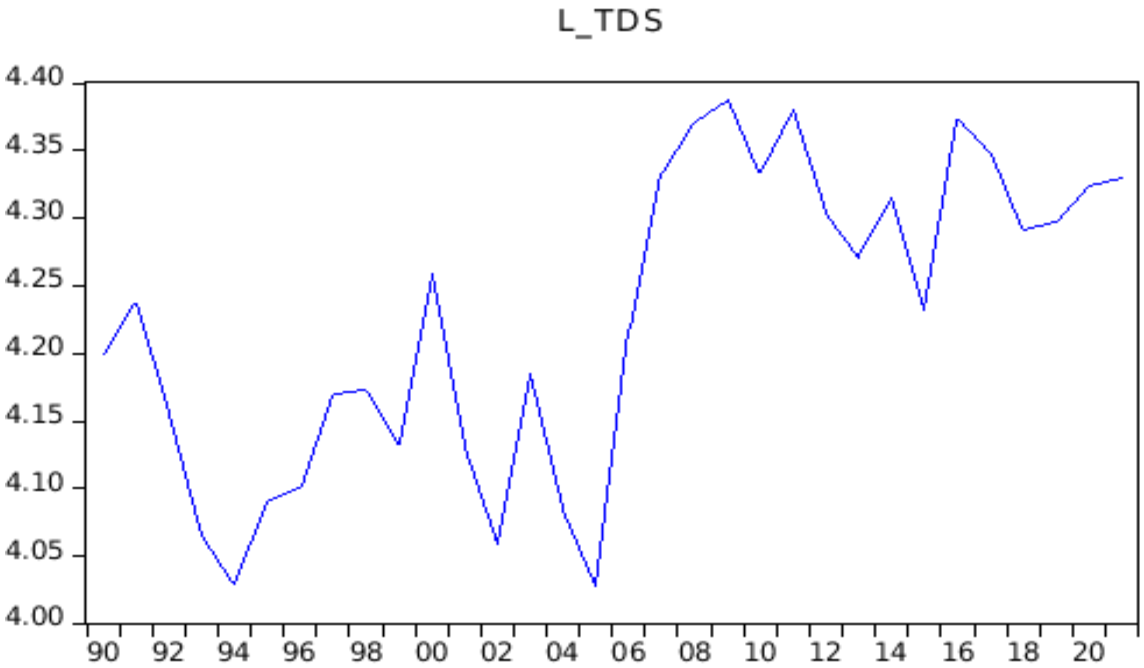
4.1.1 Data Plots

4.1.1.1 Infrastructure Development Index



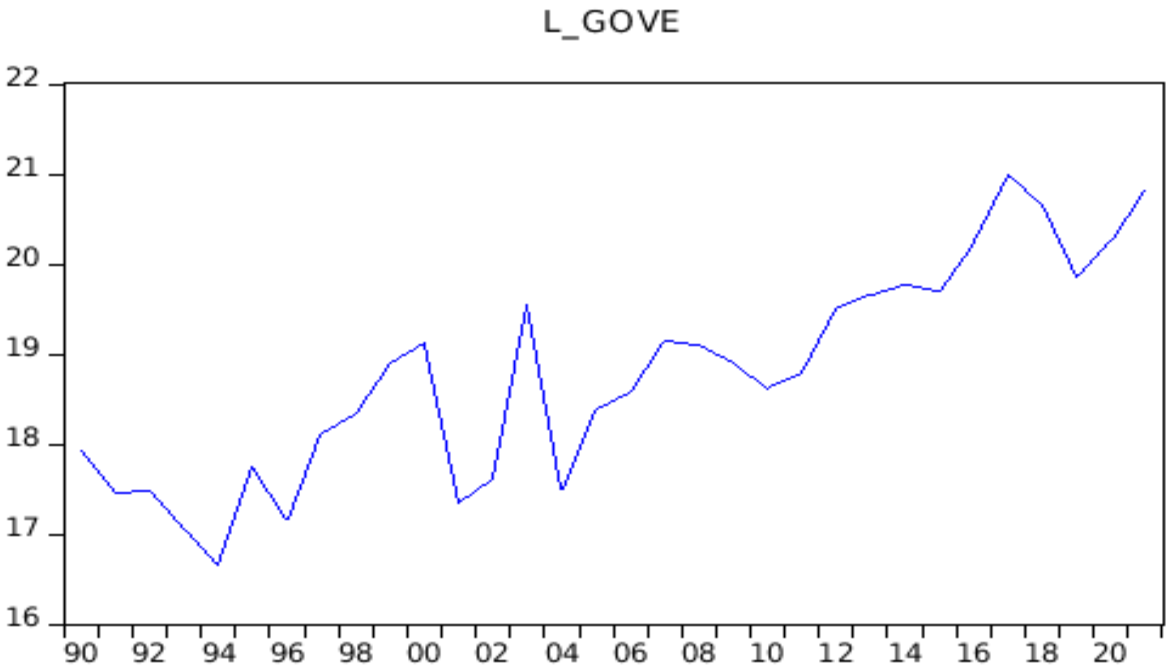
Infrastructure development over the period indicated a downward trend from 1990 to 2010. From 2010, the trend began to increase through to 2022.

4.1.1.2 Debt Financing / Servicing



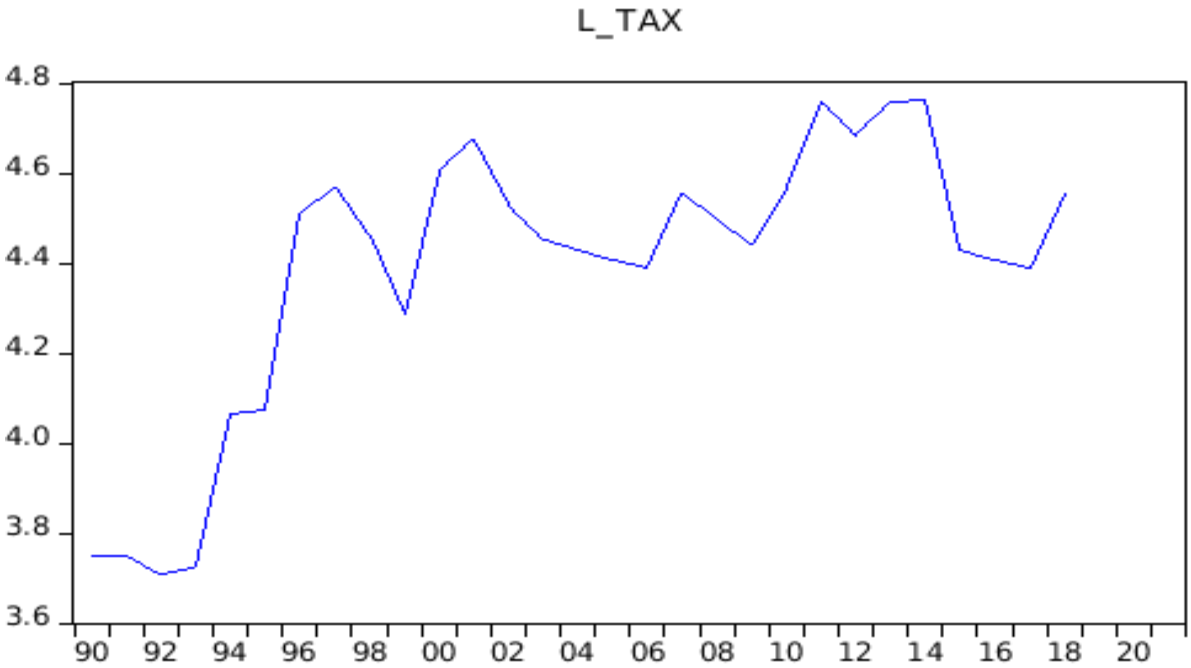
Debt financing/servicing has seen an upward trend during the period under review. This is an indication that increased debt servicing would hinder allocation towards infrastructure development.

4.1.1.3 Government Expenditure



Government expenditure has seen an upward trend for the period of 1990 to 2023 in Zambia.

4.1.1.4 Domestic Tax



The line graph for tax over a period of 30 years indicates that there has been an upward trend in the revenue collection in Zambia from 1990 to 2023.

4.2 Correlation Matrix

To determine the relationship among the infrastructure development index, total debt servicing, government expenditure and tax, the pairwise correlation was used.

Table 2: Correlation Matrix

	L_IDI	L_TDS	L_GOVE	L_TAX
L_IDI	1			
L_DTG	-0.4833	1		
L_GOVI	0.584	0.522	1	
L_TAX	0.861	0.446	0.622	1

The correlation matrix in table 2 shows the interdependency among the variables. GOVE and TAX variables are positively related with IDI. This means that when government expenditure and tax increase, infrastructure development increases as

well. On the other hand, TDS is negatively related with IDI. This means that as debt servicing increases, infrastructure development reduces.

4.3 Unit Root Test for Stationarity

The unit root test was conducted using the augmented dickey fuller (ADF) test to examine the stationarity of the variables. This test is a prerequisite to examine the long run relationship among the variables and establishing the type of econometric model to employ in data analysis.

i. Infrastructure Development Index (IDI) 1st Difference

Null Hypothesis: D(L_IDI) has a unit root			
Exogenous: None			
Lag Length: 0 (Automatic - based on SIC, maxlag=7)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.088379	0.0000
Test critical values:	1% level	-2.644302	
	5% level	-1.952473	
	10% level	-1.610211	
***MacKinnon (1996) one-sided p-values.**			

ii. Total Debt Service (TDS) Level

Null Hypothesis: L_TDS has a unit root			
Exogenous: Constant, Linear Trend			
Lag Length: 0 (Automatic - based on SIC, maxlag=7)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.084496	0.0014
Test critical values:	1% level	-4.284580	
	5% level	-3.562882	
	10% level	-3.215267	
***MacKinnon (1996) one-sided p-values.**			

iii. Government Expenditure (GOVE) 1st Difference

Null Hypothesis: D(L_GOVE) has a unit root

Exogenous: None

Lag Length: 0 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.331176	0.0000
Test critical values:	1% level	-2.644302	
	5% level	-1.952473	
	10% level	-1.610211	

***MacKinnon (1996) one-sided p-values.**

iv. Domestic Tax (TAX) 1st Difference

Null Hypothesis: D(L_TAX) has a unit root

Exogenous: None

Lag Length: 1 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.703442	0.0007
Test critical values:	1% level	-2.656915	
	5% level	-1.954414	
	10% level	-1.609329	

***MacKinnon (1996) one-sided p-values.**

Table 3: Unit root test for stationarity

Variable	t-statistic	P_value	t-statistic	P_value	Order of Integration
	Level	Level	1st difference	1st difference	
IDI	-2.8080	0.0680	-5.088379	0.0000	I (1)
GOVE			-6.331176	0.0000	I (1)
TDS	-5.084496	0.0014			I (0)
TAX			-3.703442	0.0007	I (I)

The IDI, TAX and TDS variables are stationary at first difference I (1) with trend and intercept at 5% level of significance, while government expenditure (GOVE) is stationary at level. This shows that the variables have the different order of integration as such, the auto regressive distributed lag (ARDL) model can be estimated. In implementation of the ARDL model, it is important to determine the lag length to be used in model estimation (Gujarati, 2004).

4.4 Lag length Selection Criteria

The lag length selection was determined using the following lag length selection criteria; sequential modified LR test statistic (LR), Final Prediction Error (FPE), Akaike information Criterion (AIC), Schwarz Information Criterion (SIC) and Hannan-Quinn Information Criterion (HQ).

Table 4: Lag Length Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-87.98833	NA	1.159148	11.49854	11.69169	11.50843
1	-54.06603	46.64316*	0.134425	9.258254	10.22399	9.307708
2	-30.37613	20.72867	0.085211*	8.297016*	10.03534*	8.386032*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Based on the results in table 4 above, there are four out of six criteria which suggest lag length 2. Therefore, the lag length of 2 was used in the study model.

4.5 Autoregressive Distributed Lag Model

The relationships among IDI, TDS and GOVE as determined by the order of integration through the ADF test were estimated by the ARDL model taking into consideration the lag selection criteria of 2, although the ARDL procedure may take a considerable number of lags (Marno Verbeek, 2013).

Table 5: ARDL Model Summary Results

R-squared	**0.982358**	**Mean dependent var**	**4.592025**
Adjusted R-squared	0.915317	S.D. dependent var	0.232969
S.E. of regression	0.067794	Akaike info criterion	-2.554110
Sum squared resid	0.022980	Schwarz criterion	-1.579009
Log likelihood	51.92637	Hannan-Quinn criter.	-2.283658
F-statistic	14.65323	Durbin-Watson stat	1.542208
Prob(F-statistic)	0.003739		

The model has a high R- squared of 98.2 percent which means that about 98 percent of the variations in Infrastructure development index are caused by total debt service, government expenditure and tax. The adjusted R-squared of 91.5 percent indicates that the model has captured the significance of the explanatory variables in explaining IDI as a measure of infrastructure development. The model is significant because the

probability value of the F-statistic is less than the 5% level of significance which enables us to reject the null hypothesis. That is, at least one regression coefficient is not equal to zero. In order to determine the long run relationship between the dependent variable and the explanatory variables, the ARDL bounds test was applied.

4.6 ARDL Bounds Test

Table 6: ARDL Bounds Test

F-Bounds Test		**Null Hypothesis: No levels relationship**		
Test Statistic	Value	Signif.	I(0) Asymptotic : n=1000	I(1)
F-statistic	6.752786	10%	2.37	3.2
k	3	5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66

The bounds test in EViews 10.0 was used to determine whether there is a long-run relationship between Infrastructure development and its independent variables. The null hypothesis states that there is no long-run relationship among the variables and if the F statistic is the greater than upper bound value (I1), the null hypothesis is rejected. This implied that there was cointegration among the set of (I (0) and I (1)). The result is inconclusive if computed F- statistic falls between lower bound I (0) and upper bound I (1). The results of the Bounds test were shown in Table 6. The results showed that there was at least a long-run or short-run relation among these variables. This is because at all conventional level of significance, that is at 1%, 5% and 10%, the F-statistic lies outside the bound range there by giving enough evidence to reject the null hypothesis and conclude that the variables are cointegrated. This gave the study freedom to estimate the cointegration equation co-efficient using the ECM and the short-run function.

4.7 Estimation of Short Run Coefficients

Table 7: Estimation of short run coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(L_IDI(-1))	-1.599443	0.244483	-6.542156	0.0012***
D(L_IDI(-2))	-1.335494	0.238771	-5.593206	0.0025***
D(L_IDI(-3))	-0.779907	0.195359	-3.992168	0.0104**
D(L_GOVE)	-0.009448	0.023374	-0.404199	0.7028
D(L_GOVE(-1))	0.071272	0.035183	2.025751	0.0986
D(L_GOVE(-2))	0.006100	0.026497	0.230211	0.8271
D(L_GOVE(-3))	0.068655	0.020964	3.274935	0.0221**
D(L_TAX)	0.192033	0.075793	2.533637	0.0523
D(L_TAX(-1))	-0.205842	0.076955	-2.674853	0.0441**
D(L_TAX(-2))	-0.065162	0.071717	-0.908592	0.4052
D(L_TAX(-3))	0.177655	0.089878	1.976623	0.1050
D(L_TDS)	0.610107	0.247321	2.466856	0.0567
D(L_TDS(-1))	-1.311174	0.330473	-3.967570	0.0107**
D(L_TDS(-2))	-0.807845	0.220315	-3.666779	0.0145
D(L_TDS(-3))	-1.267869	0.217022	-5.842124	0.0021***
CointEq(-1)*	0.616952	0.079139	7.795837	0.0006

The signs (***), (**), (*) represent the 1%, 5%, and 10% significance level respectively.

If the error correction approach is accurate, the coefficient of the lag of the CVA (dependent variable) should be between 0 and -1. The cointegration equation, in Table 7, showed that the variables do adjust back to equilibrium. This is because the coefficient of the cointegration equation was 0.61 which lies between 0 and -1. The error correction coefficient is significant (with $p<0.05$) as shown in Table 7, which implied that there is a cointegrating relationship among the variables. This means that the variables move back to equilibrium in the long-run within one year. The speed of adjustment was shown by the number 0.616. In other words, the speed with which the total debt finance of infrastructure, government expenditure and domestic tax adjust

from short-run disequilibrium to changes in infrastructure development in order to attain long-run equilibrium is 61.6% within one year.

4.8 Estimation of Long Run Coefficients

Table 8:Estimation of long run coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
L_GOVE	0.340680	0.112914	3.017173	0.0295**
L_TAX	-0.180865	0.264629	-0.683468	0.5247
L_TDS	-5.242144	1.758754	-2.980601	0.0308**
C	21.00411	7.257228	2.894233	0.0340**

EC = L_IDI - (0.3407*L_GOVE -0.1809*L_TAX -5.2421*L_TDS + 21.0041)

** shows 5% level of significance

The empirical results show a positive and statistically significant long-run relationship between government expenditure and infrastructure development. The findings suggest that higher levels of government expenditure lead to an increase in infrastructure development in Zambia. This also means that as debt increases as a percentage of GDP, the government spends more money servicing the debt and this affects the infrastructural development. Further, a negative relationship is established between infrastructure development index and domestic tax. This could be due to the fact that the domestic tax generated does not end up being channelled to the construction sector.

4.9 Diagnostic Tests

The long-run equation showed that total debt service and domestic taxes have negative effects on infrastructure development in Zambia; this means in the long-run there is a negative relationship between total debt servicing, domestic taxes and the infrastructure development in Zambia. The other variables positively affected the infrastructure development. The other post estimation diagnostics showed that the

model had no problems of non model specification, Autocorrelation, Model Misspecification, and Serial Correlation. The model showed desirable properties.

Table 9: Summary of Diagnostic tests

Test for	Diagnostic test	Test statistic	p-value	Conclusion
Model specification	Ramsey Reset test	**F=4.82751**	**0.6545**	Model is stable or correctly specified
Heteroscedasticity	Glejser test	**F= 1.2769**	**0.4257**	No heteroscedasticity
Autocorrelation	Breusch-Godfrey test	**F= 2.245305**	**0.2535**	Variance term is constant
Goodness of fit	R^2-Squared	R^2=**0.982358**	**N/A**	The model fits the data
Normality	Jarque-Bera test	**0.632896**	**0.7287**	The error term is normally distributed
Model significance	F-test	**14.65323**	**0.003739**	The model is significant

Conclusions are made at 5% confidence level.

The results of the diagnostic tests show no evidence of serial correlation, heteroscedasticity, and functional form specification and normality. In addition, the model is statistically significant since the probability value of the F-statistic is less than the 5% confidence level. Finally, the model also shows that about 98 percent of the variations in IDI as a proxy for infrastructural development is explained by GOVE, TDS and TAX.

CHAPTER FIVE: DISCUSSION OF THE RESULTS

5.0 Introduction

This research paper investigated the impact of debt financing on infrastructure development in Zambia from 1990 to 2023. The sole purpose of debt financing for a country is to raise funds to cover budget deficits, finance infrastructure projects, and support economic development without immediately increasing taxes or cutting government spending. It allows governments to meet their financial obligations and fund essential services while spreading the cost of current expenditures over time (Pao and Tsai, 2010). The study analysed the relationship between infrastructure spending and total debt financing using data from the World Bank's World Development Indicators (WDI).

5.1 Major findings

The log IDI, logTAX and log GOVE variables are stationary at first difference I (1) while log TDS is stationary at level I (0) at 5% level of significance. This shows that the variables have a mixture of different level of integration as such, the ARDL model can be estimated. In implementation of the ARDL model, it is important to determine the lag length to be used in model estimation (Gujarati, 2004). The lag length used in this study is 2 as established by the lag length selection criteria.

According to the findings, infrastructure development index appears to be government expenditure elastic. The elasticity of GOVE suggests a high responsiveness of infrastructure development index to change in governance measured by government expenditure. This is consistent with the results reported by Dixit (2009) who pointed out that good economic governance is required to ensure three essential prerequisites: (i) collective action, (ii) contract enforcement, and (iii) property rights security. It ensures that corruption is minimised, minorities' opinions are heard, and the voices of societies' most vulnerable are heard in decision-making. Proper economic governance also responds to society's current and future requirements (UN, 2009). Furthermore, international trade expenses can be reduced by combining strong institutional coordination with enhanced infrastructure to boost local productivity for a strong export base (Francois et al., 2009). Further, these results resonate with Kaufmann et al., (2004) who indicated that depending on the level of governance, infrastructure

can be enhanced through various approaches and channels, including production facilitation, trade mobilisation that promotes more competitiveness, more job provision, and a decrease in trade logistics and other supply chain costs

Similarly, in the log-run, infrastructure development appears to be tax inelastic. However, this relationship is not statistically significant. Infrastructure development being tax inelastic means that changes in tax revenues do not proportionally affect infrastructure investments. In other words, even if tax revenue increases, infrastructure development may not significantly improve due to several factors. This could be due to inefficient tax administration and revenue collection that is, poor tax collection mechanisms can lead to revenue leakages, reducing funds available for infrastructure development. These results resonate with Ferede and Dahlby (2012) who found that increased corporate income taxes negatively affect private investments and economic growth. Similarly, Macek (2015) reported that both personal and corporate income taxes have significant negative impacts on economic growth.

The debt financing has a negative impact on infrastructure development owing to the fact that increased debt reduces the national capacity to allocate resources to infrastructure development projects. This is in line with the crowding out hypothesis which states that the implication of huge borrowings by the Government is an increase in interest rates. The increase in interest rates may reduce or crowd out private-sector investments in plants and equipment. This decline in investment means that the overall economy has a smaller capital stock with which to work, which then decreases future growth rates. In theory, it is also argued that a high level of public debt can have adverse consequences on the macroeconomic stability, discouraging capital inflows while favouring capital flight (Alberto et al., 2008). According to Adam & Bevan (2005) Focusing on the interaction effects of deficits and debt stocks, he argued that a high debt stock exacerbates the adverse consequences of high deficits. Furthermore, the findings are in line with Essien and Onwiodukokit (2008) who suggested that the government should embark on appropriate debt management strategies with feasibility study of projects such as loan acquisition and deployment. The author further stated that project should be financial with feasibility study of projects such as loan acquisition and deployment. The author further stated that projects should be

financed with external loans since the potential of economic growth in the country can be improved through external resources invested on viable ventures

The error correction term is as low as 0.616 which implies that annually, sixty one (61) percent of the divergence between the short-run infrastructure development is eliminated from its long-run path. This is because the error correction term explains the speed of long-run equilibrium which is required to be between 0 and less than one to capture the speed of adjustment from short-run distortion in infrastructure development to its long-run equilibrium at the rate of 61 percent in response to the effectiveness of policies with regards to government expenditure and domestic tax policies. The joint test indicates that whenever a shock occurs in the system, the two variables would make the short-run adjustments to restore long-run equilibrium. Lastly, it is concluded that IDI is mainly determined by GOVE and TAX in the long-run.

Furthermore, the Jarque-Bera test of normality was done to establish whether the error term was normally distributed. This was important because an error term following a normal distribution is one of the conditions required for performing subsequent diagnostic tests. The results show that the p-value is 0.51 and it was therefore concluded that the residuals are normally distributed. The heteroscedasticity test indicated that the probability of the F-statistic was greater than 0.05. Therefore, there was homoscedasticity. The residuals are serially uncorrelated since the probability of the Chi-Square value of the Obs*R-squared is greater than 0.05

The Ramsey Reset test was applied to test for Model specification after having conducted the diagnostic tests which showed that the variables are homoscedastic and serially uncorrelated with the error term. The results showed that the functional form of the model is correctly specified since the F-statistic is greater than 0.05.

CHAPTER SIX: CONCLUSION AND POLICY RECCOMENDATIONS

6.0 Conclusion

This chapter presents the policy implications, limitations and recommendations for future studies based on findings established in the previous chapter. The results suggest that high debt-servicing costs may be constraining infrastructure investment, diverting resources away from productive sectors and creating long-term fiscal challenges. Moreover, while government expenditure has a positive effect on infrastructure growth, inefficiencies in public investment management could limit its full potential. The role of domestic tax revenue also presents a complex dynamic, as taxation provides essential funding for infrastructure but may simultaneously deter private sector investment if excessive. Overall, the study underscores the need for a balanced approach to infrastructure financing, one that enhances debt sustainability, strengthens governance, and promotes alternative financing mechanisms such as public-private partnerships (PPPs). By ensuring transparent debt management and strategic investment in high-impact infrastructure projects, Zambia can maximise the benefits of borrowing while safeguarding long-term economic stability and growth.

6.1 Policy Implications

In this study, ARDL method was used to estimate the model. The estimated infrastructure development index equation has several features of importance:

i. Total debt servicing has a significant negative impact on infrastructure development in Zambia in the long-run.
ii. Government expenditure has a significant positive effect on infrastructure development in Zambia in both the short-run and the long-run. However, its effect in the long-run it is more than its effect in the short-run.
iii. Domestic tax revenue has a significant negative effect on infrastructure development in the long-run while its effect is not significant in the short-run.
iv. The error correction term is as low as 0.616 which implies that annually 61% of the divergence between the short-run infrastructure development index is eliminated from its long-run path.

On this basis, some policy implications are discussed.

i. Infrastructure development is a primary area of importance from a political and economic stand point. The study results indicated that it is negatively affected by external debt servicing. In order to minimise the effects of external debt servicing, policy makers should endeavour to ensure that the debt servicing burden should be distributed evenly among different sectors of the economy. One way of ensuring this is achieved would be to facilitate a significant reduction in unwarranted expenditure, particularly on public administration. One such expenditure would be defence expenditure which could also be reduced considering Zambia's stable national security.

ii. The positive relationship between government expenditure and infrastructure development suggests that effective governance is crucial for improving infrastructure in Zambia. Policymakers should prioritise strengthening governance structures to ensure that infrastructure projects are executed efficiently and sustainably. Since the long-term effect is greater than the short-term effect, the government may need to focus on institutional reforms and governance improvements (e.g., transparency, accountability, rule of law, anti-corruption measures) to realise substantial infrastructure growth over time. Short-term policies may yield some benefits, but the most significant improvements will require sustained efforts.

iii. Policy makers should align infrastructure development strategies with governance improvement initiatives, ensuring that institutions are capable of managing large-scale projects effectively. This would involve capacity-building, reducing bureaucracy, and improving project management.

iv. The significant long-run effect of domestic tax revenue on infrastructure development suggests that enhancing domestic tax collection should be a key policy priority, more so, a robust tax system would provide the government with the financial resources needed for long-term infrastructure projects.

6.2 Limitations

The first limitation in this study is that the research of the debt financing-infrastructure relationship is much constrained because of the difficulty in obtaining the necessary

data. Secondly, infrastructure development is influenced by a range of factors beyond just debt financing, such as political stability, governance quality, macroeconomic conditions, technological advancements, and public-private partnerships. As such, disentangling the specific effects of debt financing can be difficult.

6.3 Recommendations for Future Studies

Using the model developed, the study suggests testing other variables to find which ones have optimal impact on infrastructure development. Additionally, a more in-depth study is recommended into how the country can make investment in public sector infrastructure profitable in order to use revenues obtained to enhance budget sustainability in the wake of this debt era.

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APPENDICES

LEVEL_IDI

Null Hypothesis: L_IDI has a unit root

Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.708219	0.0000
Test critical values:	1% level	-3.646342	
	5% level	-2.954021	
	10% level	-2.615817	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(L_IDI)
Method: Least Squares
Date: 10/12/24 Time: 17:04
Sample (adjusted): 1990 2023
Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
L_IDI(-1)	-0.503523	0.088210	-5.708219	0.0000

C	8.095524	1.397927	5.791093	0.0000

R-squared	0.512454	Mean dependent var	0.129554
Adjusted R-squared	0.496727	S.D. dependent var	0.663076
S.E. of regression	0.470398	Akaike info criterion	1.388217
Sum squared resid	6.859504	Schwarz criterion	1.478914
Log likelihood	-20.90558	Hannan-Quinn criter.	1.418734
F-statistic	32.58376	Durbin-Watson stat	2.530688
Prob(F-statistic)	0.000003		

LEVEL_DTG

Null Hypothesis: L_DTG has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=8)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-5.708219	0.0000

Test critical values:	1% level	-3.646342
	5% level	-2.954021
	10% level	-2.615817

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*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(L_DTG)

Method: Least Squares

Date: 10/12/24 Time: 17:05

Sample (adjusted): 1990 2023

Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.

L_DTG(-1)	-0.503523	0.088210	-5.708219	0.0000
C	8.095524	1.397927	5.791093	0.0000

R-squared	0.512454	Mean dependent var	0.129554
Adjusted R-squared	0.496727	S.D. dependent var	0.663076
S.E. of regression	0.470398	Akaike info criterion	1.388217
Sum squared resid	6.859504	Schwarz criterion	1.478914
Log likelihood	-20.90558	Hannan-Quinn criter.	1.418734
F-statistic	32.58376	Durbin-Watson stat	2.530688
Prob(F-statistic)	0.000003		

1ST Difference GOVI

Null Hypothesis: D(L_GOVI) has a unit root

Exogenous: Constant

Lag Length: 1 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.385625	0.0000
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(L_GOVI,2)

Method: Least Squares

Date: 10/12/24 Time: 17:07

Sample (adjusted): 1993 2023

Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(L_GOVI(-1))	-1.848259	0.289441	-6.385625	0.0000
D(L_GOVI(-1),2)	0.359065	0.176714	2.031900	0.0517
C	0.220529	0.132091	1.669523	0.1062

R-squared	0.720875	Mean dependent var	-0.012254

Adjusted R-squared	0.700937	S.D. dependent var	1.301931
S.E. of regression	0.711982	Akaike info criterion	2.250238
Sum squared resid	14.19373	Schwarz criterion	2.389011
Log likelihood	-31.87869	Hannan-Quinn criter.	2.295475
F-statistic	36.15670	Durbin-Watson stat	2.114677
Prob(F-statistic)	0.000000		

1ST Difference _TAX

Null Hypothesis: D(L_TAX) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.500295	0.0001
Test critical values:	1% level	-3.653730	
	5% level	-2.957110	
	10% level	-2.617434	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(L_TAX,2)

Method: Least Squares

Date: 10/12/24 Time: 17:09

Sample (adjusted): 1992 2023

Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(L_TAX(-1))	-1.002488	0.182261	-5.500295	0.0000
C	0.023844	0.016964	1.405548	0.1701

R-squared	0.502102	Mean dependent var	0.001833
Adjusted R-squared	0.485505	S.D. dependent var	0.130013
S.E. of regression	0.093256	Akaike info criterion	-1.846479
Sum squared resid	0.260900	Schwarz criterion	-1.754870
Log likelihood	31.54366	Hannan-Quinn criter.	-1.816113
F-statistic	30.25325	Durbin-Watson stat	2.002304
Prob(F-statistic)	0.000006		

RESEARCH TIMEFRAME

Activity	Estimated Duration											
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Submit Concept Note												
Approved Research Topic												
Preliminary Research												
Draft Research Proposal												
Submit Full Research Proposal												
Data Collection												
Data Analysis												
Draft Dissertation												
Submit Dissertation												
Oral Presentation of Dissertation												