



SCHOOL OF POST GRADUATE STUDIES

A STUDY OF TAXATION AS AN INSTRUMENT OF FISCAL POLICY IN ZAMBIA

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REQUIREMENTS OF THE AWARD OF A DEGREE OF MASTER OF SCIENCE IN
PUBLIC FINANCE AND TAXATION.

BY

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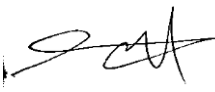
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DECLARATION

I hereby declare that this study is my original work, conducted in adherence to accepted ethical standards and with the guidance of my advisors. I have duly acknowledged all sources used and have properly cited any external references that provided quotes or data. Furthermore, I affirm that this research does not infringe upon any existing intellectual property rights. If any errors or discrepancies are identified, I take full responsibility and commit to correcting them promptly.

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DEDICATION

I dedicate this study to all the individuals and institutions that have guided, supported, and enriched my journey. To my mentors, whose wisdom and guidance have shaped my perspective and deepened my understanding. To my friends and family, whose unwavering support and love have been my foundation throughout this process. And to the countless unknown researchers whose discoveries and expertise have paved the way for my own work.

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Abstract

Taxation plays a crucial role in economic development, yet its impact on economic growth remains a subject of ongoing debate. In Zambia, limited research has explored the relationship between taxation and fiscal development, particularly in relation to key economic indicators. This study aims to narrow this gap by examining the effects of direct taxation on Zambia's economic growth, with a specific focus on labor force participation rate (LFPR), gross fixed capital formation (GFC), and real interest rates (RIR).

To achieve this, the study employs a cross-sectional annual dataset covering the period from 1990 to 2021. Data is sourced from the Zambia Revenue Authority (ZRA), the Bank of Zambia (BoZ), and the World Bank (WB). Real GDP at current market prices serves as the dependent variable, while the independent variables include taxation, LFPR, GFC, and RIR. The study applies the Cobb-Douglas production function as the primary analytical framework, complemented by three additional secondary models to enhance robustness. Methodologically, the study employs the auto-regressive distributed lag (ARDL) model to estimate both short-term and long-term relationships between the variables. The error correction model (ECM) is further used to assess the speed of adjustment towards equilibrium in response to economic shocks. Standard diagnostic tests, including serial correlation and stationarity tests, are conducted to ensure the reliability and validity of the models.

Findings indicate that while taxation is not the primary driver of economic growth, it contributes positively to Zambia's economic development. Regression analysis highlights that capital formation significantly influences GDP in both the short and long run, while interdependencies exist between labor force participation and population levels. Additionally, a U-shaped relationship is observed between the real exchange rate and real interest rates, suggesting initial negative effects before long-term adjustments stabilize the economy.

The study also identifies inefficiencies in Zambia's tax collection system and emphasizes the need for broader revenue sources to support sustainable development. Key policy recommendations include restructuring the tax system to

enhance efficiency, optimizing tax revenue utilization, and ensuring that tax policies do not impose excessive economic burdens. By contextualizing taxation's role within Zambia's economic framework, this research contributes to global discussions on the relationship between taxation and economic performance, providing insights for policymakers and researchers alike.

CHAPTER ONE: BACKGROUND TO THE STUDY

1.0 Introduction

This chapter provides a background to the study regarding taxation as an instrument of fiscal policy in Zambia. In addition, the chapter discusses the statement of the research problem, research objectives, significance, and scope of the study.

1.1 Background

Classically, fiscal policy encompasses the intentional course within any given fiscal year that a government undertakes for regulating one or many activities relating to public revenues and expenditure. This strategy forms the basis what is referred to as the fiscal wheel used in stabilizing demand in the expenditure management process as well as in the achievement of macroeconomic goals and objectives such as economic growth, inflation control and employment (Clarke & Perez, 2024). Based on discussions from previous lectures, fiscal policy deals with Government operations in matters such as taxation, expenditure and demand management and it also supervises economic conditions and employment.

Fiscal policy can therefore be basically classified into two main types. However, to comprehend its meaning it is necessary to focus on expansion and contraction policies deeper. Expansionary fiscal policy means a situation where the government increase its expenditure or reduces taxes, usually when the economy is in the state of relapse like a recession (Ahtiala & Kanto, 2002). On the other hand, a contractionary fiscal policy aims at reducing government expenditure, or increasing taxes to combat inflation and balance the economy (Chen & Brock, 2023).

The success of fiscal policy depends on the business cycle that is in force and a change that take place in taxation and public expenditure (Kramer, Boyle, & Rosenston, 2024). Because of its broad applicability and versatility in dealing with numerous economic issues, fiscal policy turns out to be one of the most effective means of stabilising the economy. It explains why of all the normatively variant forms of economic regulation, it has the ability to deliver radical changes.

However, this work narrows down its concern to direct taxes including the income and corporate taxes on economic growth in Zambia. Different from previous studies, which commenced direct and indirect taxes within the similar model, this study stands to be one of the few researches that exclusive use direct taxes within its estimates as a way of capturing the explicit impacts of these taxes on economic performance. Compared to direct taxes, current income and corporate profits have a more direct impact on investment, consumption, and productivity. In this respect, the focus of the study is more specific than the general observations made in previous research, and it allows for a greater understanding of the effects of these taxes, while providing best suggestions for the fiscal policy. It helps to fill a gap in the previous literature that evaluated taxation at a general level and could thus mask the disparities in the impacts of one type of tax to another.

Taxation and economic growth relationship has been backed by different theories but their argument vary. According to the public goods theory, government revenues enable investments in basic economic infrastructure, which are needs that will improve the people's quality, businesses' productivity, and sustainable, long-term growth (Fernando et al., 2024).

Another important axiom of the Keynesian economic theory is the activity of government intervention during recession. When well-administered taxes can work as instruments to alter income and fund government spending, raising total demand and stimulating the growth rate (Chen & Brock, 2023). In the same vain, endogenous growth postulates that although taxation can discourage private investment, it may act as a stimulus to research, education and technology hence promoting growth it is aimed at those sectors directly (Liberto & Estevez, 2023).

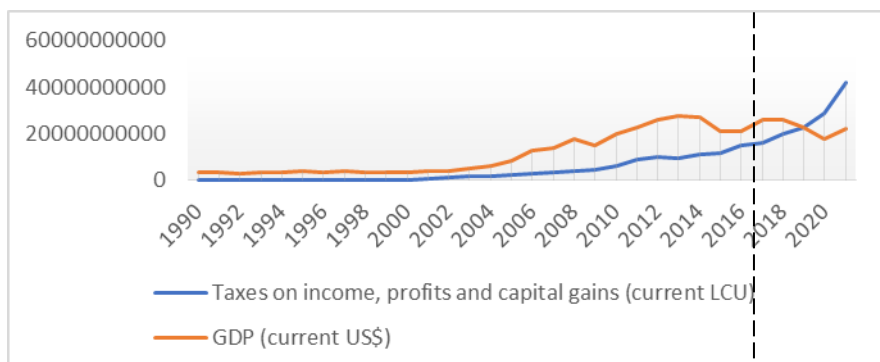
As different as these theories are in terms of the route they take, they imply in one way or another that; taxes under one condition or the other enhance growth because they improve on public resources that are fundamental for development. Nevertheless, there are cases when such theoretical predictions are refuted by the empirical data. For example, high taxes discourage investors, discourage the creation of new companies or decrease exports, and, therefore, limit growth (Kouam and Asongu 2022). These differences are a reminder that theoretical models should be checked across different settings, including Zambia to see how well they work.

When these figures, obtained from the World Bank, are compared collectively to show how directly taxes has fluctuated in relation to the GDP of Zambia over the stated period, it clearly explicate that the correlation is not linear and direct taxes on one hand and the GDP on the other can actually rise or fall independently of one another in the stated period of 1990 to 2021. Over this period, changes in levels of these variables were related as either positive, negative or insignificant. Such variations make it important to conduct an empirical study in order to reveal specifications of macroeconomic environments responsible for this relationship.

For instance, in the early 1990s direct tax revenue rose from 9.3 million Zambian kwacha in 1990 to 130 million kwacha by 1994. During this time, a not very clear correlation was revealed between it and GDP, which increased only slightly throughout the given period and reached \$3.7 billion in 1994 from \$3.3 billion in 1990. As can be seen above, in the subsequent years mostly from 1997 to 2003 direct taxes and GDP showed more positive slopes; tax revenues have risen from 310 million kwacha in 1997 to 1.6 billion kwacha in 2003 while the GDP has been \$4.3 billion in 2002 and was \$ 4.9 billion in 2003. Nonetheless, anomalies were evident, including the sharped decline in GDP in 1998 and 1999, even while tax receipts were on the rise.

The information analyses presented in this paper call attention to general distinctions between direct taxes and economic growth in Zambia. They also stress the importance of the sectoral budgets that are capable of being used as fiscal instruments which should correspond to the financial conditions of the country in order to respond to sustainable development adequately.

Figure 1: Taxation and gross domestic product dynamics in Zambia (1990-2021)



Source: Author's (2024) computation

This research utilizes macroeconomic indicators to analyze the effect of taxation on Zambia using taxation as a policy instrument in line with data obtained from World Bank. Furthermore, work demonstrates the global and spatial framework of the taxation process through concentrating on how long and cyclically taxation has occurred with direct taxation and economic growth for the period of 1990-2021. With the study spanning over thirty years, objectives statement includes; identifying the main trends in the economy and the important changes in the policies that shape the taxation effects on the Zambian economic growth.

The analysis adopts the spatial perspective as a check to limit it geographically to Zambia to facilitate better assessment of Zambia's structure of economy and fiscal systems. The study also considers the implications of such components for Zambia economy; Structure and sectoral approach to direct taxes, proportionate population, gross domestic capital formation and average market interest rate.

1.2 Statement of the research problem

Taxation is a critical component of government revenue and plays a key role in shaping economic development. However, the extent to which direct taxation influences economic growth in Zambia remains unclear. While economic theory suggests that taxation can either stimulate or hinder growth depending on its structure and efficiency, empirical evidence from Zambia indicates that the relationship between direct taxes and GDP is neither linear nor straightforward.

Between 1990 and 2021, Zambia experienced fluctuations in both direct tax revenue and GDP growth. For example, direct tax revenue increased significantly from 9.3 million Zambian kwacha in 1990 to 130 million kwacha in 1994. However, during this period, GDP only saw a marginal rise from \$3.3 billion in 1990 to \$3.7 billion in 1994. Similarly, between 1997 and 2003, direct tax revenues surged from 310 million kwacha to 1.6 billion kwacha, while GDP rose from \$4.3 billion in 2002 to \$4.9 billion in 2003. Despite these trends, inconsistencies emerged, such as the sharp GDP decline in 1998 and 1999, even as tax revenues continued to rise. These variations suggest that direct taxation alone may not be a primary determinant of economic growth, raising the need for a deeper empirical investigation into the macroeconomic factors that shape this relationship.

Given these inconsistencies, this study seeks to analyze the role of direct taxation in Zambia's economic growth while accounting for other key economic variables, including labor force participation, gross fixed capital formation, and real interest rates. The study further differentiates between direct and indirect taxes to provide a clearer understanding of how fiscal policy influences Zambia's economic trajectory. By examining the interactions among these variables, this research aims to provide evidence-based insights for policymakers on optimizing tax structures to support sustainable economic development.

1.3 Study Objectives

This research aims to investigate the influence of taxation on achieving key fiscal targets, such as fostering economic growth in Zambia, through the application of fiscal policy.

1.3.1 Specific Objectives

This research aims to achieve the following objectives:

1. To examine the relationship between direct taxation and Zambia's economic growth, assessing its effectiveness as a fiscal policy tool.
2. To analyze the role of the labor force in Zambia's economic development, considering its interaction with taxation and other macroeconomic factors.
3. To evaluate the impact of gross capital formation on economic growth, determining whether tax policies influence investment levels.
4. To investigate how real interest rates affect economic growth in Zambia, exploring potential linkages with taxation and investment dynamics.

1.4 Research Questions

1. How does direct taxation influence Zambia's economic growth, and to what extent is it an effective fiscal policy tool?
2. What role does the labor force play in Zambia's economic development, and how does it interact with taxation and other macroeconomic factors?
3. How does gross capital formation impact Zambia's economic growth, and what is the relationship between tax policies and investment levels?

4. In what ways do real interest rates affect Zambia's economic growth, and how do they interact with taxation and investment dynamics?

1.5 Significance of the study

This study holds significant value for various stakeholders, including the Zambia Revenue Authority (ZRA), the Government of Zambia (GoZ), particularly the Ministry of Finance and National Planning (MoFNP), policymakers, taxpayers, and researchers. It provides empirical insights into the relationship between direct taxation and economic growth, offering evidence-based recommendations for improving tax policies in Zambia.

For the ZRA and MoFNP, the study provides an analytical framework to assess the efficiency of direct taxation in revenue mobilization and economic growth. It highlights key principles of taxation and how they can be structured to enhance economic development. By examining tax policy's role in influencing macroeconomic variables such as investment and labor force participation, the study equips policymakers with data-driven strategies to optimize taxation without stifling economic progress.

For policymakers and government officials, the study offers guidance on implementing tax reforms that balance revenue generation with economic growth objectives. It underscores the need for a well-structured tax system that minimizes economic distortions while fostering capital investment and entrepreneurship. Additionally, it highlights the importance of aligning taxation policies with broader economic development plans and monetary policies to achieve sustainable growth.

For academics and researchers, this study contributes to the literature on taxation and economic development, particularly in the context of Zambia. While taxation and economic growth have been widely studied in developed economies, limited research has focused on direct taxation within developing economies like Zambia. By addressing this gap, the study serves as a foundation for future research on taxation policies in similar economic contexts.

Furthermore, the findings of this study can assist taxpayers and businesses by shedding light on how tax policies affect disposable income, investment decisions,

and overall economic conditions. A well-designed tax system can reduce financial uncertainties, enhance compliance, and foster a more business-friendly environment.

Overall, this study provides critical insights for improving Zambia's tax system, ensuring that fiscal policies are both growth-enhancing and sustainable. It offers practical recommendations for optimizing direct taxation while recognizing the broader macroeconomic factors influencing economic growth.

1.6 Scope of the study

This paper uses macroeconomic factors to assess the effects of taxation to Zambia with emphasis made on this as a policy objective duly collected from the World Bank. Also, the work investigates the global and regional setting of taxation and focuses on the period and cyclical character of taxation with special reference to direct taxation and economic development from the year 1990 to 2021. Covers three decades to establish the objectives of the study by inspecting certain sets of economic factors and appraising palpable policy changes that have shaped the impacts of taxation on the Zambian economy.

The analysis adopts the spatial perspective as a check to limit it geographically to Zambia to facilitate better assessment of Zambia's structure of economy and fiscal systems. The study also considers the implications of such components for Zambia economy; Structure and sectoral approach to direct taxes, proportionate population, gross domestic capital formation and average market interest rate.

With respect to the consequent objectives and impacts of direct taxes on the fiscal policies, this research focuses on size, efficiency and utilization direct taxes as fiscal policy instruments and their effects on the development of economy. By defining direct and indirect taxes the research area is refined and the questions left unanswered in prior research are addressed. This direction is intended to generate information that can guide fiscal policies that will reflect the Zambian circumstances prevailing at any one time pr Clarke et al, 2003:12).

1.7 Definition of Key Terms

- i. **Fiscal policy** - Fiscal policy involves the government changing the levels of taxation and government spending in order to influence aggregate demand and the level of economic activity (Tejvan Pettinger, 2019).
- ii. **Revenue generation** – Revenue generation is the term used to describe the process through which a corporation or organisation obtains income or financial resources from its primary operations, activities, or sources (Afuberoh & Okoye, 2014).
- iii. **Taxation** – A mandatory levy that is either included into the cost of specific commodities, services, and transactions, or enforced by the governing authority as a tax on the earnings of individuals and businesses (Kirchler, et al., 2010).
- iv. **Labor force participation rate** – it is defined as the section of working population in the age group of 18-64 in the economy currently employed or seeking employment. People who are still undergoing studies, housewives and persons above the age of 64 are not reckoned in the labor force (The Economic Times, 2025).
- v. **Gross Fixed Capital Formation** - refers to the growth in the size of fixed capital in an economy (Vajiram & Ravi, 2024).
- vi. **Gross Domestic Product** - A country's Gross Domestic Product, is the total monetary or market value of all the goods and services produced within that country's borders during a specified period of time. GDP is usually calculated annually, but it can be calculated per quarter as well (True Tamplin,2025).

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

The current chapter of this dissertation discusses literature on taxation and economic growth in a global as well as African and Zambian context in order to assess the position of taxation as a fiscal policy instrument. Moreover, it outlines the shortcomings that are evident in the available literature before moving to extend the perspectives presented in empirical research reviewed herein.

2.1 Empirical literature

2.1.1 Global Studies

Mutaşcu and Dănuleşiu (2011) used Vector Autoregressive Model (VAM) in assessing Romania's pairwise data for the period from January, 1999 to March 2010. Their work analysed theoretical as well as empirical aspects of tax buoyancy and its link with economic growth. In contrast to the usual perception that tax buoyancy leads in the short run to greater economic growth, it announced that they discovered that it has ripple impacts. For instance, based on their empirical work they found that larger the tax base and the consequent increase in tax revenue might in the first instance prove negative for economic growth. But to their long-run conclusions, the authors backed the view that growth promotes an increase in tax collection, which may be used to finance public services and investment that propel growth, again. These findings, therefore, show how complicated it is to coordinate fiscal policy, as it is composed of two parts, tax revenue and economic development which are related but not interchangeable. To the existing literature, their study adds value by urging the government to adopt a sustainable and long-run outlook in considerations of taxation, while at the same time being conscious of the short-run effects. Most notably, they used a cycle of growth which leads to increased tax collection and which can in turn be used to fund development to sustain growth and development (Murithi, 2013).

In his research, Johansson et al., (2008) examines the direction of causality between tax systems and economic development in OECD countries. According to their research, they were able to establish their empirical evidence on how there has been a switch from all the other tax instruments to corporate income tax and its decline in the follow-up years of the study. They have realized that the global corporate taxes

have the worst effect on growth, the taxes on immovable property however were the least provocative. These ideas constitute a valuable addition to the fiscal policy literature given the demonstration regarding how various taxes influence the growth of the economy. Understanding this difference is particularly important for policy makers seeking to improve on the taxation with improvement in economic performance. The work also presents the case of moving from highly distortive, growth inhibiting taxes toward those that are more friendly to the development process. This calls for well structured taxation in the economy so that it can support and encourage a robust economy (Johansson et al., 2008).

Szarowska analyzed the annual time series data of 24 EU countries for the period that covered 1995 to 2008 to assess the effects of tax changes on a country's growth. Her study revealed a negative relationship between total taxes—particularly direct taxes—with economic growth, with direct taxes being most constraining. The paper establishes the fact that the tax structure plays a central role in determining economic performance, arguing that countries with a high dependence on direct tax revenues for expenditures experience constraints on growth. Szarowska brought out positive qualitative evidences on the negative facets of Tax burdens while calling for reforms that bring solutions to these issues and enhance growth. In particular, in the context of its contribution to the fiscal policy debate, her work provides empirical and methodological grounds for countering the deleterious effects of direct taxation and proposing measures to build a pro-growth fiscal framework (Aamir & A.Q, 201)

Building upon the existing theory regarding the co-efficient inverse nature of the per capita income and both personal and corporation income taxes, Xing (2012) examines the selected group of the OECD countries. The study establishes the relationship between the tax measures and economic performance, with an advocacy for the appropriate tax policies that promote growth. Xing has highlighted this by showing the global traditional and emerging country experience of moving from ineffective tax policies to establishing sustainable and pro-development tax structures. Moreover, the study articulates the importance of appreciating probabilistic vision of taxation where the major aim is to maximize the tax revenues while at the same time promoting economic stability. This work contributes to the

fiscal policy literature on how it may optimally enhance revenue mobilization without compromising sustainable development.

2.1.2 African Studies

Babatundel and his co-authors Ibukun and Oveyemi reviewed the prior empirical literature regarding taxation and economic growth focusing on a sample of African countries for the period 2004 – 2013. In their study, they offered clear-cut empirical evidence the high taxes on rates are positively linked with the fortunes of the African economy. Using descriptive statistics and, in particular, unit root tests to analyze stationary variables, the authors established that a higher level of tax revenue stimulates GDP growth. These insights are useful in calling for appropriate fiscals structures that can enhance performance in Africa. For revenue mobilisation and globally encouraging investment and развитие, the researchers underscore the requirement of actionable, effective, and integrated approaches.

Akiza (2012) discussed the effect of investment on direct taxation level in Africa; and also discovered that investment is responsible for contributing high percentage of direct tax level among all economical activities. The same analysis also revealed the lack of understanding why public investment did not have an impact on direct taxation as expected. According to Akiza, they encourage additional studies on aspects of investment and taxation policies. The research also points out on how the government must ensure that investment plans are matched with taxes to support growth.

In their systematic review analysing the relationship between taxation and economic growth across Africa between year 2004 and 2013, Ibukun, Babatunde, and Oveyemi expressed that tax revenue was positively associated with the GDP growth rates. These findings further show that larger proportions of taxes are positively related to improved standards of GDP. In order to support this relationship, the study used such techniques as descriptive coefficients and unit root tests—conclusively proving the stationary of the relevant variables. The information outlined in this paper can be considered helpful in understanding the use of fiscal policy tools in combating the economicchevices of African countries. The authors highlight that a proper framework of revenue mobilisation is needed to sustain investment activities and maintain developmental advancement.

Another author Akiza (2012), contrasting two studies, pointed to investment as being more influential than any other economic activity in Africa in regard to direct taxes. Regarding the identification of fiscal policy effects on public investment and indirect taxation, this research also directed to the lack of clarity of especially arising from ineffectiveness of public investment on direct taxes, leading to a call for a further discussion on the subject of how investment policies influence the tax systems. Aside from creating new knowledge, Akiza's study suggests that tax policymaker should encourage coherence between the investment proposal and taxation procedures to promote economic development.

2.1.3 Zambian Studies

Chizonde, (2016), used trend augmented regression demand and proportion test to analyse the growth path of Zambia's economy within the specified period using macro economic variables. His findings are employed to assess the hypothesis that public expenditure determines long-run economic growth. This supports also the nostro hypothesis, that have been formulated that public investment encourages private investment, and in this way positively affect GDP. In his argument, Chizonde points at the following effects, which are as follows, lack of economic growth in Zambia as a result of higher corporation tax. Although, there are some perceived benefits as was assessed in the study these includes; the increase in the ratio reduces the burden of external borrowing within the government. This research advances by providing a less fragmented and more systematic narrative to the link between fiscal policy including spending and taxation in Zambia and economic growth. It emphasizes possibility to develop positive conditions for sustainable development (see table 1).

Study	Time Period	Methodology	Key Insights	Contribution to Literature
Mutaşcu & Dănuleşiu (2011)	Jan 1999 - Mar 2010	Vector Autoregressive Model	Short-term increases in tax revenues may hinder growth, while long-term growth drives higher tax revenues.	Highlights the trade-offs between short-term and long-term taxation impacts for policymakers.
Johansson et al. (2008)	Not specified	Comparative analysis across OECD	Corporate and consumption taxes negatively influence growth; personal income taxes show a declining trend.	Suggests shifting towards less growth-inhibitive tax structures.
Szarowska (2011)	1995 - 2008	Annual time series analysis	Heavy taxation harms growth, with direct taxes causing the most significant adverse effects.	Recommends reforms to reduce taxation's harmful effects and promote stable growth.
Xing (2012)	Not specified	Comparative analysis across OECD	Higher personal and corporate tax rates are linked to lower per capita income in the long run.	Advocates for reforms to reduce reliance on distortionary taxes.
African Studies				
Study	Time Period	Methodology	Key Insights	Contribution to Literature
Babatundel et al. (2017)	2004 - 2013	Descriptive statistics, unit root tests	Rising tax revenue positively correlates with GDP growth, underscoring taxation's role in economic performance.	Highlights effective tax systems as a foundation for stronger fiscal policy and growth.
Akiza (2012)	Not specified	Not specified	Direct taxes are significantly affected by investment, but public investment has a limited direct impact on tax revenue.	Encourages harmonization of tax and investment policies to maximize economic gains.

Anastassiou & Dritstaki (2005)	Not specified	Not specified	Balanced direct tax rates support economic growth while maintaining fiscal stability.	Recommends calibrating tax policies to enhance investment without compromising financial stability.
Takumah (2014)	Not specified	VAR VECM framework	A 1% rise in tax revenue increases GDP by 0.64%, reflecting a positive link between taxation and economic growth.	Stresses the importance of well-designed tax frameworks for national economic development.
Zambian Studies				
Study	Time Period	Methodology	Key Insights	Contribution to Literature
Chizonde (2016)	Not specified	ARDL approach	Public spending drives long-term growth, while corporate taxes do not hinder growth but reduce reliance on external loans.	Emphasizes the interplay between taxation and government expenditure in Zambia's growth.
William J. Byrne (1983)	Not specified	Not specified	Income and domestic consumption taxes exhibit elasticity, whereas import duties are less responsive.	Promotes deeper understanding of tax elasticity for better fiscal management.
Rabushka & Bartlett (1985)	Not specified	Not specified	High tax levels can enhance growth by financing public sector investments.	Reinforces the role of taxation in enabling public sector-driven economic development.
Nkole (2019)	1995 - 2015	Vector error correction model	Corporate taxes and PAYE have limited short-term effects, while extractive royalties negatively impact growth both short and long term.	Calls for a revision of Zambia's tax policies, especially in resource-driven industries, to promote growth.

Source: Author's (2024) compilation

In his 1983 review, William J. Byrne looked at Zambia's revenue elasticity together with the sources of domestic revenue of income tax, tax on consumption, and import duties. The study is important for Zambia to understand more about its taxation systems and that taxation responses can differ with changes in economic activity. Therefore, Borrowing from Byrne's work, policymakers want to realize that a simple conception of the tax elasticity may not suffice when designing fiscal measures for growth. Byrne also compared his cross-sectional analysis of Ireland with other comparable developing nations such as Zambia discussed by Rabushka and Bartlett (1985). Their evidences revealed that as taxes increase there's always a tendency for the levels of economic growth to reduce. It focused on taxation as one of the fiscal policy instruments arguing that tax revenues increases might contribute to the development of social infrastructure for public investment, and various initiatives to enhance the performance of the economy. Their hypothesis also supports the ideas that tax policy is a mandatory aspect of fiscal planning for sustainable economic development.

From the research conducted from 1995-2015, Nkole (2019) analyzed the effect of income taxation on Zambian economic growth using VECM. Thus, and as expected, the cost passed through by CIT and energy taxes evoked a contra contrapositive contraction of the growth of the economy only in the initial periods significantly and negligibly compared to extractive royalty taxation that applied both a negative influence in the short and long-run by down turning the wheels of growth by the same amount. The current research extends Nkole's work by acknowledging possible limitations that some taxation forms may have and calling for changes in Zambia fiscal policies, especially where concerns economic development sectors. On this basis, it underlines the desirability of rebalancing of Zambia's fiscal structure for better economic effect.

2.2 Theoretical Review

These theories and models serve as the study's foundation. We will zoom onto the theoretical framework of the research study with an emphasis to the relationship between taxation and economic growth.

2.2.1 Theoretical framework: Solow growth model in form of a Cobb-Douglas production function

The foundation for analyzing economic growth dynamics is rooted in Robert Solow's growth model, introduced in 1956. This model is built on several key assumptions, such as continuous growth in output per capita, the economy operating as a closed system producing a single good with constant technology, and the absence of governmental or external economic influences. Additionally, the model assumes that all production factors are fully utilized, the labor force (LLL) grows at a constant rate, and the initial stock of capital (KOK_0K0) and labor (LOL_0L0) are fixed exogenously.

At its core, the Solow model connects critical variables—capital (KKK) and labor (LLL)—using the Cobb-Douglas production function, represented as:

:

$$Y(t) = F[K(t), L(t)] = K(t)^\alpha L(t)^{1-\alpha} \quad (1.1)$$

In this equation, K_t represents the total capital in the economy, while L_t denotes the labor force size, both serving as production inputs driving growth. When technological progress variable A is incorporated to capture improvements in technology, the equation transforms to:

$$Y_t = A_t K_t^\alpha L_t^{1-\alpha}$$

In addition, the assumption of constant returns to scale in the model implies:

$$F(\lambda K, \lambda L) = \lambda F(K, L) = \lambda * A_t K_t^\alpha L_t^{1-\alpha}$$

And the assumption that inputs are essential underlies:

$$F(0, 0) = F(K, 0) = F(0, L) = 0$$

Besides that, the Solow growth model also follows the postulation that marginal productivities are positive as:

$$\frac{\partial F}{\partial K} = \alpha A_t K_t^{\alpha-1} L_t^{1-\alpha} > 0$$

$$\frac{\partial F}{\partial L} = (1 - \alpha) A_t K_t^\alpha L_t^{-\alpha} > 0$$

With reference to the Cobb-Douglas production function principles, the Solow growth model argues that marginal productivities are decreasing as:

$$\frac{\partial^2 F}{\partial K^2} = (1 - \alpha) \alpha A_t K_t^{\alpha-2} L_t^{1-\alpha} < 0$$

$$\frac{\partial^2 F}{\partial L^2} = -\alpha(1 - \alpha) A_t K_t^\alpha L_t^{-\alpha-1} < 0$$

Moreover, when x is defined as $\frac{x}{L}$ as a per worker variable, then the following holds,

$$y = \frac{Y}{L} = \frac{AK^\alpha L^{1-\alpha}}{L} = A \left(\frac{K}{L}\right)^\alpha \left(\frac{L}{L}\right)^{1-\alpha} = AK^\alpha \quad (1.2)$$

Therefore, as can be seen from equation (1.2) production per worker has decreasing returns to scale.

Devereux and Love (1994) argue that economic growth is driven by capital accumulation and technological progress, which enhance the efficiency of inputs used in production, thereby increasing output. Conversely, Milesi-Ferretti and Roubini (1998) highlight the adverse impact of high tax rates, which reduce the returns on investment. This decline in returns inhibits the conversion of potential growth into tangible productivity gains, leading to economic stagnation. Their findings underscore how excessive taxation can impede overall economic expansion.

However, fiscal policies such as government spending in infrastructure such as education, healthcare as well as where the government spends a lot of money in large scale construction also boost productivity, showing that policies based on government spending are also two edged. Ramsey (1903–1930), considered the pioneer of modern theories on economic growth and optimal taxation, posed two fundamental questions:

1. Which tax structure is most appropriate to achieve a specific level of consumption out of the consumers' revenue?

2. At what level of consumer welfare the government can get the maximum possible revenue?

Based on such considerations, Scully (1995) proposed a model to define the optimal tax burden rate; more about the role of taxation regarding growth is an inverted U shape. This simply means that taxation is good for growth up to some level where it turns bad for growth on the other side. Recent works, including Amgain (2017) that employs quadratic approach in the analysis, establish that tax revenue exhibits positive growth, only up to some level beyond which is detrimental.

Ramsey's theory further assumes that Hicksian demand curves are linear within the relevant range, represented mathematically as:

$$P_i = a_i - b_i X_i \quad (1.3)$$

Here, P_i implies the price of good i , a_i is constant and $b_i X_i$ implies the demand line. Also, Ramsey (1930), assuming that supply of a good is perfectly inelastic at C_i prevailing price and also a number of lump-sum taxes is zero. Within this setting at least one good is exempted from taxation, Hicksian cross price elasticities are assumed to be equal to zero, and government's required expenditure (G) is given exogenously irrespective of the particular form of taxation adopted.

$$(T_1, T_2, \dots, T_N) \sum_{i=1}^N \frac{1}{2} \frac{c_i^2}{b_i} T_i^2 \quad (1.4)$$

Subject to

$$\sum_{i=1}^N C_i T_i \frac{a_i - c_i - c_i T_i}{b_i} > G \quad (1.5)$$

Taking the first order condition with respect to T_j and solving for T_j , we get

$$T_i = \frac{\lambda}{1 + 2\lambda \eta_i} \quad (1.6)$$

Besides that, Ramsey's second problem is formulated as:

$$Max \sum_{i=1}^m R_j \quad (1.7)$$

Subject to

$$\sum_{i=1}^m U_i \geq K \quad (1.8)$$

Where (R_j) is tax revenue from the i -th consumer, (U_i) stands for utility function and (K) is a fixed level of the utility function. Before proceeding it is necessary to emphasise that the Ramsey solution was obtained by considering three specific attributes. The first characteristic postulates is All goods that are potentially liable to taxation are partly taxable; the second characteristic postulates is Goods with low elasticity of demand are taxable at higher rates; the third characteristic postulates is All rates including the international tax rates are affected in the proportion of the size of the government.

To establish the connection between the Solow growth model, the Cobb-Douglas production function, and taxation, we can express output as equivalent to the Keynesian aggregate demand:

$$Y = C + I + G$$

$$C = \beta(1 - \alpha)Y$$

$$G = \alpha Y$$

$$Y = F(K)$$

$$\frac{dk}{dt} = I + G$$

Where α is the tax rate, $(1-\alpha)Y$ is disposable income, G is the government revenue, $F(K)$ is a production function. Therefore, maximization of total consumption over some horizon $[0, T]$ implies:

$$\text{Max } (\alpha) \int_0^T C(t) dt$$

Subject to

$$K = F(K) - \beta(1 - \alpha)F(K)$$

$$K(0) = K_0$$

Where, K is capital. Hence, Ramsey's optimal formulation of growth theory becomes:

$$\max \int_0^T U(C(t))dt$$

Subject to

$$\begin{aligned} K' &= F(K, L) - C - \mu K \\ K(0) &= K_0 \\ L(t) &= L_0 e^{\gamma t} \\ K(t) &\geq 0 \\ 0 &\leq C(t) \leq F(K(t), L(t)) \end{aligned}$$

Where L is labour, μ is depreciation rate, γ is growth rate of population. Henceforth, Solow growth theory with a taxation becomes:

$$c = \frac{C}{L}$$

Subject to

$$d\left(\frac{K}{L}\right) = 0$$

Where K is capital, L is labour and c is consumption per capita. Therefore, the functional form of the Solow growth model in terms of the Cobb-Douglas production function becomes:

$$Y_t = \alpha_0 (G_{t-1})^{\alpha_1} [(1 - T)Y_{t-1}]^{\alpha_2} \quad (1.9)$$

Where, Y is the output, G is the government spending on public goods, T lump sum tax for the time period t , α_1 , α_2 are elasticity coefficients. The government budget requires that tax revenue equals the cost of public goods provided which means that:

$$G_t = TY_{t-1} \quad (2.0)$$

Where T is the tax rate or a proportion of tax revenue in GDP. Furthermore, combining (1.9) and (2.0), we obtain:

$$Y_t = \alpha_0 (TY_{t-1})^{\alpha_1} [(1 - T)Y_{t-1}]^{\alpha_2} \quad (2.1)$$

More than that, dividing both sides of the expression by Y_{t-1} , we get:

$$\frac{Y_t}{Y_{t-1}} = \alpha_0 T^{\alpha_1} (1 - T)^{\alpha_2} (Y_{t-1}^{\alpha_1 + \alpha_2 - 1}) \quad (2.2)$$

Hence, by definition of growth rate, we have $\frac{Y_t}{Y_{t-1}} = \theta$. Therefore, introducing a constant A as $A = \alpha_0 Y_{t-1}^{\alpha_1 + \alpha_2 - 1}$, we can write the function as:

$$\theta = AT^{\alpha_1}(1 - T)^{\alpha_2} - 1 \quad (2.3)$$

Moreover, according to Lemma, under the assumption $\alpha_1 > 0, \alpha_2 > 0$, and $\alpha_1 + \alpha_2 \leq 1$, the function θ is concave. Nonetheless, in order to prove concavity of the function θ , we need to check a sign of its second order derivative as:

$$\begin{aligned} \frac{\partial \theta}{\partial T} &= \alpha_1 AX^{\alpha_1 - 1} Y^{\alpha_2} - A \alpha_2 X^{\alpha_1} Y^{\alpha_2 - 1} \\ \frac{\partial^2 \theta}{\partial T^2} &= AX^{\alpha_1 - 2} Y^{\alpha_2 - 2} [\alpha_1 (\alpha_1 - 1) y^2 - 2 \alpha_1 \alpha_2 xy + \alpha_2 (\alpha_2 - 1) x^2] \end{aligned}$$

Where $\alpha_1 (\alpha_1 - 1) y^2 - 2 \alpha_1 \alpha_2 xy + \alpha_2 (\alpha_2 - 1) x^2 \leq 0$ proves concavity of θ . Now considering the problem of maximizing economic growth with respect to tax rate, the problem is $\max_T \theta$. Hence, from equation (1.7), we obtain:

$$\frac{\partial \theta}{\partial T} = A [\alpha_1 T^{\alpha_1 - 1} (1 - T)^{\alpha_2} - \alpha_2 (1 - T)^{\alpha_2 - 1} T^{\alpha_1}] = 0$$

Henceforth, we have

$$T^* = \frac{\alpha_1}{\alpha_1 + \alpha_2}$$

It is therefore important to note that, if assumption Lemma violates such that if $\alpha_1 + \alpha_2 > 1$, then function θ may not be concave on $[0, 1]$, but T^* is still its maximum point. Moreover, it is easy to check that if $\alpha_1 + \alpha_2 = 1$ then the function $(\theta + 1)$ is constant returns to scale. Furthermore, the Cobb-Douglas production function in equation (1.7) takes the following form:

$$\theta + 1 = AT^{\alpha_1}(1 - T)^{\alpha_2}, \alpha_1 + \alpha_2 = 1 \quad (2.4)$$

Therefore, linearizing equation (3.4), we take the log from both sides and obtain:

$$\begin{aligned} \ln\left(\frac{1 + \theta}{1 - T}\right) &= \ln \ln(\alpha_0) + \alpha_1 \ln \ln\left(\frac{T}{1 - T}\right) \\ \ln(Y_t) &= \alpha_0 + \alpha_1 \ln(T_{t-1} Y_{t-1}) + \alpha_2 \ln((1 - T_{t-1}) Y_{t-1}) \end{aligned} \quad (2.5)$$

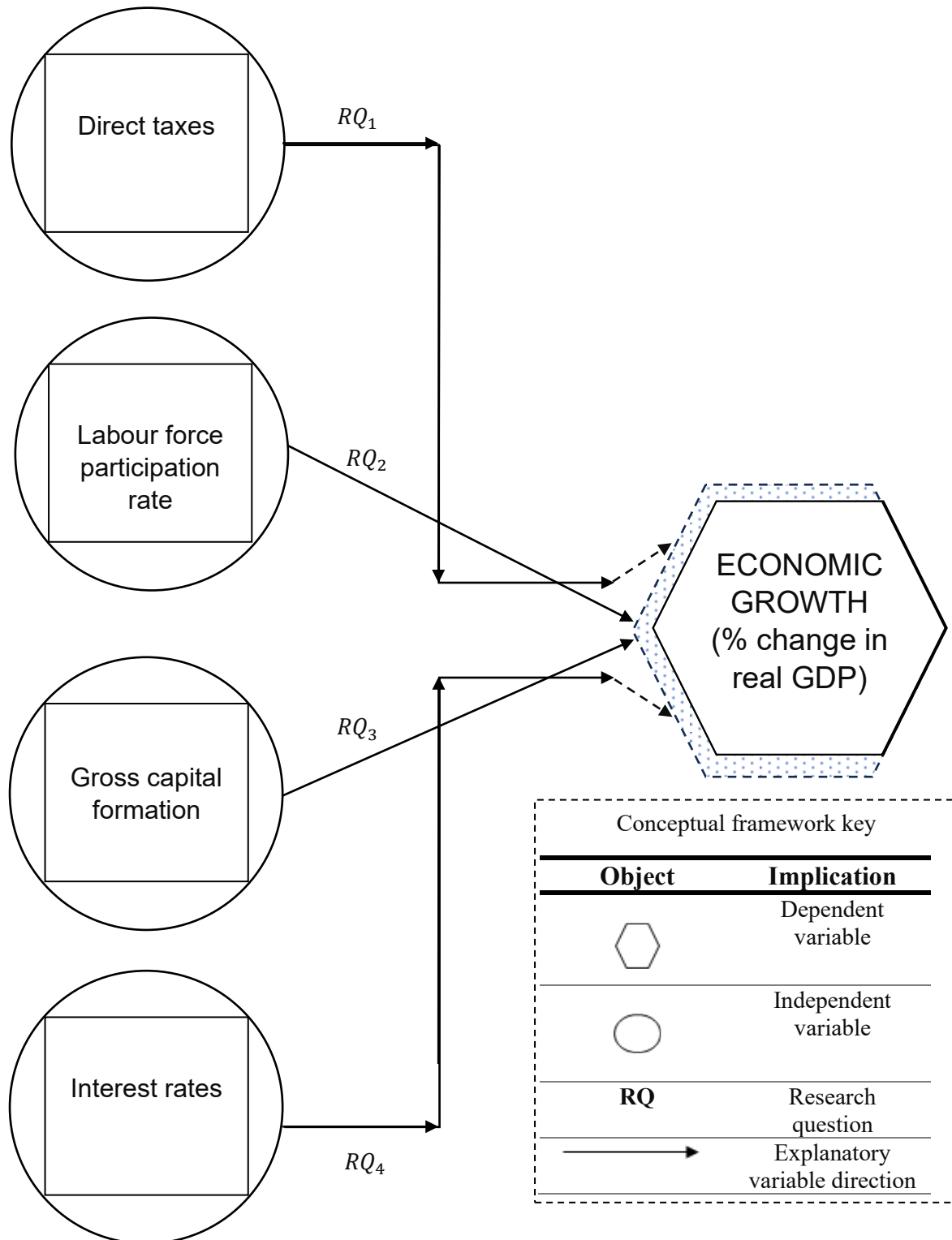
2.3 Conceptual framework of the study

This research proposal identifies **Economic Growth** as the dependent variable, representing changes or increases in a country's GDP over a specified period. Economic growth serves as a key indicator of national well-being and reflects the overall health and performance of the economy. Economic growth is traditionally conceived in terms of total volumes of an economy development capable of offering available and desirable varieties of goods and services for the population. The study will explore four key variables: rates of direct taxes, Labour force, Gross domestic capital formation and economic growth as shown below fig 1.

Direct taxes are taxes levied within one fiscal year from the public through; Income Tax. They have the important function to refill the government's income that is needed for supporting public services and improvement the country's economy. In contrast, the infrastructure changes may affect the taxes; high taxes prevent investment and consumption, and as a result, the growth of the economy. Therefore, the hypothesis that used in this context is believe to provide an answer to;" Direct taxation has a negative relationship with economic growth." As illustrated in the figure below.

The second independent variable is the labor force participation rate defined as the percentage of the working age population either in employer or employee capacity. An increase in this rate often seems to point to more participants in the creation of this GDP, thus positive economic activity. It is presupposed in this work that when the labor force participation rate is high; it results in increased economic growth because the workforce needed for production goes up as shown in figure 2.

Figure 2: Conceptual framework of the study



Source: Machiri N. (2024)

The third independent variable, Gross Capital Formation, represents the net increase in physical assets within the economy, such as investments in infrastructure, machinery, and technology. This variable is critical for economic growth, as increased capital formation leads to enhanced productive capacity and innovation. It is hypothesized that a rise in gross capital formation will positively influence economic growth, as it supports long-term economic development through improved infrastructure and productivity.

In summary, the conceptual framework illustrates the relationship between economic growth and its independent variables. The hypotheses are formulated as follows: (1) Direct taxes negatively impact economic growth; (2) Labor force participation rate positively affects economic growth; (3) Gross capital formation positively influences economic growth. These hypotheses guide the study in exploring how these factors contribute to the overall economic performance of a country.

CHAPTER THREE: RESEARCH METHODOLOGY

3.0 Introduction

This chapter outlines the research methodology employed in this study, which adopts a quantitative approach to examine the relationship between direct taxation and economic growth in Zambia. The study utilizes econometric modeling and statistical analysis to quantify the effects of taxation on key macroeconomic indicators. By relying on numerical data and objective measurements, this approach ensures precision, reliability, and generalizability of findings.

3.1 Research Design and Approach

This study adopts a longitudinal research design by utilizing time-series data spanning from 1990 to 2021 to analyze the relationship between direct taxation and economic growth in Zambia. A quantitative research methodology is employed, focusing on numerical data and statistical analysis to ensure objective and empirical findings.

Given the nature of the study, secondary data is sourced from credible institutions such as the ZRA, BoZ, and the WB. The research employs time-series econometric techniques, including the Auto-Regressive Distributed Lag (ARDL) model and the Error Correction Model (ECM), to examine both short-run and long-run relationships between taxation and economic growth.

The choice of this design is driven by the need to establish causal relationships and long-term trends, making it suitable for evaluating the impact of direct taxation on macroeconomic variables such as Gross Domestic Product (GDP), labor force participation rate, gross capital formation, and interest rates. Through this structured approach, the study provides robust empirical evidence to inform fiscal policy decisions in Zambia.

3.2 Data Collection and Sources

National-level ecological data covering the years 1990 to 2021 is used in this study. Secondary data was sourced from online platforms, including ZRA, BoZ, the World Bank, and other published reports. These sources were selected to ensure access to reliable and relevant information in an efficient manner.

3.3 Model Specification

3.3.1 Theoretical Derivation

This research bases its projection of key economic development factors on the Solow growth model, incorporating the Cobb-Douglas production function alongside elements of the Endogenous Growth (EGG) hypothesis. Knowledge capital (NK) is integrated into the model, aligning with theories by Romer (1990) and Grossman & Helpman (1991). These theories account for non-decreasing returns to knowledge capital and constant returns to physical capital and labor. The production function can be expressed as follows:

$$Y_t = C(NK)_t^\gamma K_t^\alpha L_t^{1-\alpha} \quad (2.6)$$

Where Y represents output, NK refers to knowledge capital ($\gamma \geq 1$), K stands for physical capital, L denotes labor, and C is a constant. By taking the logarithms of the variables and expressing them in first differences, the function is reformulated as:

$$\ln Y_t = \ln C + \gamma \ln NK_t + \alpha \ln K_t + (1-\alpha) \ln L_t \quad (2.7)$$

$$\Delta \ln Y_t = \gamma \Delta \ln NK_t + \alpha \Delta \ln K_t + (1-\alpha) \Delta \ln L_t \quad (2.8)$$

3.3.2 Econometric model specific

Applying phenomena behind the Cobb-Douglas production function to the process of model specification, we can consider the Cobb-Douglas production function as follows:

$$Y_t = K_t^\gamma L_t^\alpha \quad (2.9)$$

For this study, the variables are defined as follows: Y=RGDP (Real Gross Domestic Product), K=GCF (Gross Capital Formation), and L=LFPR (Labor Force Participation Rate). Substituting these variables into the production function yields:

$$RGDP_t = (GCF_t)^\gamma (LFPR_t)^\alpha \quad (3.0)$$

Then we extend the Cobb-Douglas production function in (3.0) by including direct taxes (DT_t) and Real interest rate (RIR_t) at time t and rewrite equation (3.0) as:

$$RGDP_t = (DT_t)^\mu (GCF_t)^\gamma (LFPR_t)^\alpha (RIR_t)^\varphi \quad (3.1)$$

Formally, we can let $\mu = \beta_1, \gamma = \beta_2, \alpha = \beta_3$ and $\varphi = \beta_4$ and further rewrite equation (3.1) as:

$$RGDP_t = (DT_t)^{\beta_1} (GCF_t)^{\beta_2} (LFPR_t)^{\beta_3} (RIR_t)^{\beta_4} \quad (3.2)$$

Subsequently, we can convert the mathematical model in equation (3.2) to an econometric model by including a multiplicative error or idiosyncratic term (ε_t) and a constant term (C) as:

$$RGDP_t = C(DT_t)^{\beta_1} (GCF_t)^{\beta_2} (LFPR_t)^{\beta_3} (RIR_t)^{\beta_4} \varepsilon_t \quad (3.3)$$

Therefore, linearizing equation (3.3) by taking the log on the left-hand side to convert Real GDP to economic growth and on the right-hand side to make independent variables to be linear in parameters we obtain:

$$\begin{aligned} (RGDP)_t & \\ = \ln \ln(C) & + (DT)_t + (GCF)_t + (LFPR)_t + (RIR)_t \\ + \ln(\varepsilon)_t & \end{aligned} \quad (3.4)$$

Therefore, the standard time series model that was used in this study based on the nature of data used took the following form:

$$\begin{aligned} (RGDP)_t & = C + (DT)_t + GCF_t + LFPR_t + RIR_t \\ & + \varepsilon_t \end{aligned} \quad (3.5)$$

In this research, the symbols used are defined as follows:

3.3.3 Variable Definitions

The variables used in the analysis are defined as follows:

- $\ln RGDP$ in SGD PIn GBP: Natural logarithm of Real Gross Domestic Product (economic growth proxy).
- $\ln DT$ in DT nDT: Natural logarithm of Direct Taxes.
- GCF: Gross Capital Formation.
- LFPR: Labor Force Participation Rate.

Since tests for stationarity provide support that the dataset is stationary, the work uses an augmented distributed lag Error Correction Model (ARDL-ECM). This model is especially useful for studying short-term dynamics based on the behavioral

approach. Real GDP per capita is identified as the dependent variable since the ability of a country to meet unpredictable and uncertain events requires consistent economic growth.

ARDL-ECM is designed to call attention to the economic factors that explain the dynamics of the analyzed relationships at the same time capturing short-run movement within them more cleanly than the standard ARDL, the focus of which is dynamic interactions that occur over shorter time horizons.

$$\begin{aligned}
 (RGDP)_t = & C_{01} + (DT)_{t-i} + GCF_{t-i} + LFPR_{t-i} + RIR_{t-i} + \sum_{i=1}^p \theta_{1j}(DT)_{t-i} \\
 & + \sum_{i=1}^{q1} \theta_{2j}\Delta GCF_{t-i} + \sum_{i=1}^{q2} \theta_{3j}\Delta LFPR_{t-i} + \sum_{i=1}^{q3} \theta_{4j}\Delta RIR_{t-i} \\
 & + \varepsilon_{1t}
 \end{aligned} \tag{3.6}$$

Notwithstanding, since the bounds test showed that there is cointegration in the model, the ARDL error correction model (ECM) was finally specified to estimate the short and long run dynamics as follows:

$$\begin{aligned}
 (RGDP)_t & = C_0 + \sum_{i=1}^p \beta_{1i}(DT)_{t-i} + \sum_{i=1}^q \beta_{2i}\Delta GCF_{t-i} + \sum_{i=1}^q \beta_{3i}\Delta LFPR_{t-i} + \sum_{i=1}^q \beta_{4i}\Delta RIR_{t-i} \\
 & + \lambda ECT_{t-1} + \varepsilon_t
 \end{aligned} \tag{3.7}$$

Where in equation (3.7), $\lambda = (1 - \sum_{i=1}^p \delta_i)$ is the speed of adjustment parameter with a negative sign and $ECT = ((RGDP)_{t-i} - \varphi X_t)$ is the error correction term (ECT) with $\psi = \frac{\sum_{i=0}^q \beta_i}{\alpha}$ as the long run parameter. Subsequently, $\beta_1, \beta_2, \beta_3$ and β_4 are short run dynamic coefficients of the model's adjustment long run equilibrium.

3.4 Description, Measurement and Analysis of Variables

In this section, the manifestation of the variables involved in this study, definition of these variables, hypothesized relationship, and justification for their use are discussed. For evaluation, the study focuses on the annual growth rate of real GDP, Direct Taxes, Gross Capital Formation, Real Interest Rate and Labor force Participation Rate. Each variable is measured on a nominal scale, especially, and most often, are stated in terms of money.

3.4.1 Direct taxes

Direct taxes are taxes which are charged on individuals and organizations on their revenue no matter the source of the revenue. Such taxes consist of income taxes, profit taxes, and taxes on gains arising from the sale of capital assets. In this context the focus will be made upon such taxes as income tax, profit tax and capital gains taxes focusing on their capabilities to contribute to total tax revenues.

Scholars in theoretical literature have vested fundamental education about taxation as a factor that impacts negatively on growth of the economy, and this stems from certain economic principles that shall be explained as follows. Empirical research does not paint a clear picture. Some of the existing research findings point at a positive relationship between taxation and economic growth; however, other studies show a negative relationship if taxes are boosted to a certain extent. This duality proves the fact that taxation has both positive and negative impacts on economic performance or growth depending on the way it is effected.

3.4.2 Gross capital formation

Gross capital formation can be defined as the value added to fixed capital investments, stocks or inventory and the net acquisition of assets within a given sector or the economy of a country. It plays the function of part of financing advancement with the aggregation of capital being the key to diversification and evolving technology. Third, it fosters market development and cuts reliance on outside credit markets. In this study, gross capital formation will be presented in proportionate form so as to represent the status of country's economic development as well as the progress made.

3.4.3 Real interest rate

The real interest rate represents the cost of capital, determined by the rate at which commercial banks mobilize funds from private sources to finance productive activities. Based on real interest rates, nominal interest rates are adjusted downwards or upwards in a way that would offset the effects of inflation, therefore delivering measures of the actual cost that investors or savers have to incur, or benefits that borrowers have to access. When calculating actual interest rates, they will be presented in terms of percentages PAIBOR is used as an example of

measuring real interest rates For this analysis, actual interest rates will be articulated in terms of actual as a percentage. Most of the economists have the opinion that high interest rates leads to access constraints on credit, consumption, income and therefore the economy growth. As a result of this, this study seeks to postulate a negative correlation between real interest rates and Zambian economic growth path.

3.4.4 Labour force participation rate

Labour force participation means the employment rate of the entire population that are in the required working age as restricted to the employment seeking populace. This indicator is defined as the ratio of the number of persons in the working age group actively involved in productive job to the number of persons in the working age group. In this study, the labor force participation rate is going to be looked into as an independent variable because a hypothesis could be formulated that there is a positive relationship between the labor force participation rate and economic growth.

3.5 Sample Size and Sampling Technique

In a bid to improve the credibility and reliability of the research findings, simple random sampling technique will be used with 31 annual observations. This approach will thus ensure that there is enough data required for analysis has been collected.

3.6 Data Analysis

In performing the analysis for this study, the statistical tool to be employed will be the STATA. This tool is selected on the basis of its practicality of handling data, analyse data and to produce relevant graphical depiction related to the research theme.

3.7 Tests to be carried out

3.7.1 Multivariate Estimation

Since this kind of analysis would be useful in a wide range of circumstances, multivariate estimation will be used in analyzing the model. This approach assumes that the dependent variable is function of a number of independent variables.

Since the variables of interest could be unit-root nonstationary, it is important to test for this characteristic Source (Nerlove and Pesaran, 1997). In time series analysis, three key criteria must be met: co-relationship, cut-off and trendless. For the time series where structural shifts are apparent, unit root tests have received much attention. Described systematically by Gujarati and Porter (2009), these tests give a

solution to the issue of how often and when a time series variable that is non-stationary should be differenced.

The two most common tests of unit root are probably the Dickey-Fuller (DF) test and the Phillips-Perron (PP) test. The procedures used in exogenous unit root testing using stochastic process are explained extensively by Gujarati and Porter (2009).

$$Y_t = \rho Y_{t-1} + \mu_t \dots \dots \dots (1) \quad -1 \leq \rho \leq 1.$$

For the equation above to be non-stationary, ρ must be equal to 1. Therefore, Equation (1) can be manipulated and written as ;

$$\begin{aligned} Y_t - Y_{t-1} &= \rho Y_{t-1} - Y_{t-1} + \mu_t \\ Y_t - Y_{t-1} &= (\rho - 1) Y_{t-1} + \mu_t \\ \Delta Y_t &= \delta Y_{t-1} + \mu_t \dots \dots \dots (2) \end{aligned}$$

Where $\delta = (\rho-1)$ and Δ is the first difference operator. The model in discussion has a unit root and the time series under consideration is non-stationary if $\delta = 0$.

The Augmented Dickey-Fuller (ADF) test for stationarity will be used to determine whether time series data contains unit root or is non-stationary. It takes the following form:

$$\Delta Y_t = \alpha + \beta t + \delta Y_{t-1} + \sum_{i=1}^m \Delta Y_{t-i} + \varepsilon_t \dots \dots \dots (3)$$

The hypothesis is given as

$H_0: \beta_1 = 0$ (the time series is non-stationary or the unit root exists)

$H_1: \beta_1 \neq 0$ (the time series is stationary or no unit root exists)

Y_t – dependent variable under consideration

t – time trend

m – Optimal lag length

ε_t – pure white noise term.

3.7.2 Cointegration Test

Cointegration process is a necessary condition for relating two or more time series variables over the long run. It highlights situations where the variables might be both statistically and dynamical short-term related, but in the long-run show a long-term relation. Cointegration as defined by Engle and Granger (1987), is a situation whereby two or more integrated variables cannot indefinitely trend in opposite directions in the future. This way, the researchers are able to investigate short term changes and relationships and long term parameters and relationships.

It is, however, noteworthy to show that the estimation of the long-run relationship of the Autoregressive Distributed Lag (ARDL) model starts with identification of the correct number of lags. Significant among the methods used to determine the lag length is the Akaike Information Criterion (AIC). Four types of cointegration tests, where each type suggests that at least one lag structure exists, confirm the existence of a long-mover relationship of variables. F-statistic is used to inspect the null hypothesizing which postures no long-run cointegrating relationship amongst the variables. In particular, the null hypothesis stipulates that coefficients of the lagged levels of the variables are equal to zero, and the alternative one supposes that at least one of the coefficients is not equal to zero. This is defined as follows:

$$H_0: \gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = \gamma_5 = 0 \dots \dots \dots (1)$$

$$H_0: \gamma_1 \neq \gamma_2 \neq \gamma_3 \neq \gamma_4 \neq \gamma_5 \neq 0 \dots \dots \dots (2)$$

This study utilizes the ARDL model or bounds testing to establishment of direct tax effects on the long run economic growth to determine the causality and the variables' dynamic nexus. From the same authors Jayaraman et al. (2011), it becomes clear that the ARDL model focuses on lagged and current values of both the dependent and independent variables for both short and long-term impacts.

Compared to other methods defining cointegration such as Engle and Granger (1987) or Johansen of (1988), the ARDL bounds testing method has numerous benefits. First, it helps in making estimates easily, this is because the long route eliminated makes the estimation practice easier. From here, given the lag order the analysis can move forward using Ordinary Least Squares (OLS). Moreover, compared to other methods of cointegration analysis, the ARDL approach does not

necessitate testing of variables for stationarity or order integration in advance. It allows for variables that can be initially integrated at $I(1)$, differenced at $I(1)$ or both, which makes it usable for analyzing dynamics of connections between the variables. According to Jayaraman and Choong (2011), the ARDL model combines the lagged and current values of dependent and independent variable making it possible to estimate the short-run and long-run couplings.

The ARDL bounds testing method offers several advantages over traditional cointegration techniques, such as those proposed by Engle and Granger (1987) and Johansen (1988). Notably, the ARDL approach simplifies the estimation process by relying on Ordinary Least Squares (OLS) once the lag order is specified. Moreover, it eliminates the need to pre-test variables for stationarity, as it accommodates regressors integrated at levels $I(0)$, first differences $I(1)$, or a mix of both.

The analysis of the model using the ARDL bounds testing procedure consists of the following three steps. First, the model equation is tested through the F-statistic with OLS to check on the presence of a long-term relationship between the analyzed factors. This step assesses the level of significance for the coefficients of the lagged level variables. It allows the test of only one long run equilibrium relationship between the dependent and the independent variable. The Wald test is then utilized to estimate the F statistic for the joint hypothesis testing of all the coefficients against definite critical limits.

3.8 Diagnostic Tests

In this context, diagnostic tests are beneficial to check the basic assumptions of the regression analysis and to confront frequent econometric problems. These tests check things like: Multicollinearity; Auto correlation; Heteroscedasticity.

3.8.1 Multicollinearity

This is a problem which happens when two or more of the elements used in developing the model under consideration are related in a linear way. This is particularly problematic because it goes against the assumption made in the classical form of linear regression, that of no relationship between any two regressors. Checking for multicollinearity the model will use the Variance Inflation Factor (VIF). The VIF is calculated as:

$$VIF = \frac{1}{(1 - R_j^2)} \dots \dots \dots (i)$$

Where $(1 - R_j^2)$ is sometimes termed as tolerance. Then the above equation can also be expressed as;

$$VIF = \frac{1}{Tolerance} \dots \dots \dots (ii)$$

If the value of the mean VIF is less than 10, then there is no multicollinearity.

3.8.2 Autocorrelation

Autocorrelation occurs when the error terms in a regression Equation are not independent over intervals of time thus breaking one of the main assumptions of regression analysis. To eliminate this, the Durbin-Watson statistic test shall be employed with the view of identifying autocorrelation of residuals. If autocorrelation is found, it will be eliminated using the estimated GLS methodology of arriving at accurate regression coefficients.

3.8.3 Heteroscedasticity

Heteroscedasticity is a condition where the variance of the error term changes with the change in observation differing from the regression model assumption of homoscedasticity. This can impact the efficiency of estimators, however it doesn't threaten the unbiasedness or consistency of estimators. In this study, heteroscedasticity will be diagnosed using the Breusch-Pagan test which tests on whether the variance of the errors is systematically different. That is, while heteroscedasticity may degrade the efficiency of the estimators specified herein, it does not impact their unbiasedness or consistency. Here Breusch-Pagan test will be employed to check and, if needed, to overcome the heteroscedasticity problem.

3.9 Ethical Consideration

This present study adhered to fundamental ethical principles to ensure the integrity and credibility of the research process. All data used in the study are sourced from reputable sources, ensuring accuracy and reliability. No personally identifiable information is collected or used, maintaining confidentiality and data protection standards. Additionally, proper citations and references are provided to acknowledge prior

research and avoid plagiarism. The study also ensures objectivity in data analysis and interpretation, minimizing bias.

CHAPTER FOUR: DATA ANALYSIS

4.0 Introduction

This chapter presents the conclusions and recommendations derived from the findings of the study. It encompasses pre-estimation tests such as the Augmented Dickey-Fuller (ADF) or Phillips-Perron (PP) tests, followed by cointegration or bounds testing. Subsequently, parameter estimation of the established model is performed. Diagnostic checks, including tests for heteroscedasticity, multicollinearity, and serial correlation, are also conducted to ensure the validity and reliability of the results.

4.1 Pre-Estimation Tests

4.1.1 Unit Root Test for Stationarity

To analyze the collected time series data, the Augmented Dickey-Fuller (ADF) test was applied to each dataset. The test was conducted to determine the stationarity of the data at a 5% significance level. The null and alternative hypotheses for the ADF test are as follows:

- H_0 : A unit root is present (the series is non-stationary).
- H_1 : No unit root is present (the series is stationary).

The test results evaluated the stationarity of the variables on $\ln GDP$, $\ln GDP$, RIR, GFCF, $\ln DTR$, $\ln DTLR$, and LFPR. Each variable was assessed at its level to determine its stationarity properties and the implications for its economic impact.

Table 4. 1: ADF Test at level

Variable	Augmented Dickey-Fuller test	Critical Value	Probability (P-value)	Level of Significance	Order of Integration
LGdp	-7.748999	-2.957110	0.0000	5%	I(0)
RIR	-2.916255	-2.963972	0.0553	5%	-
GFCF	-1.146127	-2.976263	0.6822	5%	-
LDTR	-3.5766	-2.960411	0.0123	5%	I(0)
LFPR	-1.146127	-2.976263	0.6822	5%	-

Source: Machiri N. (2024)

At the first difference, only two variables: GDP and Direct Tax Rate are broken, while the others are stationary as their p-values are above 0.05 as tabulated below. The first difference of the stationary variables, as shown below, have also been analysed.

Table 4. 2: ADF Test at First Difference

Variable	Augmented Dickey-Fuller test	Critical Value	Probability (P-value)	Level of Significance	Order of Integration
RIR	-4.458340	-3.004861	0.0022	5%	I(1)
GCFC	-4.146127	-2.976263	0.0220	5%	I(1)
LFPR	-2.402591	-1.953858	0.0183	5%	I(1)

Source: Machiri N. (2024)

Due to the differenced stationarity of the variables, that is, I(0) and I(1), the Auto-Regressive Distributed Lag (ARDL) model will be used to estimate the equation.

4.1.2 Bounds Test

Engle's bounds test was employed to test the existence of co-integrating relationship of the dependent variable with the independent variables. The results of this estimation are given below.

Table 4. 3: Bounds Test

F-Bounds Test		Null Hypothesis: No long run relationship		
Test Statistic	Value	Significance	I(0)	I(1)
F-statistic	36.38494	10%	1.9	3.01
K	4	5%	2.26	3.48
		2.5%	2.62	3.9
		1%	3.07	4.44

Source: Machiri N. (2024)

The applied techniques support the conclusion derived from the bounds test according to which the dependent variable and the explanatory variables are cointegrated in the long run. The coefficient analysis also shows that value of F –

calculated 36.38494 is wider than the F –critical 3.48 at 5% level, restricted intercept and trend. As a result, the null of no cointegration is rejected, supporting the presence between the variables in the model at least at the long-run.

4.2 Lag Selection Criteria

The ARDL model performance and selection are evaluated based on the dependent variable: LNGDP, for the selected sample of 1990-2022. Model fitness is assessed using measures such as LogL, Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), Hannan-Quinn Criterion (HQ), and Adjusted R-Squared (Adj:R-sq).

Table 4. 4: Model Selection Criteria Table

Model Selection Criteria Table						
Dependent Variable: LNGDP						
Sample: 1990 – 2022						
Model	LogL	AIC*	BIC	HQ	Adj. R-sq	Specification
377	64.737560	-3.672120	-2.849518	-3.435241	0.999444	ARDL(1, 1, 4, 4, 3)
252	64.812941	-3.600995	-2.730006	-3.350182	0.999378	ARDL(1, 2, 4, 4, 3)
376	64.792438	-3.599418	-2.728428	-3.348605	0.999377	ARDL(1, 1, 4, 4, 4)
380	60.238142	-3.556780	-2.879344	-3.361703	0.999410	ARDL(1, 1, 4, 4, 0)
379	61.211699	-3.554746	-2.828921	-3.345735	0.999403	ARDL(1, 1, 4, 4, 1)
251	64.969804	-3.536139	-2.616760	-3.271391	0.999297	ARDL(1, 2, 4, 4, 4)
127	64.815134	-3.524241	-2.604863	-3.259493	0.999289	ARDL(1, 3, 4, 4, 3)
2	65.803621	-3.523355	-2.555589	-3.244674	0.999231	ARDL(1, 4, 4, 4, 3)
450	53.689236	-3.514557	-3.127450	-3.403084	0.999349	ARDL(1, 1, 2, 0, 0)
25	58.612054	-3.508620	-2.879571	-3.327476	0.999383	ARDL(1, 4, 4, 0, 0)
395	56.594346	-3.507257	-2.974986	-3.353982	0.999376	ARDL(1, 1, 4, 1, 0)
397	58.463590	-3.497199	-2.868151	-3.316056	0.999376	ARDL(1, 1, 4, 0, 3)
378	61.445061	-3.495774	-2.721561	-3.272829	0.999355	ARDL(1, 1, 4, 4, 2)

Source: Machiri N. (2024)

Using the Akaike Information Criterion (AIC) as a measure of model suitability, the ARDL (1, 1, 4, 4, 3) model emerged as the most appropriate choice, with an AIC value of -3.672. This model demonstrated an optimal balance between accuracy and

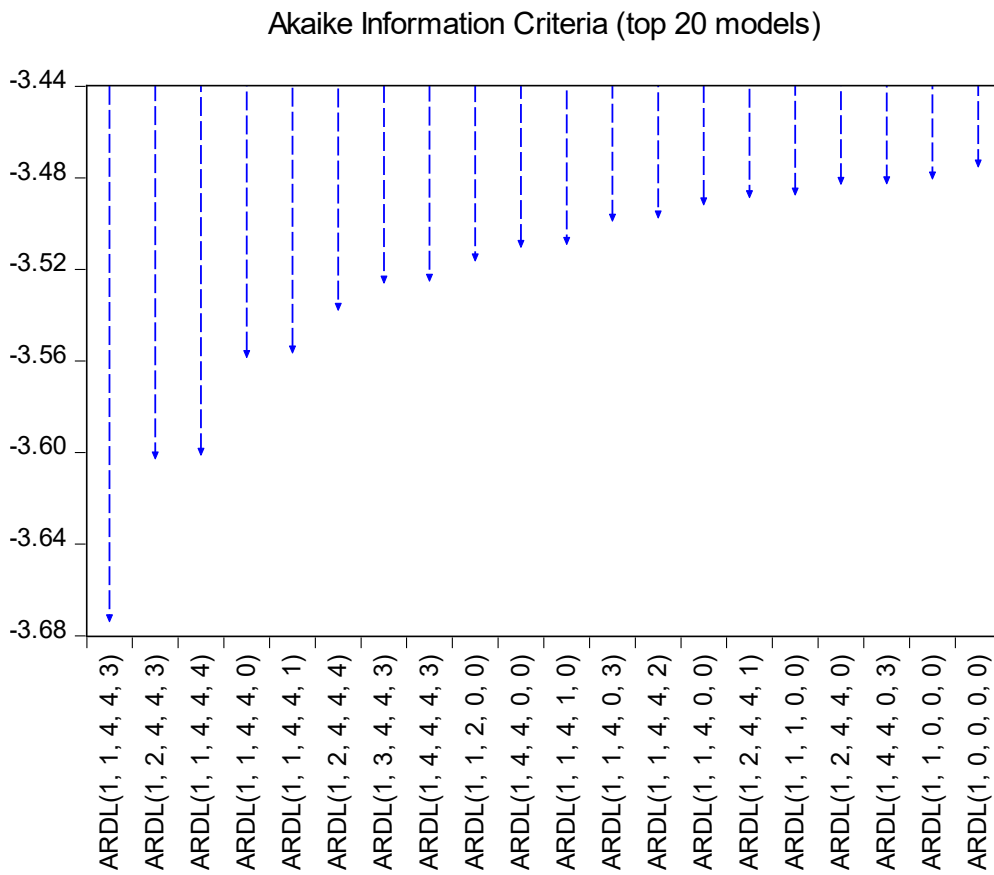
complexity, achieving an adjusted R^2 value of 0.999444. This high R^2 indicates the model's strong ability to explain variations in the natural logarithm of GDP ($\ln \text{GDP}$) effectively.

By contrast, other models, such as ARDL (1, 2, 4, 4, 3), yielded lower AIC values (-3.601) and slightly reduced adjusted R^2 scores (0.999378), indicating relatively lower efficiency. Similarly, the ARDL (1, 1, 4, 4, 4) model produced an AIC value of -3.599 with a lower adjusted R^2 . While these models are valid, they do not perform as well as the selected ARDL (1, 1, 4, 4, 3) model in balancing explanatory power and simplicity.

It is noteworthy that while the ARDL model with an AIC of -3.523 demonstrates lower proximity to zero compared to ARDL (1, 1, 4, 4, 3), its log-likelihood value of 65.803 suggests a higher cost associated with increased model complexity. Models with higher-order lag structures may yield high R^2 values but often compromise predictability due to overfitting.

Moreover, AIC, being closely aligned with the penalties imposed by Bayesian Information Criterion (BIC) and Hannan-Quinn Criterion (HQ), also indicates that more complex models are penalized accordingly. The ARDL (1, 1, 4, 4, 4) model, although meeting reasonable criteria for complexity and explanatory power, does not outperform the ARDL (1, 1, 4, 4, 3) model. Thus, the selected ARDL (1, 1, 4, 4, 3) model is validated as the most satisfactory and reliable choice for analysis.

Figure 3: Akaike Information Criteria



Source: Machiri N. (2024)

The ARDL (1, 1, 4, 4, 3) model has been identified as the most suitable framework for modeling $\ln GDP \backslash \ln GDP$ in this analysis. This model strikes a balance between simplicity and high explanatory power, demonstrating strong performance across multiple selection criteria. This underscores the significance of achieving a trade-off between model fit and parsimony to enhance reliability and interpretability.

4.3 ARDL Model Regression Output

From the findings of the unit root tests and co-integration equations further support the existence of long-run relationship between taxation other control variables with Zambia's economic represented by Log of GDP (LnGDP). This is evident by high coefficient of determination (R^2) of 0.9998 and an adjusted R^2 of 0.9994 showing that the above stated model fits the data very well. This therefore implies that multitude of changes in the dependent variable can be accounted by the included predictors.

In addition, the model's overall statistical significance has been established and testifies to the result of the F-statistic that is equal to 5.525; p-value condition is less than 0.05. The value of 2.195 in the Durbin-Watson statistic means that there is no much worry about the autocorrelation problem in the model, affirming its credibility for analysis. On this ground, the study reveals that the chosen model can properly explain the role of tax for economical progress and does not tend to get influenced by modifications.

Table 4. 5: ARDL Model Regression Output

R-squared	0.999800		
Adjusted R-squared	0.999444		
F-statistic	5.3332		
Prob (F-statistic)	0.0000		
Durbin-Watson	2.195109		
Variable	Coefficient	Std Error	P-value
LNGDP(-1)	1.041992	0.125266	0.0000
LNTAXES(-1)	-0.199929	0.079243	0.0326
RIR(-1)	0.004592	0.001619	0.0195
RIR(-4)	0.002418	0.001055	0.0476
LFPR(-4)	-0.740010	0.351760	0.0447

Source: Machiri N. (2024)

The coefficient for the lagged dependent variable ($\ln \text{GDP}(-1) \backslash \ln \text{GDP}(-1) \backslash \ln \text{GDP}(-1)$) is positive (1.042) and highly significant ($p=0.0000$), indicating strong persistence in GDP levels, where past values have a notable impact on current GDP. Similarly, the lagged natural logarithm of taxes ($\ln \text{TAXES}(-1) \backslash \ln \text{TAXES}(-1) \backslash \ln \text{TAXES}(-1)$) shows a negative and statistically significant coefficient ($\beta = -0.1999, p = 0.0326$), implying that higher direct tax rates in prior periods negatively influence current GDP levels.

For the real interest rate (RIR), a positive and significant effect is observed at both the first ($\beta=0.0046, p=0.0195$) and fourth lags ($\beta=0.0024, p=0.0476$). This suggests that increased real interest rates, in both the short and medium term, contribute positively to economic growth, possibly due to their role in encouraging savings and investments. Conversely, the fourth lag of the labor force participation rate (LFPR(-4)) has a negative and significant coefficient ($\beta=-0.7400, p=0.0447$), implying that labor market dynamics four periods earlier may negatively impact GDP, potentially due to inefficiencies or structural mismatches in labor usage.

These findings highlight the critical role of fiscal policy tools such as direct taxation and interest rates in influencing Zambia's economic growth. The results suggest that policymakers should account for these lagged effects when crafting growth-centric economic policies.

4.4 ERROR CORRECTION MODEL

As shown in **Table 2**, the short-run values derived from the Error Correction Model (ECM) results indicate the magnitude of change in economic growth ($\ln(GDP) - \ln(GDP_{t-1})$) due to shifts in the explanatory variables. The model exhibits a high goodness of fit, with an R^2 value of 0.9085 and an adjusted R^2 of 0.8241, which reflects the strong explanatory power of the independent variables on GDP in the short term.

The Durbin-Watson statistic value of 2.195 further suggests the absence of autocorrelation, as it lies above the lower critical value of 1.5 and below the upper critical value of 2.5. These findings reinforce the effectiveness of the ECM in capturing short-run adjustments in the economy. The sensitivity of GDP towards shock impacts occasioned by variation in fiscal and other macroeconomic variables.

Table 4. 6: ECM Regression

ECM Regression				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTAXES)	0.098031	0.045214	2.168167	0.0483
D(RIR)	-0.002944	0.000966	-3.047399	0.0139
D(RIR(-3))	-0.002418	0.000699	-3.460595	0.0072
D(LFPR(-3))	0.740010	0.209874	3.525978	0.0065
D(GFCF(-2))	6.58E-12	2.43E-12	2.709111	0.0240
CointEq(-1)*	0.041992	0.002590	16.21049	0.0000
R-squared	0.908518	Mean dependent var		0.188928
Adjusted R-squared	0.824074	S.D. dependent var		0.067649
S.E. of regression	0.028374	Akaike info criterion		-3.979812
Sum squared resid	0.010466	Schwarz criterion		-3.350764
Log likelihood	64.73756	Hannan-Quinn criter.		-3.798669
Durbin-Watson stat	2.195109			

Source: Machiri N. (2024)

Short-Term Dynamics

The results also provide evidence that the short-term coefficient of the changes in taxes is positive ($\beta = 0.0980$, $p = 0.0483$) to show that the tax revenues increase with the GDP because of the better allocation of public resources in terms of productivity.

Impact of Real Interest Rates (D(RIR)): The results obtained in this study suggest that there is a negative relationship between real interest rates and economic growth in the short run ($\beta = -0.0029$, $p = 0.0139$). Further, the third lag of real interest rate (-0.0024 ; $p < 0.0072$), also supports high interest rate contractionary effect hypothesis.

Labor Force Participation Lag (D(LFPR(-3))): A positive and significant coefficient of the third lag of labor force participation means that previous improvement in workforce activity leads to current improvement in economic growth ($\beta = 0.7400$, $p = 0.0065$).

Investment Lag (D(GFCF(-2))): Gross fixed capital formation, if lags two periods ($\beta = 6.58 \times 10^{-12}$, $p = 0.024$), has a positive and significant effect on GDP, which underlines the Twelve's need for physical capital accumulation of the sort that spurs later development after a period of underinvestment.

Speed of Adjustment

The coefficient of the error correction term (CointEq(-1)*) equals 0.0420 and the P-value is 0.0000 confirming that long term movement back to equilibrium amounts to approximately 4.2% of the total error per period. This significant term captures the long run cointegration relationship establishing in the study and provides evidence that economy returns back to equilibrium in the long run path.

These ECM findings show that there are several interacting factors, which help in determining economic performance in the short run. Wherein, taxation, labor force participation, and investment stand out as the uses of funds supporting growth; high interest rates limits the growth. The significance of the error correction term underscores the need to integrate short-run policy interventions with sound long-run economic policies anchored on the Zambian economy.

POST ESTIMATION TESTS

SERIAL CORRELATION

The Breusch – Godfrey LM test was done to ascertain the series correlation of the residuals. The results indicate a lack of serial correlation with F-statistic of 5.8446 and p-value of 0.1322. Further, the observed R-squared test yielded a p-value of 0.1603 which is also greater than the statistical significance level and that shows there is no need to make any corrections for serial correlation. The results shown here further enhance the level of confidence in the overall model.

Table 4. 7: Breusch-Godfrey Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test
F-statistic
Prob. F(2,7)
Obs*R-squared
Prob. Chi-Square(2)

Source: Machiri N. (2024)

This findings imply that the residuals are independent of their past values and therefore conform with the first assumption of basic regression analysis. This makes the level of coefficients in a model more accurate, allows for hypothesis testing, and

eradicates unneeded parameters, against possible, due to the nature of autocorrelation. Therefore, it is possible to conclude that the derived model seems to be valid and appropriate for the following interpretation and analysis.

Residual Tests – Variance of the Residuals

As has been evidenced by the values on table A.1 using the Breusch-Pagan-Godfrey test, there is no presence of heteroskedasticity problem this regression model. Using the F-statistic of 0.719213 and the p-value of 0.7308 we reject null hypothesis, which infers that variance in samples is equal therefore concluding the data is homoscedastic. Furthermore, Obs*R-squared is a statistical chi-square test calculated that equal to 15.71652 and the probability level is 0.5440, this implies that there is no any heteroskedasticity in the model.

The last test in support of these is explained below is the Scaled Explained Sum of Squares Test with the observed p-value of 0.9999 thereby suggesting that the variance of the residuals does not decrease with observation from z indust. This makes the model more dependable in the sense that it can give relevant and precise conclusions.

Table 4. 8: Heteroskedasticity Test: Breusch-Pagan-Godfrey

Breusch-Pagan-Godfrey Heteroscedasticity Test
F-statistic
Prob. F(17,8)
Obs*R-squared
Prob. Chi-Square(17)
Scaled Explained SS
Prob. Chi-Square(17)

Source: Machiri N. (2024)

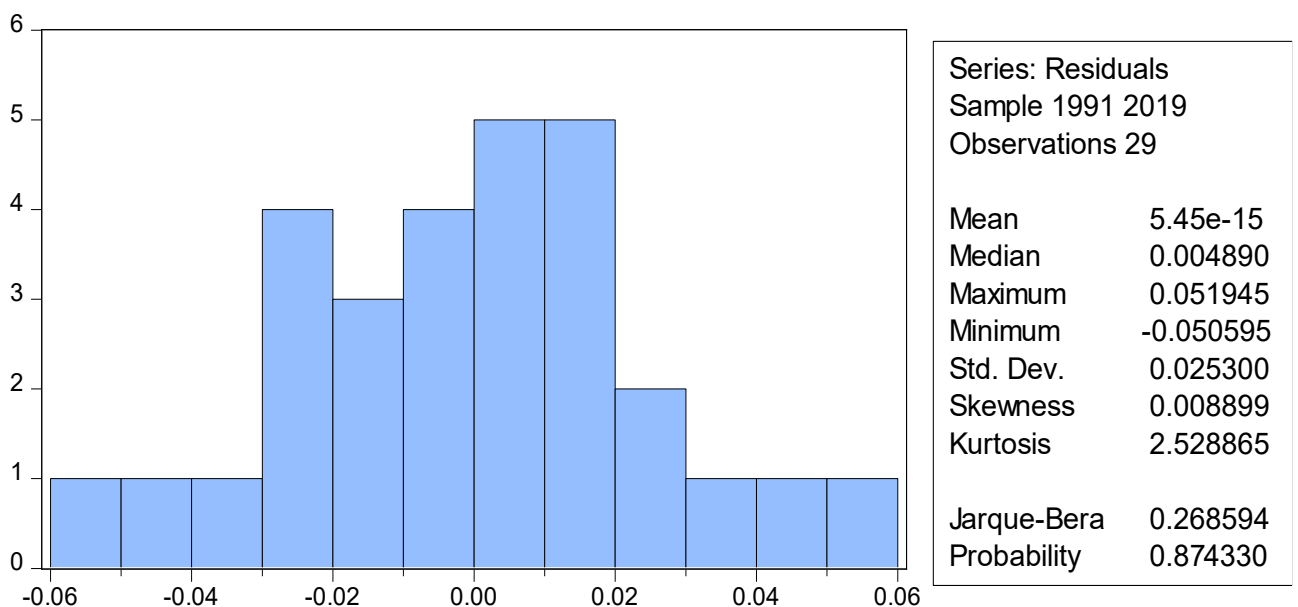
These results support the model to be homoscedastic, thereby justifying tight standard errors and accurate statistical tests. Such applied validation enhance the awareness of dependable regression results and encourages the model adequacy of reliable inferences.

NORMALITY TEST

Tests on the residual including the histogram of the residual, and mean and median showed the degree up to which the residuals of sample regression model are symmetrically located within zero. The residual distribution seems to be normally distributed as indicated by Skewness and kurtosis test. 5.45×10^{-15} and a median of 0.00489. The value of the standard deviation is equaled to 0.025300, which means that the residuals are concentrated around the estimated regression line that can be considered high model fit.

Looking at Skewness, the calculated skew value is 0.008899 and it is very close to the ideal skewness value of 0 meaning that the residuals distribution is symmetrical. However, kurtosis value is 2.528865, which means that the residuals are slightly lower than the ideal normal distribution of kurtosis value of 3 in the lower tail. However, the general performance of the model is not marred as most of the data points maintain a good distance from the perfect regression line.

Figure 4: Histogram test of normality



Source: Machiri N. (2024)

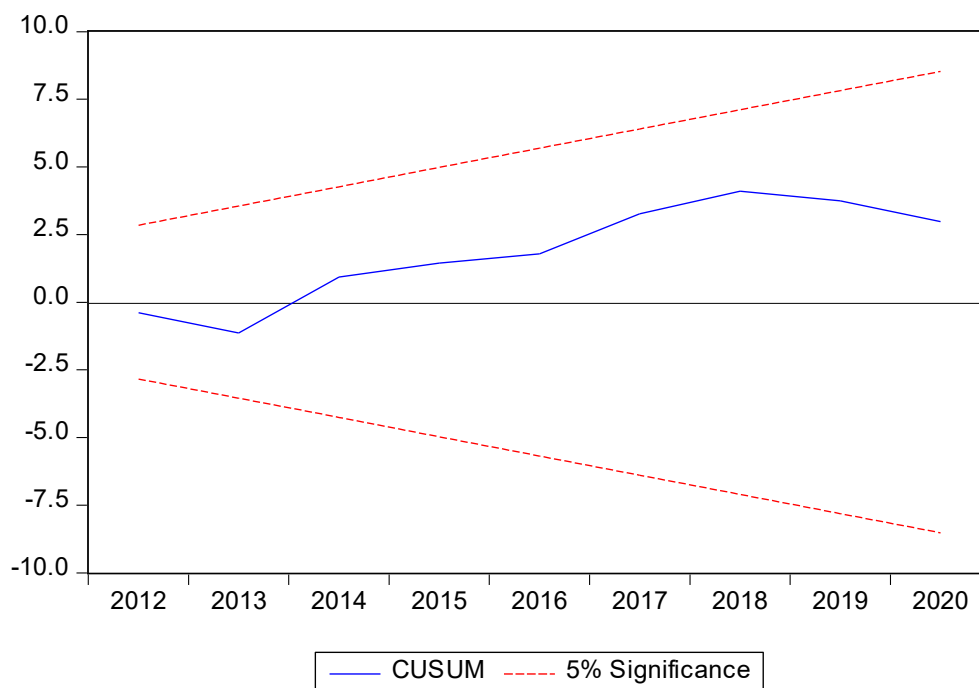
The results of the estimation give me a Jarque-Bera test statistic of 0.268594 with the p-value equivalent of 0.874330 which again holds up the assumption of normality. Likewise, a chi-square of normality of residuals test returns a p of 0.255. Since this value is above 0.05 we do not reject the null hypothesis of normality of the

residuals. This is desirable because residuals which are random deviations from the regression line should ideally follow normal distribution and this is a key aspect of any analysis based on linear regression. In conclusion, it is established that this model exhibits stability and there injection of residual disturbances is not problematic.

STABILITY TEST

The CUSUM test is used to test for constancy of the regression model parameters and can be downloaded from the Internet. In this test the previous observed usual level of the CUSUM statistic is denoted as the blue line while the red dashed lines are the 5% level of significance bounds. The predetermined significance levels to establish these bounds are 1% and 5%. In case of a stable model, the cumulative sum line must remain between these two limits for the time under observation. This test gives information concerning the stability of the structure of the model throughout the time.

Figure 5: CUSUM test



Source: Machiri N. (2024)

In constructing the plot, the CUSUM line stays strictly in the area bounded by two red lines that represent the 5% level of significance, suggesting that there is no structural break and parameter instability from the year 2012 to 2020. This shows the stability

of the coefficients of the model and is interpreted as structural invariance across time.

In conclusion, the analysis confirms the efficiency of the model to give consistent and accurate conclusions throughout the sample period.

CHAPTER FIVE: DISCUSSION OF FINDINGS

5.0 Introduction

This paper focuses on the analysis of taxation as one of the main fiscal policy tools, using the ARDL model and relevant diagnostic tests to reveal long run and short run dependencies. The study outcomes thus corroborate and enrich current knowledge regarding the centrality of fiscal policy to development.

5.1 Long-Run Dynamics

This paper establishes that taxation policy, interest rates and labour market trends are factors that affect Zambia's long-run economic growth. The negative and significantly estimated coefficient of the lagged tax variable $\ln TAXES(-1)$ confirms that direct taxes negatively impact economic growth. This assertion is supported by Barro (1990) who suggested that high taxation rates could slow development as this reduces the amount of money individuals can save for investment. Although it is possible to estimate the level of taxes that would produce an optimal amount of government revenues with the least loss in efficiency, the process has not been easy, as rightly noted by Slemrod and Bakija (2017).

This confirms with McKinnon (1973) view that real interest rates affects growth, more so in the short run, reflecting his view that real interest rates mobilise savings for investment. Nonetheless, free and high continuous interest rates can also affect long-term growth as has the need to harmonize both fiscal and monetary policies.

5.2 Short-Run Dynamics

In the short-run, the result of the ECM shows that taxation directly has a positive effect on GDP as it facilitates government's investment in development-oriented expenditures. This reflects Keynesian fiscal theories where the aspect of public expenditure is held to foster growth. Gross fixed capital formation (GFCF) also shares this same pattern of association with GDP per capita growth, and hence supporting infrastructure investment as Calderon & Servén aptly pointed out (2004).

And there is, of course, another crucial indicator to make its appearance: labor force participation. PREVIOUS experience would require that concerted and efficient labour policies are needed to sustain favourable tendencies in labour market. This observation agrees with the findings of Mankiw, Romer, and Weil (1992) who argue

that human investment plays a central role in determining rates of income per capita growth.

5.3 Diagnostic Tests and Model Robustness

Diagnostic checks including the Breusch-Godfrey Serial Correlation LM Test were used to confirm that the model does not have serious serial correlation. This makes the estimates of the model more accurate and increases the confidence in the conclusion made in this study hence making the political recommendations made in this study credible.

5.4 Comparison with Other Scholars

The study, recommendations for a two-tax system, aligns with Musgrave and Musgrave remark that the form and administration of taxes are closely related to economic impacts. Along this line, the advice given by Tanzi and Zee (2000) to do away with distortion in the tax system will be useful as Zambia persist in overhauling its tax systems.

The findings of this study are also consistent with Solow's (1956) growth model: capital deepening and efficient labour factor as the main drivers of economic growth. But sustaining high interest rates pose some challenges, Ndulu, et al (2007) affirm that high interest rate negatively impacted on access to credit by the private sector in Sub-Saharan Africa.

5.5 Comparison with Global Studies

The empirical findings of a negative longer term direct tax on GDP growth are in support with literature review by Johansson et al (2008), Szarowska (2011) advocating harms of direct and corporate taxes on economic performance. Likewise, Xing (2012) stated income taxes have the effect of impacting negatively on long-run growth consequently calling for tax systems that have least degree of economic restraints.

On the other hand, the small and short-run proven positive result of the relationship between taxation and growth that is established in this study by the ECM coefficient of $= 0.0980$, $p = 0.0483$ means that efficient utilization of the collected taxes can promote economic growth. This perspective corresponds to Rabushka and Bartlett's (1985), who contended that taxes can help provide for public investment if applied correctly.

5.6 Comparison with African Studies

The findings also corroborate some previous works done in African countries; for example, Babatunde et al. (2017) and Takumah, (2014) posited that efficient tax collection increases the GDP. Similarly to Babatunde et al.'s findings, I found short-term direct positive relationship between taxation and growth. However, the negative long-term implications of direct taxes, which is incompatible with Takumah's notion that tax revenue unswervingly spurs growth. This difference could be due to the fact that different types of taxes have varying impacts; while some like the extractive royalties upon which Zambia relies may be growth minimizing or even contracting as Nkole opines (2019).

5.7 Comparison with Zambian Studies

This research validates Chizonde's (2016) finding that effective utilization of tax revenues enhances long-run economic growth in Africa. It is in this context that the short-run revenues can be equated with Rabushka and Bartlett's (1985) argument that growth is possible through efficient systems of taxation in the developing world. But the negative long-run consequences may build upon some issues with some taxes, particularly the extractive royalties as indicated by Nkole (2019).

Also, the results imply that there is a need to coordinate fiscal and monetary policies with regard to real interest rates. Such a scenario corresponds to Chizonde's (2016) argument that fiscal and monetary policies are important for economic policy coordination in Zambia.

5.8 Policy Implications and Contributions

The works suggest that there is a challenge in government looking for more points of revenue without suppressing growth and levying appropriate taxes. Preventable tax measures such as contractionary tax measures, as highlighted by Nkole (2019) and Szarowska (2011) should be shunned. However, the solutions should related to better tax collection, as well as the efficient use of taxes as highlighted by Babatunde et al. (2017) and Chizonde (2016). Furthermore, the findings are relevant to Akiza's (2012) compilation of policies that facilitate productivity and accumulation of capital.

5.9 Conclusion

It is apparent that taxation is an important fiscal policy instrument for maximizing revenue as well as economic growth. One of the defining elements of this process is

a set of strategic investments in infrastructure and regulation of the labor market that may be underfinanced or simply disregarded. The results concur with trends noted in the existing global and sub-Saharan literatures, furthering arguing that Zambia requires more policy flexibility and improved comprehension of fiscal policy for its future growth.

CHAPTER 6: CONCLUSION AND RECOMMENDATION

6.1 Conclusion

This research undertakes to analyse the ability of taxation as a fiscal tax measure in realising the Zambian economic goals with emphasis on the GDP impact in the subsequent short and long terms. The paper gives an opportunity to understand the interactions between GDP and other variables like the labor force, the real interest rates, and the gross fixed capital formation in greater detail. Since the current literature on direct taxation and economic growth has limitations, this endeavour provides a differentiated Zambia-centered analysis of the topic.

The findings indicate that taxation has dual effects: in the short run it may increase GDP through Financing government expenditure that promote growth enhancing activities while in the long run high taxes are know to discourage growth. Likewise, the real interest rate that is positive with saving and investment in the short-run term becomes contractionaries if maintained. The other two variables of labor force participation and gross fixed capital formation also speak to an inclusive, investment biased form of growth.

This research contributes to filling critical gaps in the literature by:

1. Giving a comprehensive account of direct taxation, unlike other research done on indirect taxes or total governmental expenditure.
2. Specifying labor force participation and capital formation as two other variables that have never been considered by most empirical studies.
3. Including recommendations that are relevant to Zambia's facts and circumstances, denoting the drawbacks of using general applicable benchmarks for economic and fiscal tracking.

6.2 Recommendations

Based on the findings, the following recommendations are proposed:

1. **Optimize Tax Policy Design:** Therefore, to moderate the drive for revenue as a principal source of revenue, policymakers should streamline taxes and possibly lower the rates involved as far as possible. They believed that this

could spur investment and consumption expenditure and at the same time support sufficient revenue mobilisation.

2. **Optimize Revenue Allocation:** Policy makers should ensure that taxation revenues are driven to core areas of development, these include; construction, education, and health sectors. Stakeholding these areas can promote economic development because it can increase production capacity and optimal performance within the system of employment.
3. **Boost Labor Market Effectiveness:** More attempt should be directed towards the establishment of employment chances since women and youths can help to augment other employment force strengths. Thus, possible activities include vocational training, liberalized labour market policies, social security with the right cover diversification for the target group.
4. **Stimulate Investment:** It is found that there is a need for other positive action which in turn can improve the level of gross fixed capital formation and these include; Further improvement in tax incentives on physical infrastructure development and FDI for faster and sustainable economic growth.
5. **Harmonize Fiscal and Monetary Policies:** There is need to have close cooperation of fiscal and monetary policies to ensure that the interest rate regime set and fiscal objectives fall in line to encourage proper inflows for investment.

6.3 Policy Implications

The findings have several implications for Zambia's fiscal policy:

1. **Sustainable Revenue Generation:** Direct taxes come with efficiency challenges in tax administration and more important, inability to overstretch certain industries or groups of population.
2. **Growth-Oriented Taxation:** There is no reason why fiscal objectives cannot be achieved and growth encouraged by eliminating wasteful tax distortions or improving the productive efficiency of the tax system.
3. **Strategic Public Spending:** The short run and positive effects of taxation imply that revenues must be appropriated to productive sectors in order to

reap growth influences. Expenditure control should be directed towards achieving strategic recognition of economic goals.

4. **Inclusive Policies:** Labour market changes need to take into account demographic and gender characteristics for improving the available opportunities for growth.

6.4 Areas for Future Research

While this study provides a comprehensive analysis, several areas warrant further exploration:

1. **Impact of Indirect Taxes on Economic Growth:** Further research could explore how different kind of indirect taxation entities for example Value Added Tax (VAT) affect the Zambian economy. This would expand the literature on how mechanisms other than direct taxes impact on economic performance.
2. **Sectoral Taxation Analysis:** Some possible suggestions include the proposal for cases studies on implications of taxation, involving original research of particular business areas: for example, of the agriculture or mining industry. The approach may assist in offsetting overcentralization of some industries as major sources of revenue while at the same time excluding them from taxation.
3. **Comparative Regional Studies:** Comparing Zambia's fiscal policies to those of other countries from the Sub-Saharan Africa region may help elicit factors that might inform effects and realisation of fiscal policies. Such comparisons may emphasize the regional practices that are considered the best practice reference or some issues that are essential at the regional level.
4. **Tax Equity and Distributional Impacts:** Analyzing how the tax revenues and subsidies for these individuals end up tugging at a time of fiscal equality of opportunities could help in design of fiscal structure. Such an analysis would inform legal changes that might serve to ensure that the tax structure was progressive across the different periods of economic class.
5. **Long-Term Investment Dynamics:** Perhaps, further research towards the long-run consequences of gross fixed capital formation (GFCF) on

economic growth might help to explain when and how these impacts happen. It implies that more research findings on investment approach would be useful to policy makers in enhancing understanding of how to get improved returns on investment based strategies.

6.5 Gap Filled by the Study

This research addresses critical gaps in the literature by:

1. These studies need to be done for Zambia rather than extrapolated across regions as was the case with the previous research.
2. Stepping out from the conventional analysis of direct taxation as means of replenishing the state's revenues only and considering its macroeconomic consequences.
3. Including the elements of labor force participation and capital formation of binding growth components which are usually excluded.
4. Building on the theories of how fiscal and monetary factors operate alongside each other, although often researched separately.

This study serves to support taxation as a means of attaining fiscal and economic goals while at the same time, underlining the need to adopt growth taxation regime. The results therefore present a clear guideline for the policy makers in formulating Zambia appropriate fiscal policies that are optimal for economic development as well as minimizing inequality. Doing so, this work fills the gaps of the literature and offers the corresponding recommendations to help Zambia unleash its economic potential.

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APPENDIX – Time series

year	GDP	Real interest rate (%)	Labor force participation rate,)	Direct Taxes	Gross capital formation	Ingdp	Inintrest	Infpr	Intaxes	Ingfcf
1990	1.13E+08	-34.539		9253800	1.08E+09	18.5459	#NUM!	#NUM!	16.04054	20.79584
1991	2.18E+08	-25.7739	59.223	13528400	1.33E+09	19.20127	#NUM!	4.08131	16.4203	21.0104
1992	5.70E+08	-41.7902	59.18	44246600	1.65E+09	20.16038	#NUM!	4.080584	17.60529	21.22495
1993	1.48E+09	-12.456	59.159	75606000	2.05E+09	21.11674	#NUM!	4.080229	18.14105	21.4395
1994	2.45E+09	-5.63447	59.063	1.32E+08	2.54E+09	21.61844	#NUM!	4.078605	18.69826	21.65405
1995	3.29E+09	11.42491	59.02	1.62E+08	3.14E+09	21.91406	2.435796	4.077876	18.90434	21.8686
1996	4.35E+09	23.67049	59.019	2.43E+08	3.75E+09	22.19231	3.164229	4.077859	19.30734	22.04435
1997	5.66E+09	16.97663	59	3.05E+08	4.72E+09	22.4561	2.831838	4.077537	19.53615	22.2748
1998	6.59E+09	12.73931	58.958	3.96E+08	6.12E+09	22.60844	2.544692	4.076825	19.79642	22.53524
1999	8.13E+09	19.1588	58.934	4.78E+08	7.44E+09	22.81876	2.952762	4.076418	19.98449	22.7305
2000	1.12E+10	4.664768	58.906	3.96E+08	9.57E+09	23.13927	1.540038	4.075943	19.79642	22.98153
2001	1.48E+10	16.67746	58.977	9.28E+08	1.26E+10	23.41686	2.814058	4.077148	20.64803	23.25487
2002	1.84E+10	21.61562	59.039	1.24E+09	1.41E+10	23.63817	3.073416	4.078198	20.93539	23.36898
2003	2.32E+10	19.52534	59.104	1.60E+09	1.66E+10	23.8675	2.971713	4.079299	21.19237	23.53071
2004	2.97E+10	9.196934	59.162	2.02E+09	1.82E+10	24.11542	2.21887	4.080279	21.42504	23.62554
2005	3.72E+10	9.909085	59.212	2.40E+09	1.87E+10	24.33929	2.293452	4.081124	21.60004	23.64942
2006	4.60E+10	7.51782	59.283	2.88E+09	2.07E+10	24.55113	2.017276	4.082323	21.7821	23.75478
2007	5.63E+10	5.240871	59.334	3.52E+09	2.03E+10	24.7533	1.656488	4.083182	21.98059	23.73458
2008	6.71E+10	7.613795	59.367	3.91E+09	2.11E+10	24.92928	2.029962	4.083739	22.08686	23.77222

2009	7.73E+10	15.6336 3	59.395	4.42E+ 09	2.34E+ 10	25.07 159	2.7494 25	4.08421	22.2087 8	23.87758
2010	9.72E+10	6.11294 2	59.419	6.42E+ 09	2.90E+ 10	25.30 02	1.8104 08	4.08461 4	22.5834	24.09214
2011	1.14E+11	6.95656	59.372	9.01E+ 09	3.84E+ 10	25.45 972	1.9396 85	4.08382 3	22.9215 8	24.3704
2012	1.31E+11	4.82147 7	59.328	1.02E+ 10	4.17E+ 10	25.60 054	1.5730 8	4.08308 1	23.0450 3	24.45341
2013	1.51E+11	-0.19143	59.267	9.50E+ 09	5.15E+ 10	25.74 274	#NUM!	4.08205 3	22.9740 6	24.66506
2014	1.67E+11	5.81636 8	59.184	1.08E+ 10	5.69E+ 10	25.84 158	1.7606 76	4.08065 1	23.1052 5	24.76481
2015	1.83E+11	6.17921 6	59.071	1.22E+ 10	7.85E+ 10	25.93 483	1.8211 91	4.07874	23.2274 2	25.08631
2016	2.16E+11	1.69392 9	58.953	1.46E+ 10	8.26E+ 10	26.09 9	0.5270 51	4.07674 1	23.4024 4	25.13683
2017	2.46E+11	2.09149	58.806	1.61E+ 10	1.01E+ 11	26.22 962	0.7378 77	4.07424 4	23.5024 8	25.3381
2018	2.75E+11	2.21586 5	58.644	2.02E+ 10	1.06E+ 11	26.34 067	0.7956 43	4.07148 5	23.7292 5	25.38982
2019	3.00E+11	2.46967 4	59.855	2.32E+ 10	1.18E+ 11	26.42 854	0.9040 86	4.09192 5	23.8680 2	25.49363
2020	3.33E+11	-3.89303	61.168	2.89E+ 10	1.07E+ 11	26.53 057	#NUM!	4.11362 4	24.0870 7	25.39875
2021	4.42E+11		60.516	4.21E+ 10	1.39E+ 11	26.81 534	#NUM!	4.10290 8	24.4635 9	25.65592
2022	4.94E+11		59.964		1.33E+ 11	26.92 573	#NUM!	4.09374 4	#NUM!	25.61567

Null Hypothesis: LNGFCF has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=8)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.560934	0.4896
Test critical values:		
1% level	-3.670170	
5% level	-2.963972	
10% level	-2.621007	

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

Null Hypothesis: D(LNGFCF) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=8)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.892820	0.3310
Test critical values:		
1% level	-3.670170	
5% level	-2.963972	
10% level	-2.621007	

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

Null Hypothesis: LNGDP has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic - based on SIC, maxlag=8)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-7.748999	0.0000
Test critical values:		
1% level	-3.653730	
5% level	-2.957110	
10% level	-2.617434	

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

Null Hypothesis:
 LABOR_FORCE_PARTICIPATION_RATE__TOTAL___OF_TOTAL_POPULATION_AGE has a unit root
 Exogenous: Constant
 Lag Length: 4 (Automatic - based on SIC, maxlag=7)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.146127	0.6822
Test critical values:		
1% level	-3.699871	
5% level	-2.976263	
10% level	-2.627420	

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

Null Hypothesis:
 D(LABOR_FORCE_PARTICIPATION_RATE__TOTAL___OF_TOTAL_POPULATION_AGE) has a unit root
 Exogenous: Constant
 Lag Length: 3 (Automatic - based on SIC, maxlag=7)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.263310	0.1903
Test critical values:		
1% level	-3.699871	
5% level	-2.976263	
10% level	-2.627420	

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

Null Hypothesis:
D(LABOR_FORCE_PARTICIPATION_RATE__TOTAL___OF_TOTAL_POPULATION_AGE) has a unit root
Exogenous: None
Lag Length: 3 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.402591	0.0183
Test critical values:	1% level	-2.653401	
	5% level	-1.953858	
	10% level	-1.609571	

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

Null Hypothesis: GROSS_CAPITAL_FORMATION__CURRENT_LCU_ has a unit root
Exogenous: Constant
Lag Length: 8 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		2.337599	0.9999
Test critical values:	1% level	-3.737853	
	5% level	-2.991878	
	10% level	-2.635542	

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

Null Hypothesis: D(GROSS_CAPITAL_FORMATION__CURRENT_LCU_) has a unit root
Exogenous: Constant
Lag Length: 5 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.367805	0.9009
Test critical values:	1% level	-3.711457	
	5% level	-2.981038	
	10% level	-2.629906	

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

Null Hypothesis: REAL_INTEREST_RATE has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.916255	0.0553
Test critical values:		
1% level	-3.670170	
5% level	-2.963972	
10% level	-2.621007	

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

Null Hypothesis: D(REAL_INTEREST_RATE) has a unit root
 Exogenous: Constant
 Lag Length: 7 (Automatic - based on SIC, maxlag=7)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.458340	0.0022
Test critical values:		
1% level	-3.769597	
5% level	-3.004861	
10% level	-2.642242	

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

Null Hypothesis: LN TAXES has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic - based on SIC, maxlag=7)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.576600	0.0123
Test critical values:		
1% level	-3.661661	
5% level	-2.960411	
10% level	-2.619160	

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

Dependent Variable: LNGDP
 Method: ARDL
 Date: 12/01/24 Time: 10:17
 Sample (adjusted): 1995 2020
 Included observations: 26 after adjustments
 Maximum dependent lags: 1 (Automatic selection)
 Model selection method: Akaike info criterion (AIC)
 Dynamic regressors (4 lags, automatic): LN TAXES REAL_INTEREST_RATE
 LABOR_FORCE_PARTICIPATION_RATE_TOTAL_OF_TOTAL_P
 OPULATION_AGE GROSS_CAPITAL_FORMATION_CURRENT_LCU
 —
 Fixed regressors:
 Number of models evaluated: 625
 Selected Model: ARDL(1, 1, 4, 4, 3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
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LNGDP(-1)	1.041992	0.125266	8.318228	0.0000
LN TAXES	0.098031	0.089931	1.090074	0.3040
LN TAXES(-1)	-0.199929	0.079243	-2.522996	0.0326
REAL_INTEREST_RATE	-0.002944	0.002301	-1.279001	0.2329
REAL_INTEREST_RATE(-1)	0.004592	0.001619	2.836870	0.0195
REAL_INTEREST_RATE(-2)	-0.002302	0.001952	-1.179310	0.2685
REAL_INTEREST_RATE(-3)	-0.001855	0.001455	-1.274827	0.2343
REAL_INTEREST_RATE(-4)	0.002418	0.001055	2.291918	0.0476
LABOR_FORCE_PARTICIPATION_RATE__ TOTAL____OF_TOTAL_POPULATION_AGE	-0.030246	0.047979	-0.630394	0.5441
LABOR_FORCE_PARTICIPATION_RATE__ TOTAL____OF_TOTAL_POPULATION_AGE (-1)	0.054107	0.072829	0.742937	0.4765
LABOR_FORCE_PARTICIPATION_RATE__ TOTAL____OF_TOTAL_POPULATION_AGE (-2)	-0.186321	0.382120	-0.487598	0.6375
LABOR_FORCE_PARTICIPATION_RATE__ TOTAL____OF_TOTAL_POPULATION_AGE (-3)	0.924658	0.619199	1.493313	0.1696
LABOR_FORCE_PARTICIPATION_RATE__ TOTAL____OF_TOTAL_POPULATION_AGE (-4)	-0.740010	0.351760	-2.103735	0.0647
GROSS_CAPITAL_FORMATION__CURREN T_LCU_	-2.95E-12	3.12E-12	-0.946107	0.3688
GROSS_CAPITAL_FORMATION__CURREN T_LCU_(-1)	6.17E-12	3.74E-12	1.648823	0.1336
GROSS_CAPITAL_FORMATION__CURREN T_LCU_(-2)	4.03E-12	3.87E-12	1.040632	0.3252
GROSS_CAPITAL_FORMATION__CURREN T_LCU_(-3)	-6.58E-12	4.09E-12	-1.610612	0.1417
R-squared	0.999800	Mean dependent var	24.58921	
Adjusted R-squared	0.999444	S.D. dependent var	1.445839	
S.E. of regression	0.034102	Akaike info criterion	-3.672120	
Sum squared resid	0.010466	Schwarz criterion	-2.849518	
Log likelihood	64.73756	Hannan-Quinn criter.	-3.435241	
Durbin-Watson stat	2.195109			

ARDL Long Run Form and Bounds Test

Dependent Variable: D(LNGDP)

Selected Model: ARDL(1, 1, 4, 4, 3)

Case 1: No Constant and No Trend

Date: 12/01/24 Time: 10:18

Sample: 1990 2022

Included observations: 26

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGDP(-1)*	0.041992	0.125266	0.335226	0.7451
LN TAXES(-1)	-0.101898	0.122928	-0.828921	0.4286
REAL_INTEREST_RATE(-1)	-9.08E-05	0.002834	-0.032018	0.9752
LABOR_FORCE_PARTICIPATION_RATE__ _TOTAL____OF_TOTAL_POPULATION	0.022189	0.011293	1.964833	0.0810

AGE(-1)				
GROSS_CAPITAL_FORMATION_CURR				
ENT_LCU_(-1)	6.67E-13	1.42E-12	0.468197	0.6508
D(LN TAXES)	0.098031	0.089931	1.090074	0.3040
D(REAL_INTEREST_RATE)	-0.002944	0.002301	-1.279001	0.2329
D(REAL_INTEREST_RATE(-1))	0.001739	0.001418	1.226108	0.2513
D(REAL_INTEREST_RATE(-2))	-0.000563	0.001157	-0.486617	0.6382
D(REAL_INTEREST_RATE(-3))	-0.002418	0.001055	-2.291918	0.0476
D(LABOR_FORCE_PARTICIPATION_RA				
TE_TOTAL___OF_TOTAL_POPULATI				
ON_AGE)	-0.030246	0.047979	-0.630394	0.5441
D(LABOR_FORCE_PARTICIPATION_RA				
TE_TOTAL___OF_TOTAL_POPULATI				
ON_AGE(-1))	0.001673	0.061159	0.027350	0.9788
D(LABOR_FORCE_PARTICIPATION_RA				
TE_TOTAL___OF_TOTAL_POPULATI				
ON_AGE(-2))	-0.184648	0.396526	-0.465665	0.6525
D(LABOR_FORCE_PARTICIPATION_RA				
TE_TOTAL___OF_TOTAL_POPULATI				
ON_AGE(-3))	0.740010	0.351760	2.103735	0.0647
D(GROSS_CAPITAL_FORMATION_CU				
RRENT_LCU_)	-2.95E-12	3.12E-12	-0.946107	0.3688
D(GROSS_CAPITAL_FORMATION_CU				
RRENT_LCU_(-1))	2.55E-12	4.42E-12	0.577336	0.5779
D(GROSS_CAPITAL_FORMATION_CU				
RRENT_LCU_(-2))	6.58E-12	4.09E-12	1.610612	0.1417

Levels Equation
Case 1: No Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN TAXES	2.426575	4.409183	0.550346	0.5955
REAL_INTEREST_RATE	0.002161	0.068277	0.031654	0.9754
LABOR_FORCE_PARTICIPATION_RATE_TOTAL___OF_TOTAL_POPULATION_AGE	-0.528397	1.768424	-0.298796	0.7719
GROSS_CAPITAL_FORMATION_CURRENT_LCU_	-1.59E-11	6.28E-11	-0.253039	0.8059

$$EC = \text{LN GDP} - (2.4266 * \text{LN TAXES} + 0.0022 * \text{REAL_INTEREST_RATE} - 0.5284 * \text{LABOR_FORCE_PARTICIPATION_RATE_TOTAL_OF_TOTAL_POPULATION_AGE} - 0.0000 * \text{GROSS_CAPITAL_FORMATION_CURRENT_LCU_})$$

F-Bounds Test

Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)	
F-statistic k	36.38494 4	Asymptotic: n=1000	10%	1.9	3.01
		5%	2.26	3.48	
		2.5%	2.62	3.9	
		1%	3.07	4.44	
		Finite Sample: n=35	10%	-1	-1
Actual Sample Size	26	5%	-1	-1	
		1%	-1	-1	
		Finite Sample: n=30	10%	-1	-1
		5%	-1	-1	
		1%	-1	-1	

t-Bounds Test

Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
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t-statistic	0.335226	10%	-1.62	-3.26
		5%	-1.95	-3.6
		2.5%	-2.24	-3.89
		1%	-2.58	-4.23

F-Bounds Test Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	36.38494	10%	1.9	3.01
k	4	5%	2.26	3.48
		2.5%	2.62	3.9
		1%	3.07	4.44
			Finite Sample: n=35	
Actual Sample Size	26	10%	-1	-1
		5%	-1	-1
		1%	-1	-1
			Finite Sample: n=30	
		10%	-1	-1
		5%	-1	-1
		1%	-1	-1

t-Bounds Test Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
t-statistic	0.335226	10%	-1.62	-3.26
		5%	-1.95	-3.6
		2.5%	-2.24	-3.89
		1%	-2.58	-4.23

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	5.844608	Prob. F(2,7)	0.0322
Obs*R-squared	16.26176	Prob. Chi-Square(2)	0.0003

19.47%

SIMILARITY OVERALL

7.56%


POTENTIALLY AI

SCANNED ON: 20 JAN 2025, 12:38 PM

Similarity report

Your text is highlighted according to the matched content in the results above.


 **IDENTICAL**
0.49%

 **CHANGED TEXT**
18.97%

AI Detector Results

Highlighted sentences with the lowest perplexity, most likely generated by AI.

 **LIKELY AI**
5.28%

 **HIGHLY LIKELY AI**
2.28%

Report #24477941