THE IMPACT OF INCOME TAXATION ON ECONOMIC GROWTH IN ZAMBIA (1995 – 2015)

BY

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DECLARATION

I hereby solemnly declare that this thesis represents my own work and that it has not been previously submitted for a degree to this or any other University.

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Joreen Chanda Nkole

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ABBREVIATIONS AND ACRONYMS

ADF	Augmented Dickey Fuller
ARDL	Autoregressive Distributive Lag
BOZ	Bank of Zambia
CTAX	Corporate Income Tax
CSO	Central Statistics Office
EXCH	Exchange Rate
ERT	Extractive Royalty Tax
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
IRF	Impulse Response Functions
JCTR	Jesuit Centre of Theological Reflection
KPSS	Kwiatkowski–Phillips–Schmidt–Shin
OECD	Organization for Economic Co-operation and Development
PAYE	Pay As You Earn
UCP	Unique Campaign Proposition
VAT	Value Added Tax
VAR	Vector Auto Regressive
ZRA	Zambia Revenue Authority

ABSTRACT

This study examines the impact of income taxation (corporate income tax, extractive royalty tax, and pay-as-you-earn) on economic growth in Zambia over the period 1995 to 2015. The study applied a vector error correction model (VECM). The study found that corporate income and pay-as-you earn taxation had no significant impact on economic growth in the short-run. However, extractive royalty taxation was retrogressive to economic growth in the short-run. The study also found that pay-as-you earn and extractive royalty taxation had a significant negative impact on economic growth in the long run. Furthermore, economic growth was found to respond to changes pay-as-you-earn and extractive royalty taxation with a lag, over a number of years. The findings of this study suggest that policymakers should come up with an optimal taxation structure in which taxation of income is not excessive. This is because excessive taxation of income can reduce economic agents' incentives to save, invest, and work.

Key words: Income taxation, economic growth, VECM, Zambia.

CHAPTER ONE: INTRODUCTION

1.1 Background

Tax revenue is an important determinant of economic growth. Taxes can affect economic growth through several channels. For example, taxation can stifle economic growth by reducing the rate of growth of labour and capital as well as their productivity (Engen and Skinner, 1996). Empirical evidence from around the world on the impact of taxation on economic growth is mixed. Some scholars find that taxation has a positive impact on economic growth (Okafor, 2012; Takumah, 2014; Adejare, 2015) while others find that it stifles economic growth (Lee and Gordon, 2004; OECD, 2012; Okoi and Edame, 2014).

Taxation has many objectives that render it important to economic growth. The main reason for taxation is to finance government expenditure and to redistribute wealth, which translates to financing development of the country. In addition to this objective, taxation helps to raise money for the provision of services such as defence, health services, education etc. It also helps redistribute income and wealth, that is the rich pay more tax than the poor and to discourage the consumption of harmful goods such as alcohol and cigarettes. Taxes help to harmonize diverse trade or economic objectives of different countries to provide for the free movement of goods and service's capital and people between member state (Feld and Kirchgassner, 2001). Adina (2009) argues that, for the management of the economy, taxation is important in the planning, savings and investment. Furthermore, taxation can be used to achieve specific objectives of a nation.

According to Kormendi (2005), primarily, a country's tax system must provide sufficient funds for government expenditure programs. However, the means of attaining this basic requirement to get a sufficient level of taxation matters a lot. This mainly relates to the structure and productivity of the tax system. A productive and well-structured tax system should espouse two basic principles: it should minimize the distortion caused by taxation as economic agents attempt to limit their tax liability (the principle of 'efficiency') and extract tax without disadvantaging or discriminating against any taxpayer (the principle of 'equity').

Zambia undertook major tax reforms in the mid-1990s as part of a broader economic liberalization program. An independent taxation authority was established, tariffs were dramatically reduced and a value-added tax (VAT) was introduced. The Zambia Revenue

Authority (ZRA) was established in 1994 to collect direct taxes (income tax), indirect taxes (excise tax, VAT, property-transfer tax), customs and the mineral-royalty tax for the Zambian government. For revenue improvement purposes, there was the abolition of sales tax and its replacement by VAT in 1995 (DiJohn, 2010). There have been continued changes in the country's tax system to improve revenue collection and ease tax burden. For example, in 2011 the government assured the international monetary fund (IMF) that fiscal policy will focus on creating space to facilitate spending on infrastructure and the social sector and also undertake a comprehensive reform on tax policy to ease the tax burden on personal income tax payers (JCTR, 2011).

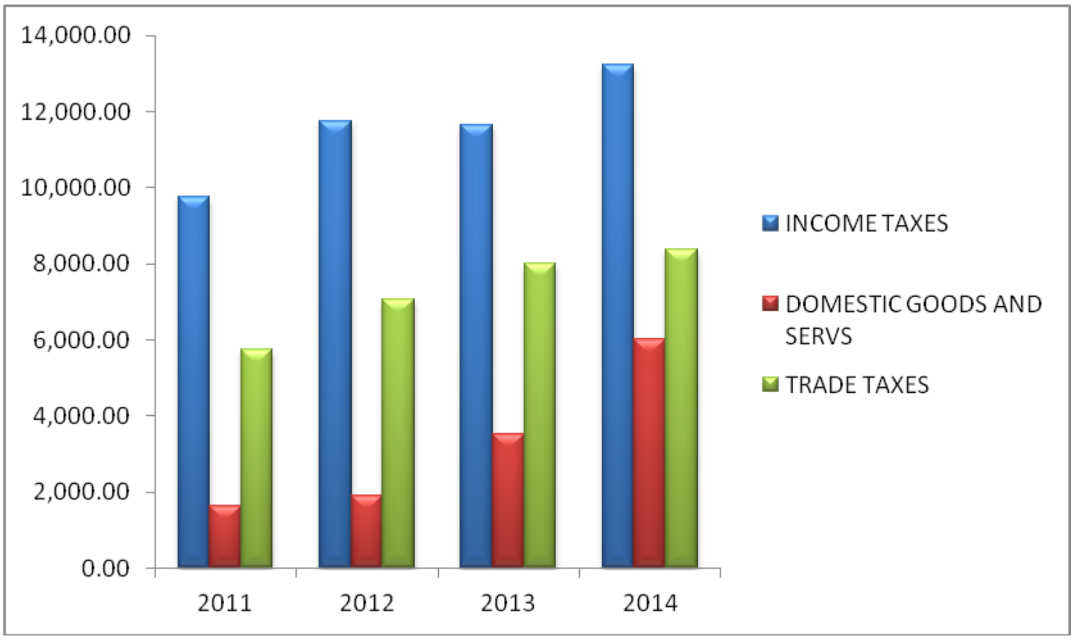
Zambian taxes are broadly categorised into three groups as follows: income taxes, consumption taxes and trade taxes. In Zambia, tax revenue is a major component of the government budget, and is expected to finance up to 68.5% of the 2018 national budget (GRZ, 2017). Other revenues that Government mobilises to supplement tax revenue come from funding from external donors through budgetary support, Foreign Direct Investment (FDI), and debt provision. The political, economic and social development of any country depends ultimately on the amount of revenue generated for financing infrastructure development and the provision of other social amenities in any given country (Mwansa and Chileshe, 2010).

Presently, Zambia's Personal Income Tax (PIT) system is not equitable. This may have a significant impact on how the tax structure affects key macroeconomic variables such as economic growth. For example, too much of the burden is on low- and middle-income individuals, and less on high-income individuals. Two main issues have given rise to this situation. Firstly, there is a lack of wealth taxation within the country, as discussed earlier, and consequently about 98 percent of all PIT revenue in 2011 came from PAYE (JCTR, 2011). Income from capital, such as property or shares is not efficiently and effectively taxed. Since wealthy individuals derive much of their income from these assets rather than from salaries, the PIT system is regressive, resulting in taxing the middle-class more than the high-class. Secondly, PAYE deductions favour high-income individuals. Deductions could be made on PAYE from mortgage interest, pension and saving fund payments. However, these sort of payments are mainly made by the well off, since few can afford mortgages or structured savings plans (JCTR, 2011).

In Zambia, government often times introduces tax incentives and instruments to attract and retain local and foreign investors. For example, in the manufacturing sector, there is refund of VAT on export of Zambian products by non-resident businesses under the commercial exporter's scheme, guaranteed input tax claim for two years prior to commencement of production and the suspension of import duty on machinery, equipment and other capital goods . In the agriculture sector, there is no import duty on irrigation equipment and reduced duty rates on imports of other farming equipment and an income tax at reduced rate of 10% (JCTR, 2011). The mining sector is guaranteed input tax claim for seven years on pre-production expenditure for exploration companies and 100% mining deduction on capital expenditure on buildings, railway lines, equipment, shaft sinking or any similar works (JCTR, 2011).

A government uses tax proceeds to be able to perform its traditional functions, such as provisions of public goods, maintenance of law and order, defence against external aggression, regulation of trade and business to ensure social and economic maintenance. Musgrave and Musgrave (1989) stated that economic effects of tax include micro effects on the distribution of income and efficiency of resources use as well as macro effect on the level of capacity output, employment, prices and growth. Furthermore, Marc and Hall (2006) states that taxes are imposed to regulate the production of certain goods and services, protection of infant industries, control business and curb inflation, reduce income inequalities and so on.

This paper focuses on income taxes in Zambia and on how they affect economic growth. In Zambia, income taxes comprise of corporate income tax (CTAX), pay-as-you-earn (PAYE), mineral royalties and withholding tax (WHT). The Income Tax Act in Zambia requires every economic agent (business entity, enterprise or individual) receiving an income to pay taxes; and should notify ZRA in writing accordingly within 30 days from the first date of receiving such an income (National Assembly of Zambia, 2017). Income taxes continued to be the major source of revenue accounting for more than 50 percent of the total tax collections in the last four years in Zambia (figure 1). The trend analysis of tax type contributions to total tax revenue is a useful tool for long term tax planning. Figure 1 below shows the contribution of different taxes to the total revenue in Zambia.



Source: ZRA database

Figure 1: Contribution of Income Taxes to Total Tax Revenue, 2011-2014

The above graph shows that in the last four years' income taxes have contributed to government revenue more than the other types of taxes. This can be attributed to the fact that income taxes are easier to administer and they capture the ability to pay. Companies and individuals are required by law to make self-assessments and submit tax to the government at regular intervals (Mulenga, 2005). The dependence on income taxes to provide most of the revenues needs to be assessed for long-term sustainability of revenue flows. Some scholars suggest that it is better to rely more on consumption taxes as these are more broad - based. The tax base of the consumption taxes is therefore much broader than income taxes like PAYE and company tax, which are paid by a limited section of the population. External shocks have less impact on a broader base compared to a narrower base (Bahl and Bird, 2008).

Thus, taxation plays a pivotal role in promoting investment and accelerating economic growth. A fair assessment would conclude that well designed tax policies have the potential to raise economic growth, but there are many obstacles along the way and certainly no guarantee that all tax changes will improve economic performance.

For example, the high tax rate on selected goods or industries in Zambia has had an adverse effect on GDP. As tax rate rises, individuals get to keep less and less of their additional earnings. It discourages work effort, as taxes reduce the amount of additional earnings that one is permitted to keep. It also distorts price signals and encourages individuals to substitute less desired but tax-deductible goods for non-deductible ones that are more desired. A high tax rate will reduce the incentives for people to invest in both physical and human capital. When tax rates are high foreign investors will look for other places to put their money and domestic investment will look for investment projects abroad were taxes are low. This therefore contributes to a reduction in GDP (OECD, 2012).

In addition, OECD (2012) has attributed the lapse in poor investment growth and low contribution to GDP of Zambia's manufacturing sector to a persistent increase in high and multiple taxation. Corporate taxes might reduce investment in manufacturing because most manufacturing firms operate in the formal sector, but shift activity from the formal to the informal sector in services, where informality is more prevalent (Davis and Henrekson, 2004). Tax revenue from the mining sector has in recent years been increasing due to increased mining activities, increased production and favourable metal prices. The mining industry in Zambia contributes not more than 8% of the total formal employment (ICMM, 2014). While this is important, the potential contribution to tax revenues is much higher. However, for Zambia, protecting mining employment at the expense of tax revenue is not advisable. The mining revenue can be used to spur more economic growth and may create higher levels of employment (ICMM, 2014).

1.2 Statement of the problem

Income tax is tool to achieve economic growth in any country. Of all the different types of taxes, income tax plays a major role in generation of revenue and distribution of income in any country. In Zambia, it makes over 50% of the total revenue (JCTR, 2011). Financing public expenditure through taxes reduces debt burden, promotes economic growth and protects sovereignty of a country. If income taxation is poorly designed, it may lead to fiscal imbalance, insufficient tax revenue and distortions in resource allocation that can reduce economic welfare and growth (World Bank, 1991). Hence, an ideal tax system would achieve a balance between resource allocation, income distribution and economic stabilization (Lewis, 1984).

The income tax administration system in Zambia faces several challenges. Among them is the fact that there is a large informal cash economy, low taxpayer compliance and complexities associated with taxation of international transactions. In addition, there is poor traceability of taxpayers and inadequate funding to Zambia Revenue Authority (ZRA) for infrastructural and technological development. PAYE mainly drives income tax contribution. The prominence of PAYE within income tax has the potential to cause efficiency and equity problems for certain classes of people in society (Sloan, 2013). Based on this backdrop, the Zambian tax system therefore should promote the following but not limited to: optimum allocation of available resources, enable government raise adequate revenue, encourage savings and investment, acceleration of economic growth, price stability and efficient control mechanism.

According to the researcher's best knowledge, no empirical, econometric study has been conducted in Zambia on the effect of taxation on economic growth in Zambia. However, several studies have looked at the reverse relationship: the impact of economic growth on tax revenue. For example, a ZRA study, cited in JCTR (2011) used annual time series data to estimate the elasticity and buoyancy of tax revenue with respect to economic growth. Studies that have analysed the effect of taxation on economic growth in Zambia are largely descriptive. An example is JCTR (2011). Given evidence that seems to show a negative correlation between income taxation and economic growth across at least 25 countries (OECD, 2012), it is important to conduct an econometric investigation of the impact of income taxation on economic growth in Zambia.

1.3 Objectives of the study

1.3.1 General Objective

The primary focus of this study was to establish the effect of income taxation on economic growth over the period of 1995-2015. In order to achieve this, the specific objectives of this study are given below.

1.3.2 Specific Objectives

- To analyse the trends in income tax revenue and economic performance over the study period.

- To determine the impact of corporate income tax revenue on economic growth in Zambia.

- To determine the impact of extractive royalty tax revenue on economic growth in Zambia.

- To determine the impact of pay-as-you-earn tax revenue on economic growth in Zambia.

- To determine the impact of withholding tax revenue on economic growth in Zambia.

1.4 Research Hypothesis

The general propositions of this study are as follows:

H_0: Corporate income tax revenue has no impact on economic growth in Zambia.

H_1 : Corporate income tax revenue has a statistically significant (negative) impact on economic growth in Zambia.

H_0: Extractive royalty tax revenue has no impact on economic growth in Zambia.

H_1 : Extractive royalty tax revenue has a statistically significant (negative) impact on economic growth in Zambia.

H_0: Pay-as-you-earn tax revenue tax has no impact on economic growth in Zambia.

H_1 : Pay-as-you-earn tax revenue tax has a statistically significant (negative) impact on economic growth in Zambia.

H_0: Withholding tax revenue has no impact on economic growth in Zambia.

H_1 : Withholding tax revenue has a statistically significant (negative) impact on economic growth in Zambia.

The hypotheses above show that all four types of (income) taxes under study have a negative impact on economic growth. According to Engen and Skinner (1996), taxation can reduce economic growth based on five related pathways. First, taxation reduces the growth rate of capital stock. Secondly, taxation reduces the growth rate of effective labour. Third, taxation may reduce productivity growth. Fourth, taxation may divert the allocation from efficient to less efficient sectors. Fifth, taxation of high social productivity sectors may discourage workers from working in such sectors.

1.5 Justification of the Study

Income taxation is not only a means of raising the required public revenue, but also as an essential fiscal instrument for managing the economy (Burgess, 1993). The contribution of income taxes to Zambia's revenue is significant and makes up over 50% of total revenue. It is therefore important to study how changes in the income tax structures can affect economic growth, as this will help policy makers in planning and decision-making.

For Zambia, income tax is evidently important because it generated more revenues than VAT in both 2007/08 and 2008/09. A recurring problem with income taxes is the non-compliance of employers to register their employees and to remit such taxes to the relevant authorities. Further, capital income, predominantly earned by relatively wealthy individuals, either faces low effective rates or escapes taxation altogether. In Zambia, for instance, there is no tax on capital gains (Fjeldstad and Heggstad, 2011).

In addition, there is also an increasing need for governments to mobilize their own internal resources to meet public expenditure. Broadening the tax base is important, both for the sake of increasing tax revenue and for good tax governance. This includes finding more effective ways to tax the informal sector and hindering illicit capital flows out of the country (IMF, 2011).

1.6 Limitations of the Study

A key limitation of this study is the use of tax revenue to examine the effect of taxation on economic growth. The study would have benefited from using marginal tax rates to investigate the effect of taxation on economic growth in Zambia. However, given the lack of consistent and comprehensive data coupled with the absence of significant (and frequent) tax reforms implies that marginal tax rates could not be incorporated in the study. Nevertheless, using the tax revenue variable will yield important insights into the effect of taxation on economic growth.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Literature gives differing views on the effect of income taxes on economic performance. Governments use fiscal policy to control the level of activity in the economy. Fiscal policy is the use of taxes and government spending by the state to control the economy (Truett and Truett, 1987). Debate on whether taxes impact negatively or positively on the economy remains inconclusive. The direction of their relationship also remains unclear. Most empirical studies on taxation and economic performance are carried out on a cross-country level. This section discusses the theoretical and empirical literature.

2.2 Theoretical Literature

The importance of taxation for economic growth has been the subject of discussion over many generations. Adam Smith (1776) in *The Wealth of Nations* recognized the important role of taxes in the economy and gave the characteristics of a good tax system (Canons of Taxation) as certainty, equity, convenience and economy. (Musgrave and Musgrave, 1989) defined a good tax structure as one that yields adequate revenue, is equitable, causes minimal distortion and facilitates stabilization and growth. Keynes (1936) advocated for government intervention in the economy. Keynesian economics support the fact that the aggregate demand influences the level of output in the economy. The government through fiscal policies can influence aggregate demand in the economy.

According to Renelt (1991), the sources of economic growth have been explained in growth models such as the neo-classical growth model and endogenous growth models. Effect of taxes on growth has been incorporated in many growth models including the neo-classical economic growth models, which state that growth is not influenced by policy decisions. The Solow neo-classical growth model suggests that taxes affect only the level of income but not the rate of economic growth (Solow, 1956). Changes in taxation will only cause temporary changes, during the period of transition to steady states. Once steady state is achieved, only technical progress will influence economic growth.

However, endogenous growth models do not support Solow's assumption that growth is only influenced by technical progress. Endogenous growth models allow the growth rate to be determined within the model; growth is influenced by economic policy. Therefore, in this growth model, taxes affect the long run growth rate, through accumulation of physical and human capital (Renelt, 1991).

According to modern economic theory, the economy grows through capital formation, which comes from resource mobilization. Taxes on the resources will discourage production, hence capital formation thereby hurting the economy. Taxes affect capacity output through work effort, private sector savings and private investment (Musgrave and Musgrave, 1989). Mintz and Wilson (2000) find that productivity of factors influence growth. Taxes can reduce this productivity in various ways. Taxes distort economic decisions resulting in inefficient use of resources. Taxes also reduce the incentive to work and to improve work skills. Taxes may also discourage innovations and adoption of new ideas, since more productivity will increase tax liability and people want to reduce their tax liability as much as possible.

High taxes may result in capital flight. Resources will shift from countries with high taxes to lower tax countries. High corporate taxes lower the rate of return thus discouraging investment hence deterring economic growth. High personal income taxes will discourage savings, which will reduce human capital formation hence impeding growth. (Leibfritz et al, 1997) support the view that taxes affect economic growth through its distortionary effects on savings, physical and human capital formation and labor supply.

Engen and Skinner (1996), inspired by Solow (1956), develop a simple model of economic growth in which they seek to explain the expected effect of taxation on economic growth. Specifically, let $\dot{y}_i$ be the growth rate of real GDP. They argue that economic growth can be decomposed into different components as follows:

$$\dot{y}_i = \alpha_i \dot{k}_i + \beta_i \dot{m}_i + u_i$$

where $\dot{k}_i$ is the growth rate of capital stock, $\dot{m}_i$ is the growth rate of effective labour, and u_i is the overall productivity growth in country i. The coefficient α_i is the marginal productivity of capital and β_i is the output elasticity of the labour force.

The above theoretical framework can be used to explain how taxes influence economic growth in five ways. Firstly, higher taxes reduce economic growth by reducing the growth rate of capital stock $\dot{k}_i$. Secondly, higher taxes reduce economic growth by the growth rate of effective labour $\dot{m}_i$. This is because higher taxes reduce desired labour force participation, and the incentive to invest in education and training. Thirdly, higher taxes could reduce productivity growth u_i by discouraging firms' investment in research and development (R&D). Consequently, this discourages investments in activities that might enhance the productivity of both capital and labour.

Fourth, higher taxes can distort the allocation of resources from more efficient to less efficient sectors, a point also stressed by (Harberger, 1962). Lastly, high taxes on labour can discourage workers from seeking employment in high social productivity, but highly taxed sectors. This implies an inefficient use of human capital.

2.3 Empirical Literature

Gale (2014) writes that policy makers and researchers have long been interested in how potential changes to the income tax system affect the size of the overall economy. Their meta-analysis of recent evidence also showed that tax rate cuts may encourage individuals to work, save, and invest, but if the tax cuts are not financed by immediate spending cuts they will likely also result in an increased federal budget deficit, which in the long-term will reduce national saving and raise interest rates (which are detrimental to economic growth). Specifically, they observed that a 1% decrease in taxes increased economic growth by between one and two percentage points.

Easterly and Rebelo (1993), using historical data, cross-sectional data, and constructed public investment theories found that the effects of taxation on economic growth is empirically mixed. Specifically, they state that some taxes are more distortionary than others as different taxes have more or less stable tax bases. For instance, high corporate tax rates are often assumed to be more harmful for economic activities than taxation of property. Corporate tax reforms and corporate tax systems designed to minimize economic distortions can help promote an efficient economy. Generally, tax systems that impose large tax rates on broad tax bases limit tax-induced distortions in economic activity. Broadly, the corporate tax system distorts the allocation of capital across economic sectors. The corporate tax may reduce economic efficiency to the extent that it causes a misallocation of capital between corporate and non corporate business forms (Keightley, 2014).

Parker and Hseih (2007) in a study conducted in Chile argued that taxation of retained profits is particularly distortionary in an economy with good growth prospects and poorly developed financial markets because it primarily reduces the investment of financially constrained firms, investment that has marginal product greater than the after-tax market real interest rate. Contrarily, taxes on distributed profits or capital gains primarily reduce the investment of financially unconstrained firms. Chile experienced a banking crisis over the period from 1982 to 1986 and in 1984 reduced its tax rate on retained profits from 50 percent to 10 percent. Thereafter there was a large increase in aggregate investment and economic growth. Particularly, investment increased by between 10 percent and 18 percent of GDP.

Takumah (2014) used a VAR VECM framework to investigate the effect of taxation on economic growth in Ghana. The study used quarterly data from 1986 to 2010. The study found that taxation has a significant positive impact on economic growth in both the short- and long-run. In the long run, it was found that a 1% increase in overall tax revenue led to a 0.64% increase in GDP. The government should therefore generate more tax revenue in order to increase economic growth in Ghana.

Adejare (2015) empirically analyses the effect of corporate tax on revenue profile in Nigeria and also examines the impact of corporate tax revenue on economic growth in Nigeria. Secondary data were obtained from Central Bank of Nigeria Statistical Bulletin from 1993 to 2013. Multiple regression analysis was employed to analyse the relationship between the dependent variable (Gross Domestic Product (GDP)) and independent variables (company income tax, value added tax, petroleum profit tax and inflation). It was found that only value added tax and corporate income tax had a significant impact on economic growth. In particular, a 1% increase in value added tax revenue led to a 1.22% increase in GDP while a 1% increase in corporate income tax led to a 1.38% increase in economic growth. It is recommended that government should reduce corporate tax rate rather than eliminate corporate tax in Nigeria, lower corporation tax will increase the demand for labour that in turn raises wages and increases consumption. Therefore, a reduction in the corporation tax rate will reduce the incentives to shift profits out, protecting the Corporation Tax base. Tax reductions will also increase the level of investment in the country. Furthermore, other assistance should be provided for corporations by the government to cushion the effect of corporate tax rate on the payers in Nigeria.

Okafor (2012) investigated the impact of income tax revenue on the economic growth (proxied by the growth in gross domestic product (GDP)) of Nigeria. The study used annual data and adopted the ordinary least square (OLS) regression analysis technique to explore the relationship between the GDP (the dependent variable) and a set of federal government income tax revenue heads over the period 1981-2007. The regression result indicated a very positive and significant relationship between the components of income tax revenue (namely personal income tax, corporate income tax and petroleum profit tax) and the growth of the Nigerian economy. For example, a 1% increase in corporate income tax was associated with a 0.383% increase in economic growth.

Lee and Gordon (2004) in their paper, "*Tax structure and economic growth*" conducted in South Korea explore how tax policies affect a country's growth rate, using cross-country data during 1970–1997. The method of analysis used was ordinary least squares regression (cross sectional growth regression). Their findings revealed that statutory corporate tax rates are significantly negatively correlated with cross-sectional differences in average economic growth rates, controlling for various other determinants of economic growth, and other standard tax variables. In the fixed-effect regressions, increases in corporate tax rates lead to lower future growth rates within countries. The coefficient estimates suggest that a cut in the corporate income tax rate by 10 percentage points will raise the annual growth rate by one to two percentage points.

OECD (2012) conducted a study on 25 OECD countries and the objective of this study was to analyse how income tax influences economic growth. More precisely how statutory tax rates on corporate and personal income tax affect growth by using panel data from 1975-2010. They found that taxation of both corporate and personal income taxation negatively influences economic growth. The correlation between corporate income tax and economic growth is more robust, however. Earlier studies revealed that there would be higher economic development if income tax rates were high, more so in developed nations. The higher tax rates lead to increase in the total tax revenue, total revenue of the country and there will be direct positive effect in boosting the GDP. One should also seriously think whether the boosting of tax revenue, total revenue and GDP of the country is in terms of nominal value of money and real value after inflation adjustment.

Edame and Okoi (2014) examined the impact of income tax on investment and economic growth in Nigeria from 1980-2010. The ordinary least squares method of multiple regression analysis was used to analyze the data. The annual data were sourced from the central bank of Nigeria statistical bulletin and NBS. The parameter estimates of corporate income tax (CTAX) and personal income tax (PIT) had negative signs, this means that an inverse relationship exists between income taxation and investment. The economic implication of the result is that a one percent (1%) increase in CTAX will result in decrease in the level of investment in Nigeria; leading to a 0.24% decrease in GDP. Consequently, an increase in PIT will result in decrease in the level of investment. Finally, the result therefore showed that income tax is negatively related to the level of investment and the output of goods and services (GDP) and is positively related to government expenditure in Nigeria. In addition, it was also observed that income taxation statistically is significant factor influencing investment, GDP and government expenditure in Nigeria. Based on the result of these findings, it was recommended that the government of Nigeria should use taxation to achieve its set target that will enhance economic growth and development.

2.4 Summary of the Empirical Literature Review

The debate on the impact of taxes on the economy has gone on through the years without reaching a consensus. While most theoretical literature identifies fiscal policy particularly taxes as a driver of economic growth and development (Musgrave and Musgrave, 1989), the existing empirical literature fails to give a definite direction on how taxes influence the economy. The direction of the effect of taxation on economic growth is not clear across the various empirical literature reviewed; hence, the need to do a formal investigate for the case of Zambia.

From the above review of empirical evidence, several studies have investigated the effect of taxation on economic growth in Kenya, Chile, Ghana, Nigeria, South Korea, and several OECD countries. This study significantly contributes to understanding the effect of taxation on economic growth in the Zambian context. According to the researcher's best knowledge, there is no empirical study has been conducted on the effect of taxation on economic growth in Zambia. However, a ZRA study conducted for the period 1973 to 2005, cited in JCTR (2011), estimated the buoyancy and elasticity of income tax and the effect of economic growth on tax revenue but not the reverse relationship. They found that a one percent rise in economic growth would result in more than one percent increase in tax revenue (JCTR, 2011).

A strength of the reviewed literature is the mix of econometric methodologies that have been applied to the study of the effect of taxation on economic growth. The reviewed empirical studies an array of estimation techniques such as ordinary least squares (OLS) estimation (Lee and Gordon, 2004; Okafor, 2012; Adejare, 2015), and panel regression (OECD, 2012). Table 1 below shows that the results of the effect of taxation on economic growth are hardly driven by the estimation technique adopted. For example, two out of four reviewed studies that adopted OLS regression found that corporate and personal income taxation has a positive effect on economic growth while the other two found that income taxation has a significant negative impact on economic growth. In addition, two other studies that adopted a VECM methodology and panel data models respectively show mixed results.

Table 1: Summary of Empirical Literature Review

Author	**Data Type**	**Methodology**	**Key Findings**
Okafor (2012)	Annual Data 1981-2007	Ordinary least squares regression	Positive significant relationship between income tax and GDP
Adejare (2015)	Secondary annual data 1993-2013	Multiple regression analysis	Corporate income tax and value added tax have a positive impact on revenue profile in Nigeria
Lee and Gordon (2004)	Cross Country Data 1970-1997	Ordinary least squares regression (cross sectional growth regression)	Negative correlation between corporate tax and average economic growth
OECD (2012)	Panel Data 1975-2010	Panel Regression	Personal income taxes and corporate income taxes both negatively influence economic growth
Okoi and Edame (2014)	Annual Data 1980-2010	Ordinary Least Squares regression	Inverse relationship between income tax, investment and economic growth
Takumah (2014)	Quarterly data; 1986 to 2010	VAR VECM framework	Taxation has a positive impact on economic growth.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

This chapter presents the research methodology for this study. It is divided into four parts. Part one gives the empirical model specification. Part two describes the variables to be used for the study. Part three highlights the data types and sources. The last part outlines the estimation procedure.

3.2 Empirical Model Specification

The study made use of the Vector Error Correction Model (VECM) to estimate the various components of income taxation to economic growth, similar to the study done by Takumah (2014). Gross fixed capital formation (GFCF) and the size of the labour force (LF) have been included to the growth model in line with a growth model suggested by Engen and Skinner (1996). A Vector Error Correction Model (VECM) helps to determine the short- and long-run effects of a particular relationship; and allows us to estimate the speed of adjustment of variables to their long-run equilibrium levels (Anguyo, 2008; Asteriou and Hall, 2011). The system of equations to be estimated is given below:

$$\Delta lr\_gdp_t = \sum_{j=1}^{k} \beta_j \Delta lr\_gdp_{t-j} + \sum_{j=1}^{k} \alpha_j \Delta lr\_ctax_{t-j} + \sum_{j=1}^{k} \alpha_j \Delta lr\_ert_{t-j} + \sum_{j=1}^{k} \alpha_j \Delta lr\_paye_{t-j} + \sum_{j=1}^{k} \alpha_j \Delta lr\_wtht_{t-j} + \sum_{j=1}^{k} \alpha_j \Delta lr\_gfcf_{t-j} + \sum_{j=1}^{k} \alpha_{j\Delta} lr\_lf_{t-j} + \Delta\mu_{1t}$$

(1)

Where Δ is the first difference operator, lr_gdp_t is the natural logarithm of the real Gross Domestic Product (GDP),lr_ctax_t is the natural logarithm of the real corporate income tax,lr_paye_t is the natural logarithm of the real pay-as-you-earn,lr_wtht_t is the natural logarithm of the real withholding tax, lr_ert_t is natural logarithm of the extractive royalty tax, $lr\_ gfcf$ is the natural logarithm of gross fixed capital formation, lr_lf is the natural logarithm of the labour force, and µ is the error term.

To identify the structural shocks, the variables of interest were appropriately ordered. The order of the variables, based on the transmission mechanism, from the first to the last, was as follows:lr_gdp_t, lr_ctax_t, lr_ert_t, lr_paye_t and lr_wtht_t.

As a robustness check, an autoregressive distributive lag (ARDL) model was used to estimate the short- and long-run relationships among the variables. This model is run for a number of reasons. Firstly, it is ideal for a study with a relatively small sample size, such as this one. Secondly, it works even when the variables have different orders of integration. A caution, however, is that it cannot be used if some variables have an order of integration of more than one (Pesaran et al., 2001). Thirdly, using a single-equation cointegration method, the ARDL model gives unrestricted short- and long-run coefficients for the variables. The estimated equation is summarised below:

$$lr\_gdp_t = \beta_0 + \mu_0 lr\_wtht_t + \mu_1 lr\_wtht_{t-1} + \dots \mu_m lr\_wtht_{t-m} + \beta_1 lr\_gdp_{t-1} + \dots\dots\dots + \beta_p lr\_gdp_{t-p} + \alpha_0 lr\_ctax_t + \alpha_1 lr\_ctax_{t-1} + \dots\dots\dots + \alpha_q lr\_ctax_{t-q} + \delta_0 lr\_ert_t + \delta_1 lr\_ert_{t-1} + \dots\dots + \delta_r lr\_ert_{t-r} + \gamma_0 lr\_paye_t + \gamma_1 lr\_paye_{t-1} + \dots\dots\dots + \gamma_s lr\_paye_{t-s} + \alpha_{0a} lr\_gfcf_t + \dots + \alpha_u lr\_gfcf_{t-u} + \alpha_{0b} lr\_gfcf_t + \dots + \alpha_v lr\_gfcf_{t-v} + + \varepsilon_t \quad (2)$$

where lr_gdp_t, lr_ctax_t, lr_ert_t, lr_paye_t lr_wtht_t. lr_gfcf_t and lr_lf_t are as defined earlier; m, p, q, r, s, u and v are optimal lag lengths of corresponding variables; μ_0, α_0, δ_0, γ_0, α_{0a} and α_{0b} are the long-run coefficients while all other coefficients represent the short-run coefficients, and ε_t is the error term. The optimal lag lengths were determined using an unrestricted vector autoregressive (VAR) framework. The Schwarz information criterion, Akaike and Quinn-Hannan were used to determine the optimal lag length because that it performs reasonably well in small samples.

3.3 Description, Measurement and Analysis of Variables

Annual data on the various components of income taxes (pay-as-you-earn, withholding tax, corporate income tax and extractive royalty), gross fixed capital formation, size of the labour force, and growth domestic product (GDP) was collected from 1995 to 2015. Preferably, quarterly data should have been used for the study. Hence, annual data was used due to constraints related to the availability of consistent and comparable quarterly data.

3.4 Data Types and Sources

All data used in this study was secondary. The data was collected from the Central Statistics Office (CSO), Zambia Revenue Authority (ZRA), Bank of Zambia Statistical Bulletin, working papers, published data from the Ministry of Finance and published National Budgets. These sources were chosen because of their reliability in providing reliable data and information.

3.5 Estimation Procedure

This investigation began by determining the order of integration of the variables. For this purpose, the Augmented Dickey Fuller (ADF) and the Kwiatkowski–Phillips–Schmidt–Shin (KPSS) unit root tests were used. This is necessary, especially before conducting cointegration tests, to ensure that variables are stationary and to eliminate the possibility of spurious regression estimates. According to Asteriou and Hall (2011), two or more variables are said to be cointegrated if there exists a long-term or equilibrium relationship among them. This equilibrium relationship is given by the stationary linear combination of the variables, called the cointegrating equation. The ADF unit root tests are based on the following regression equation:

$$\Delta x_t = \alpha + \beta t + \delta x_{t-1} + \sum_{i=1}^{m} \Delta x_{t-i} + \varepsilon_t \quad (3)$$

where x is the variable of interest and m is the optimal lag length.

Due to the relatively small sample size for this study, the KPSS test will also be used to determine the order of integration of the variables. The KPSS test performs relatively well in small samples (Arltova and Fedorova, 2016). The null hypothesis for the test is that the time series of interest is stationary. The null hypothesis is rejected if the KPSS test statistic exceeds the KPSS critical value at the chosen level of significance.

The study first estimates a VAR model specified as follows:

$$lr\_gdp_t = \beta_0 + \sum_{j=1}^{k} \beta_j lr\_gdp_{t-j} + \sum_{j=1}^{k} \alpha_j lr\_ctax_{t-j} + \sum_{j=1}^{k} \alpha_j lr\_ert_{t-j} + \sum_{j=1}^{k} \alpha_j lr\_paye_{t-j} + \sum_{j=1}^{k} \alpha_j lr\_wtht_{t-j} + \sum_{j=1}^{k} \alpha_j lr\_gfcf_{t-j} + \sum_{j=1}^{k} \alpha_j lr\_lf_{t-j} + \mu_{1t}$$

(4)

The study then proceeded to test for co-integration. A procedure that was useful in testing for cointegration was the Johansen (1991) maximum likelihood procedure:

$$\Delta X_t = \mu + \sum_{t=1}^{p} \boldsymbol{A}_i \Delta X_{t-i} + \boldsymbol{B} X_{t-p} + \omega_i \quad (4)$$

where Δ is the first difference lag operator; X_t is a (kx1) random vector of time series whose order of integration is one, that is, I(1), μ is a (kx1) vector of constants; A_i are (kxk) matrices of parameters; ω_i is a sequence of zero-mean p-dimensional white noise vectors; and **B** is a k (kxk) matrix of parameters, whose rank contains very useful information about the long-run relationship between variables. The variables in the vector X_t are; lr_gdp_t, lr_ctax_t, lr_ert_t, lr_paye_t lr_wtht_t. lr_gfcf_t and lr_lf_t which are as defined earlier.

If **B** (=$\alpha\beta'$) has less than full rank, the variables are cointegrated, with β being the cointegrating vector. On the other hand, if **B** has full rank, the variables are stationary in levels. In this paper, the cointegration rank is determined using the maximum eigenvalue and trace test. Furthermore, this paper used (Johansen and Juselius, 1990) and (MacKinnon-Haug-Michelis, 1999) (asymptotic) critical values.

To determine the optimal lag length, the Akaike, Schwarz and Hannan-Quinn information criteria were utilised.

The study then proceeded to estimate the vector error correction model (VECM) specified in equation (1). Furthermore, the diagnostic tests for autocorrelation (using the VEC residual serial correlation LM test), heteroscedasticity (using the VEC residual heteroskedasticity test) and normality (using the VEC Residual Normality test) were conducted. The empirical results of the VECM were also tested for stability using the AR roots test. To show how economic growth responds to shocks in the corporate income tax, extractive royalty tax, pay-as-you-earn and withholding tax, impulse response functions were estimated. Variance decomposition was also estimated to illustrate the percentages that each of these shocks contributes to changes in economic growth.

As part of robustness checking, the ARDL model specified in equation (2) was estimated. The ARDL model is estimated based on the assumption that the error terms in equation (2) are not serially correlated. To test for the validity of this assumption, the Breusch-Godfrey (BG) test was applied. To check for the existence of a long-run relationship among the variables, the ARDL bounds test was employed (Caporale and Pittis, 2010).

In light of possible bi-directional causality between taxation and economic growth, it is also important to check for the direction of causality between income taxation and economic growth. For example, high tax revenue may result from high economic growth or high tax revenue may stimulate economic growth. For checking the direction of causality between the two variables, the Granger causality test was employed.

CHAPTER FOUR: PRESENTATION AND DISCUSSION OF FINDINGS

4.1 Introduction

This chapter contains a presentation and discussion of the findings of this study. It is divided into ten parts. The first part will provide descriptive statistics for the variables included in the model. The second part contains an analysis of the relationship between national income (as measured by real GDP) and income tax revenues. The third part summarises the results of the ADF and KPSS tests for stationarity. Part four presents the results the unrestricted VAR model. The fifth part presents the results of the Johansen cointegration test. The sixth part summarises the short- and long-run results of the VECM. The seventh part estimates the relevant impulse response functions (IRFs), and summarises the results of the variance decomposition analysis. Part eight presents the results of the ARDL model – which in this study serves a robustness check for the results of the VECM given the relatively small sample used in this study. Part nine presents the results of the granger causality tests; given the likely bi-directional causality between income tax revenues and economic growth. The last part provides a discussion of the key findings of the study.

So as not to clutter the text with too many tables, the detailed calculations leading to the various tests are provided in the appendix.

4.2 Descriptive Statistics

A summary of the descriptive statistics for the variables (LR_GDP, LR_CTAX, LR_ERT, LR_PAYE, LR_WTHT, LGFCF and LLF) used in the model is given. Descriptive statistics are brief descriptive coefficients that summarize a given data set, which can be either a representation of the entire population or a sample of it (Sorensen, 2005). The statistics of interest are the measures of central tendency (mean and median), measure of dispersion (standard deviation, maximum and minimum) and measures of normality of the distribution (skewness and kurtosis). In addition, a Jarque-Bera statistic, used to determine the normality of the distributions of the variables, is given. Its probability value (p-value) is used to determine whether the null hypothesis of normality of a given variable is rejected or not. Precisely, the null hypothesis of normality of a given variable is rejected if the p-value of its Jarque-Bera statistic is less than the chosen level of significance. In this study, the chosen level of significance (the probability of rejecting a true null hypothesis) is five (5) per cent. Table 2 below summarises the descriptive statistics of the variables included in the empirical models.

Table 2: Descriptive Statistics

	LGDP	LCIT	LERT	LPAYE	LWTHT	LGFCF	LLF
Mean	11.12	6.228	4.213	7.129	5.463	7.734	15.46
Median	11.07	6.119	3.669	7.451	5.505	7.856	15.45
Maximum	11.74	8.389	8.229	8.915	7.811	9.164	15.75
Minimum	10.59	3.532	0.916	4.651	3.195	4.808	15.18
Std. Dev.	0.391	1.568	2.299	1.341	1.321	1.234	0.173
Skewness	0.231	-0.132	0.318	-0.452	0.013	-0.664	0.082
Kurtosis	1.612	1.654	1.775	1.989	1.926	2.584	1.883
Jarque-Bera	1.871	1.646	1.667	1.611	1.009	1.694	1.115
Probability	0.392	0.439	0.434	0.447	0.604	0.429	0.573

Source: Author's estimates

From the table above, it is clear that the variables vary widely in terms of their means, medians, maxima, minima, skewness coefficients, and kurtosis coefficients. It can also be observed that all variables are normally distributed since the p-values of their Jarque-Bera statistics are greater five (5) per cent. It is important to understand the distribution of the variables, as this gives the researcher an insight into whether there are outliers present in the data, which may bias the results of the estimated model (Gujarati, 1995).

4.3 Trends in Income Tax Revenue and Economic Performance

In last decade, Zambia experienced growth in GDP due to factors such as rising copper prices and growth in the Chinese economy increased demand for Zambia's mineral exports (Hampwaye et al., 2015). The figures below show GDP trends and government revenues from the main income taxes: PAYE, corporate income tax, withholding tax and extractive and mineral royalty tax. Between 1995 and 2015, Zambia's GDP grew from K70219.32 billion to K183790.4 billion in real terms owing to various factors discussed above.

Corporate income tax has also been a major contributor to Zambia's GDP as the increase in wages in the public sector also triggered an increase in wages in the private sector. Company tax revenue increased from K34.2 million in 1995 to K2846.4 million in 2015 due to increased payments of mining company tax.

From Figure 2 below, it is clear that increases in GDP were associated with increases in corporate income tax revenue at least for the period 1995Q1- 2012Q1. Beyond this period, there seems to be a reduction in corporate income tax revenue as well as a seemingly negative relationship between GDP and income tax revenue.

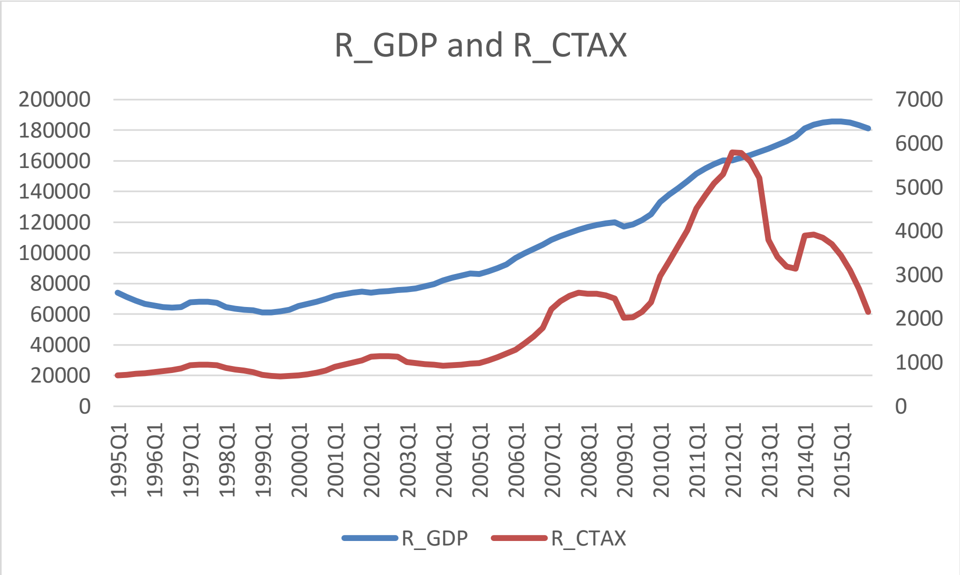
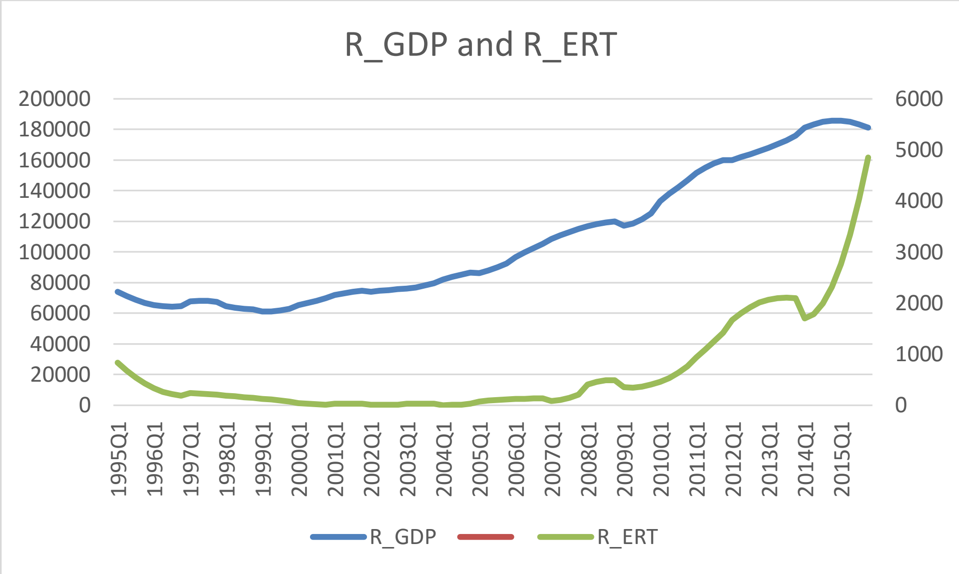


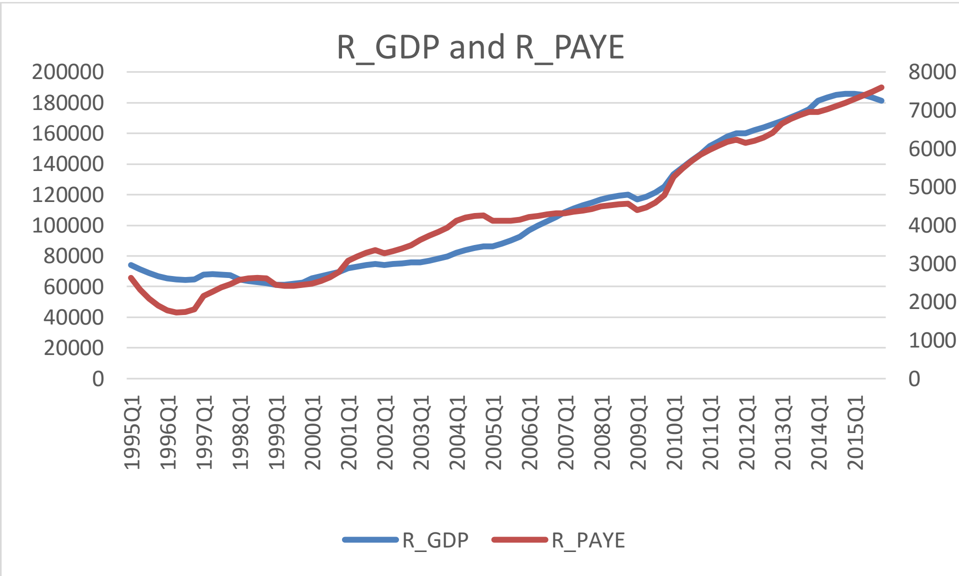
Figure 2: Trends in GDP and Income Tax Revenue, 1995-2015

Although extractive royalty tax revenue has shown strong growth from K104.7 million in 1995 to K7, 444.1 million in 2015, its contribution to total tax revenue was relatively insignificant before the early 2000s. It is also important to note that there was a significant reduction in extractive royalty tax revenue due to a slowdown in the demand and subsequently the price of copper in international commodity markets during the Great Recession of 2008-2009 (JCTR, 2011).

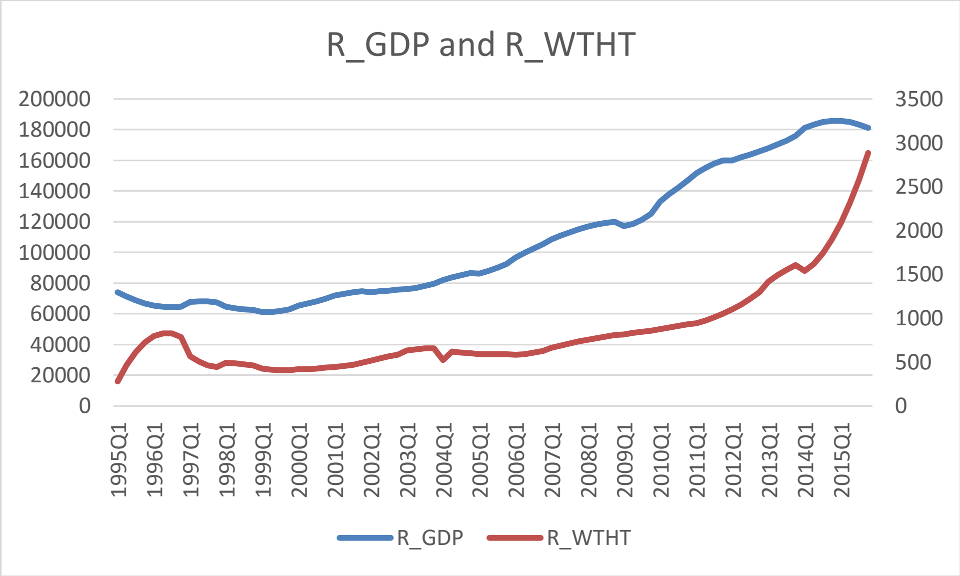
Furthermore, in the recent past tax revenue from the mining sector has shown an upward trend due to increased mining activities, increased production and favourable metal prices (Hampwaye et al., 2015). These revenues represent a growing share of total tax revenue from 0.06 percent in 2005, to 12.6 percent in 2010 and 19.7 percent in 2012.



For the period under study (1995-2015) income taxes increased from a total of K192.1 million to K16507.8 million. PAYE mainly drove this increase in income taxes because of the steady increase in public sector wages. PAYE revenue increased from K104.7 million in 1995 to K7, 444.1 million in 2015.



Withholding taxes also increased over the same period because of increases in rental income and dividends. PAYE continues to be the biggest contributor to income taxes and is contributed by the working population, who form a small percentage of the total population (less than 20%) (JCTR, 2011). From the above graphs and analysis, it is clear that there seems to be a correlation between GDP and income taxes as they seem to trend closely. This is more so for the PAYE, which trends closest with the GDP over the period of analysis. PAYE is the largest single source of income tax revenue and even total tax revenue in Zambia (JCTR, 2011).



Source: Zambia Revenue Authority (ZRA) data

4.4 Unit Root Tests

The variables of the formulated model will be tested for stationarity using the ADF and KPSS stationarity tests. The ADF tests the null hypothesis if the unit root is present in a time series sample. The test will enable us determine the time series of each of the variable is stationary. Table 3 below shows the results of the ADF test in level form. The table below shows that only LGFCF is stationary in level form or is I(0).

Table 3: ADF Unit Root Test Results in Level Form

Variable	ADF test statistic	5% ADF Critical Value
LGDP	-1.96	-3.73
LCIT	-0.91	-3.66
LERT	-3.14	-3.71
LPAYE	-0.87	-3.66
LWTHT	-3.06	-3.67
LGFCF	-4.09*	-3.66
LLF	-1.03	-3.67

* means that the variable is stationary in level form, I(0)

Source: Author's computations

Table 4 shows the results of the ADF test in first difference form. The results show that LERT, LPAYE and LWTHT become stationary at first difference. That is, they are I(1).

Table 4: ADF Test - At First Difference

Variable	ADF test statistic	5% ADF Critical Value
LGDP	-0.87	-3.69
LCIT	-3.56	-3.67
LERT	-6.50*	-3.67
LPAYE	-5.66*	-3.67
LWTHT	-8.50*	-3.67
LGFCF	-5.04*	-3.67
LLF	-3.08	-3.73

* means that the variable is stationary in first difference, I(1)

Source: Author's computations

Table 5 below shows the results of the KPSS test in level form. The table shows that LGDP, LCIT, LWTHT, and LLF are all stationary in level form. Therefore, the variables have an order of integration of zero. That is, they are I(0).

Table 5: KPSS Test in Level Form

Variable	KPSS test statistic	5% KPSS Critical Value
LGDP	0.144*	0.146
LCIT	0.114*	0.146
LERT	0.148	0.146
LPAYE	0.171	0.146
LWTHT	0.060*	0.146
LGFCF	0.192	0.146
LLF	0.142*	0.015

* means that the variable is stationary in level form, I(0)

Source: Author's computations

Table 6 below shows the results of the KPSS test at first difference form. The table shows that LERT only becomes stationary at first difference. Thus, it is I(1).

Table 6: KPSS Test at First Difference

Variable	KPSS test statistic	5% KPSS Critical Value
LGDP	0.159	0.146
LCIT	0.132*	0.146
LERT	0.111*	0.146
LPAYE	0.380	0.146
LWTHT	0.079*	0.146
LGFCF	0.087*	0.146
LLF	0.143*	0.146

* means that the variable is stationary in first difference, I(1)

Source: Author's computations

The above unit root tests show that almost all are I(1). For example, the KPSS test which has greater power in smaller samples shows that LCIT, LERT, LWTHT, LGFCF and LLF are I(1) although it shows that LGDP is I(0). On the other hand, the ADF test shows that LPAYE is I(1). Given these findings, the VAR model is estimated in section 4.4 below.

4.5 Estimated VAR Model

The study then proceeded to estimate the VAR model (from which the VECM is derived) specified in equation (4). The estimated VAR model is summarised in table 7 below (see appendix for full estimated model). The optimal lag length was determined to be one; using the Schwarz information criterion, which is ideal if the sample size is relatively small.

Table 7: Estimated VAR Model

Variable	**Coefficient**	**Standard Error**	**t-statistic**
LGDP(-1)	0.813*	0.254	3.206
LCIT(-1)	0.020	0.027	0.744

LERT(-1)	0.010	0.010	1.036
LPAYE(-1)	0.084*	0.035	2.398
LWTHT(-1)	0.034	0.033	1.019
LGFCF(-1)	-0.039	0.022	-1.755
LLF(-1)	-0.457	0.463	-0.988
Intercept	8.561	5.225	1.639

* implies that the variable has a significant impact on GDP growth.

Source: Author's computations

The above results that only PAYE and the lagged value of GDP had a significant (positive) impact on economic growth. Note that the above VAR model is based on the Johansen cointegration test summarised in the next subsection.

4.6 Johansen Cointegration tests

Given that the unit root test results indicate that the variables are mainly integrated of order one, it is necessary to carry out the Johansen cointegration test to confirm if there is a long run relationship between the variables in the model. The results of this test are summarised in Table 8 below.

Table 8: Johansen Co-integration Test

Hypothesised No. of CEs	Trace Statistic	Critical Value [Trace] at 5%	Max-Eigen Statistic	Critical Value [Eigen] at 5%
None	130.1*	69.8	60.5*	33.9
At most 1	69.6*	47.9	40.8*	27.6

At most 2	28.8	29.8	17.1	21.1
At most 3	11.6	15.5	6.3	14.3
At most 4	5.4*	3.8	5.4*	3.8

Johansen cointegration test was carried out to test the presence of a long run relationship among variables. The test has two test statistics; and Trace and Max- Eigen statistics. The asterisk (*) on both the maximum statistic and trace statistics indicates the rejection of the null hypothesis of no cointegrating equations at the 5 per cent level of significance (see appendix).

Trace test indicates two cointegrating equations at 5 per cent level of significance. Max- Eigen test also indicates presence of two cointegrating equations at 5 per cent level of significance. Overall, the results indicate presence of two cointegrating equations. There exists a long run relationship among the variables; meaning they move together in the long run. This means that vector error correction model (VECM) can be used to estimate the model.

4.7 VECM Results

The VECM was used to determine the short- and long-run dynamics of the system. First, the short-run results are presented. Table 9 presents the estimated VECM results based on two cointegrating equations, as suggested by the Johansen cointegration test.

Table 9: Short-Run Estimates

Variable	**Coefficient**	**Standard Error**	**t-statistic**
Speed of Adjustment 1	-0.840*	0.225	-3.737
Speed of Adjustment 2	0.061*	0.018	3.404
D(LGDP(-1))	0.489*	0.196	2.498
D(LCIT(-1))	-0.029	0.018	-1.56

D(LERT(-1))	-0.031*	0.010	-2.988
D(LPAYE(-1))	-0.039	0.038	-1.028
D(LGFCF(-1))	0.041	0.023	1.765
Intercept	0.042*	0.016	2.601

Notes: (1) R-squared = 0.763, Adjusted R-squared = 0.613, F-statistic = 5.071 (0.000); (2) * denotes significance at 5%.

It is important to note that the LWTHT and LLLF variables were dropped because of a high degree of collinearity with the LGDP variable. The high correlation among the three variables prevented the researcher from running equations (1), (2) and (4) specified in section 3.4.

The coefficients in the table above show the short-run elasticities of economic growth with respect to each of the remaining variables. The short-run results show that only the first lagged differences of real GDP and the withholding tax revenue had a statistically significant impact on the real GDP. In particular, an increase in withholding tax revenue led to a significant reduction in real GDP growth. The rest of the variables are statistically insignificant at the 5% level of significance.

The first error correction term (or speed of adjustment) has the expected negative sign, which is statistically significant at the 5% level of significance. This implies that the system converges to its long-run equilibrium. The second error correction term is positive and significant. Enders (1995) shows that a positive and significant error correction in the presence of two cointegrating equations guarantees converge of the system. The results also indicate the disequilibrium is largely corrected within two years after a shock.

The results above show that the estimated model is a good fit. The R-squared value of 0.763 implies that 76.3% of the variations in economic growth are explained by variations in corporate income tax, extractive royalty tax, pay-as-you-earn, and gross fixed capital formation. Despite this, the F-statistic of 5.07, which is statistically significant at the conventional 5% level of significance, shows that corporate income tax, pay-as-you-earn, extractive mineral royalty tax and gross fixed capital formation, jointly significantly influence economic growth in Zambia.

Next, the long-run results are presented. The long-run relationship between economic growth and the various components of income taxation was also estimated. Table 10 shows the long-run relationship between economic growth (proxied by *lgdp*), corporate income tax (*lctax*), pay-as-you-earn (*lpaye*), extractive mineral royalty tax (*lert*) and gross fixed capital formation (*lgfcf*), based on the two cointegrating equations.

Table 10: Long-run results

Cointegrating Equation	**(1) (standard errors) [t-statistics]**	**(2) (standard errors) [t-statistics]**
LGDP(-1)	1.000	0.000
LCIT(-1)	0.000	1.000
LERT(-1)	-0.072* (0.003) [-23.89]	-0.139 (0.289) [-3.731]
LPAYE(-1)	-0.239* (0.023) [-10.29]	0.223 (0.289) [0.771]
LGFCF(-1)	0.012 (0.028) [0.452]	-1.806* (0.342) [-5.278]
Constant	-9.209	6.805

Notes: * denotes significance of the coefficient at the 5% level of significance.

The results also show that only extractive royalty tax revenue and pay-as-you-earn revene have a significant (and negative) impact on real GDP growth. Specifically, the results show that, holding all other factors constant, a 10% increase in extractive royalty tax revenue leads to a 0.72% decrease in the real GDP in the long-run. In addition, holding all other factors constant, a 10% increase in pay-as-you-earn tax revenue leads to an 2.39% decrease in the real GDP in the long-run. Gross fixed capital formation and other income tax revenue variables have no significant impact on real GDP growth in the long-run.

Next, diagnostic tests for residuals and the stability of the estimated VECM were conducted. Table 11 summarises the results of the diagnostic tests for the residuals. The VEC residual normality test indicates that the residuals are normally distributed. In addition, the table indicates that there was no serial correlation among the error terms. Furthermore, based on VEC residual heteroscedasticity test (with no cross terms), the vector error correction residuals were found to be homoscedastic (or to have equal variances).

Table 11: Summary of Diagnostic Tests for the Residuals

Test	Null Hypothesis	Test Statistic	Probability	Conclusion
VEC Residual Serial Correlation LM Test	No serial correlation at lag order *h*[1]	27.288	0.342	Null hypothesis not rejected
VEC Residual Heteroscedasticity Test (No Cross Terms)	The VEC error terms are homoscedastic	212.16	0.445	Null hypothesis not rejected
VEC Residual Normality Test	Residuals are normally distributed	3.107	0.684	Null hypothesis not rejected

Furthermore, the estimated model was tested for stability, by observing the AR roots. The null hypothesis is that the model is stable. Since all the AR roots lie inside the unit circle, the null hypothesis was not rejected, implying that the estimated model was stable (figure 3).

[1] At lag order 2. The null hypothesis was also not rejected at lag orders 2 and beyond.

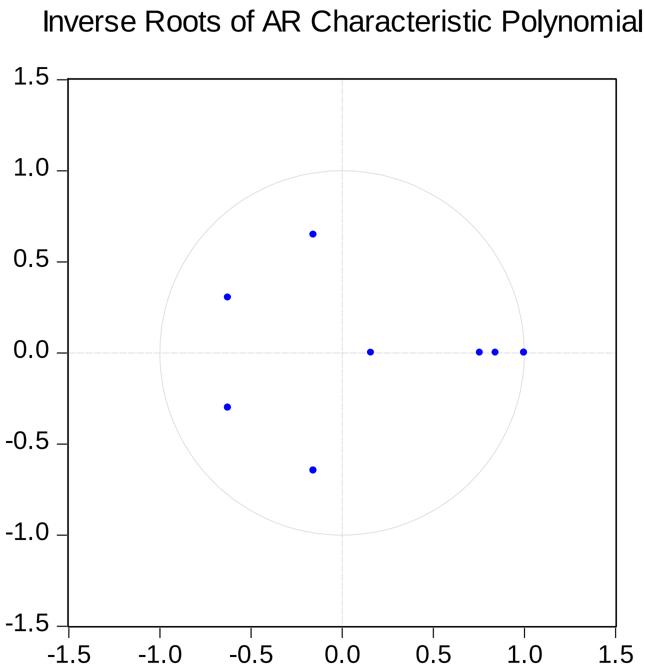


Figure 3: AR Roots Stability Test

All diagnostic tests conducted led to the non-rejection of the null hypotheses of stability in the model, homoscedastic error terms, normally distributed error terms and non-serially correlated error terms. Thus, the specified VECM model is a reliable for interpretation and discussion.

Given that the impact of a given variable on GDP growth is not instantaneous, it is important to track this effect over time. For this purpose, impulse response functions are useful. An impulse response function (IRF) describes the evolution of the variable of interest along a specified time horizon after a shock at a given moment. This is useful in assessing how shocks to an economic variable reverberate through a system. An IRF indicates what the impact of an upward unanticipated one-unit change in the 'impulse variable' on the 'response' variable over the next several periods.

Results of the estimated IRFs can be shown in tabular or graphical form. This study adopted the graphical presentation where the vertical axis is expressed in units of the Y variable (*lgdp*). The solid line is a loci of point estimates for the amount *lgdp is* expected to change following a unit impulse in the relevant variable after the number of periods on the horizontal axis. Figure 4 shows the estimated IRF for *lgdp* and *lcit*.

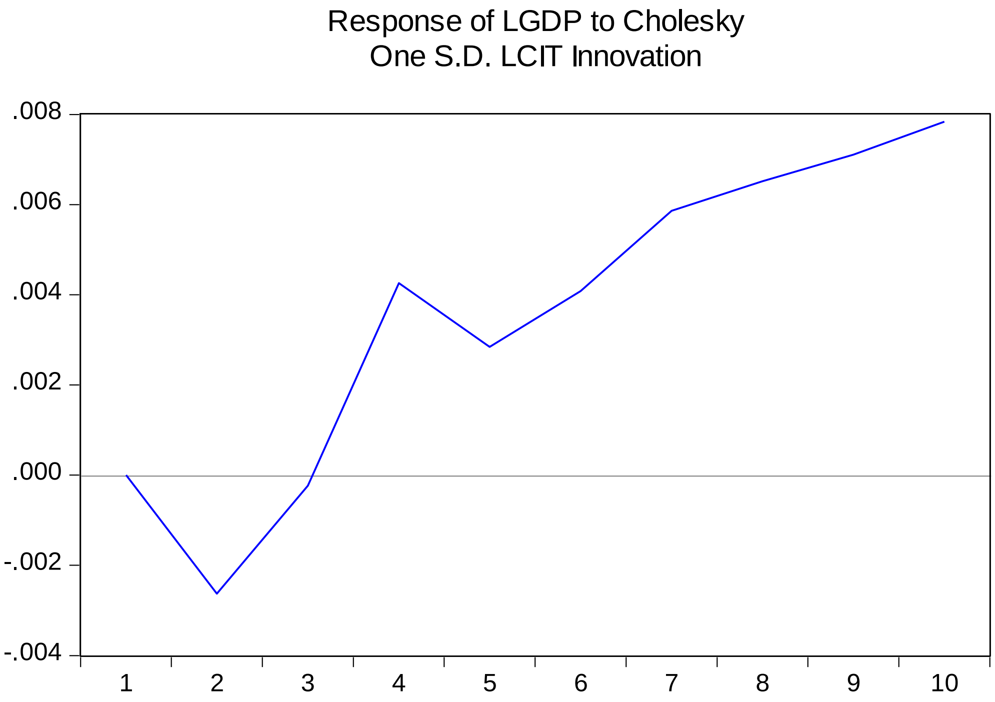


Figure 4: Estimated Impulse Response Function (lgdp and lcit)

The graph above evidently shows that there is a slight decrease in real GDP after the shock to corporate income taxes in the first two years; because an increase in such taxes will reduce the ability of companies to work, save and invest. After that, there is a gradual increase in real GDP.

From figure 5 below, a one standard deviation shock to extractive royalty tax revenue will lead to an increase in GDP only in the first three years. After the third year, an increase in extractive tax revenue, as expected, reduces GDP growth. This is because excessive taxation of mining sectors can disincentivise mining companies to investment.

Figure 5: Estimated Impulse Response Function (lgdp and lert)

Figure 6 shows the response on *lgdp* to shocks in *lpaye*. From the figure, it can be concluded that a 1% shock to pay-as-you-earn tax revenue will leads to a gradual increase in the real GDP over a ten-year period.

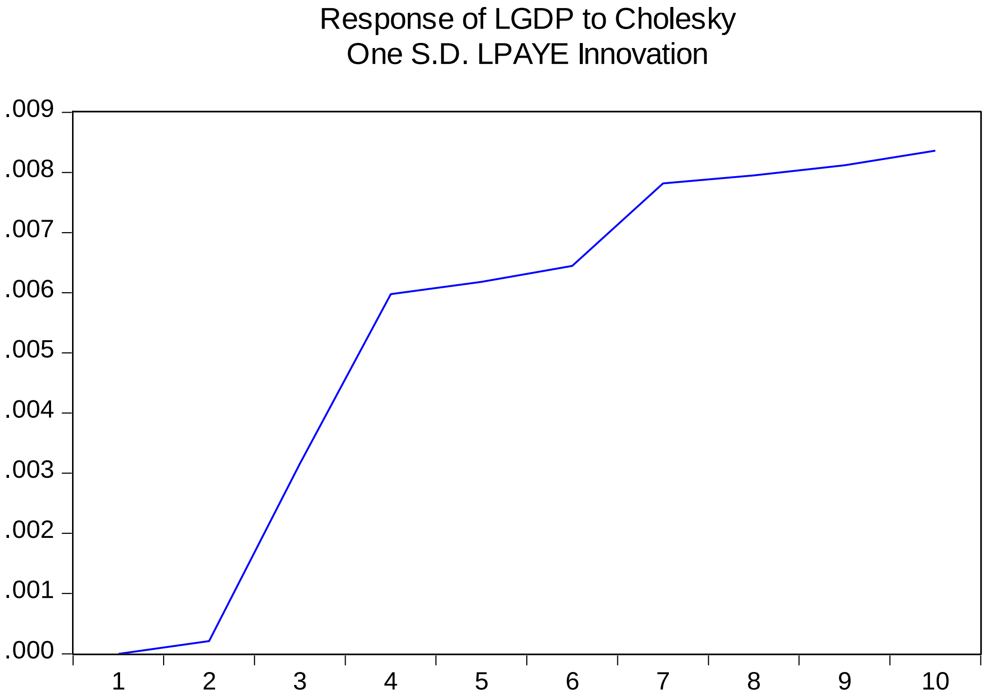


Figure 6: Estimated Impulse Response Function (lgdp and lpaye)

Figure 7 shows the response of *lgdp* as a result of a random shock to *lgfcf* over an eight-year period. The figure below shows that the unexpected shock to withholding tax revenue tends to provide a positive jolt to real GDP. An impulse shock to withholding tax will increase over the next eight years, although at a decreasing rate.

Figure 7: Estimated Impulse Response Function (lgdp and lgfcf)

Furthermore, it would be interesting to determine the proportion of the variance in real GDP growth that is explained by each of the explanatory variables. Variance decomposition analysis was used to estimate the percentage that each of the shocks to corporate income, extractive royalty, pay-as-you-earn and gross fixed capital formation contributed to the variance in economic growth in various periods.

Figure 8 shows the percentage that shocks to corporate income tax revenue contributed to economic growth. It is clear from the figure that the contribution of shocks to corporate income tax revenue was near-zero in the first year, before rising to about 1% in the second year and to about 2% between second and fourth years. Generally, the contribution of variations in corporate income tax revenue to variation in economic growth was below 2%.

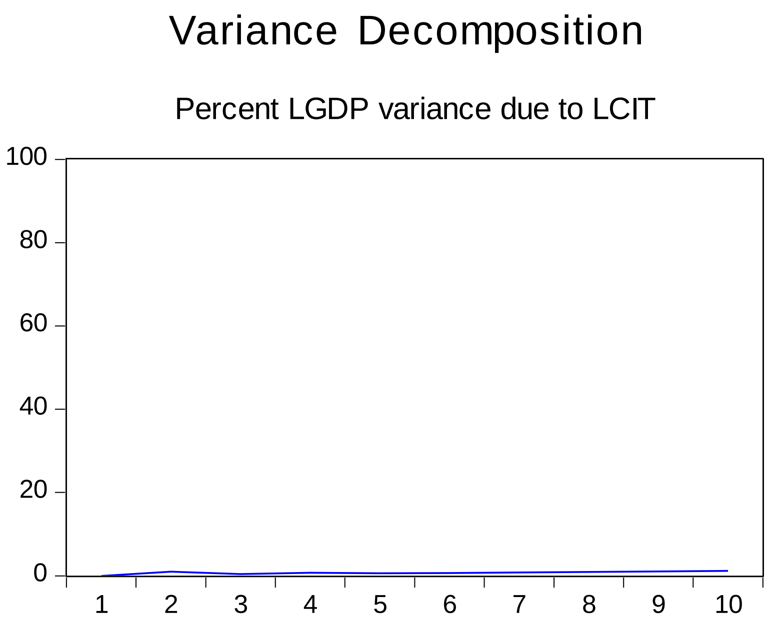


Figure 8: Contribution of lcit Shocks to lgdp

Figure 9 below shows the percentage that shocks to extractive royalty tax revenue contributed to economic growth. It is clear from the figure that the contribution of shocks to extractive royalty tax revenue was also below 2% over the ten-year period.

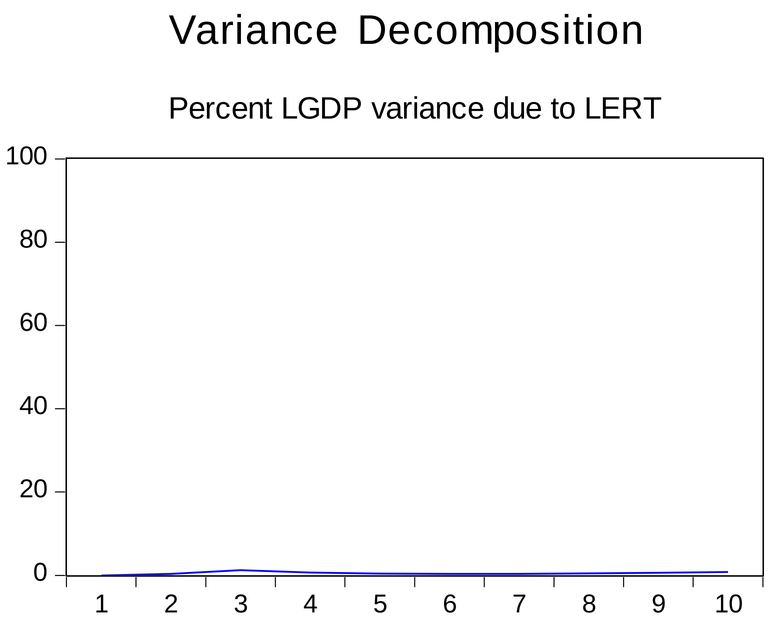


Figure 9: Contribution of lert Shocks to lgdp

Figure 10 below shows the percentage that shocks to the pay-as-you-earn revenue contributed to economic growth. It is clear from the figure that the contribution of shocks to pay-as-you-earn revenue was near-zero in the first two years, before steadily rising to about 4% by the end of the tenth year.

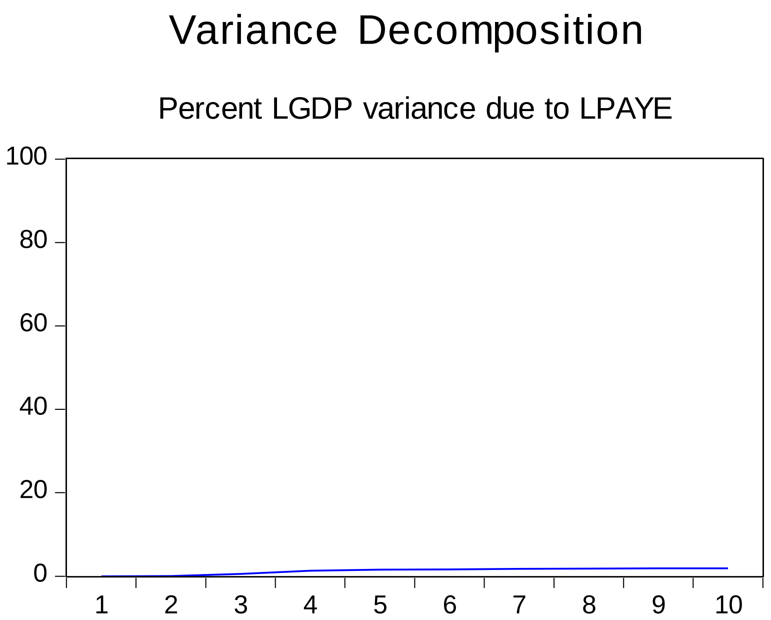


Figure 10: Contribution of lpaye Shocks to lgdp

Figure 11 below shows the percentage that shocks to gross fixed capital formation contributed to economic growth. It is clear from the figure that the contribution of shocks to gross fixed capital formation was almost zero per cent in the first year. After the first quarter, it rose to about 5% by the end of the tenth year.

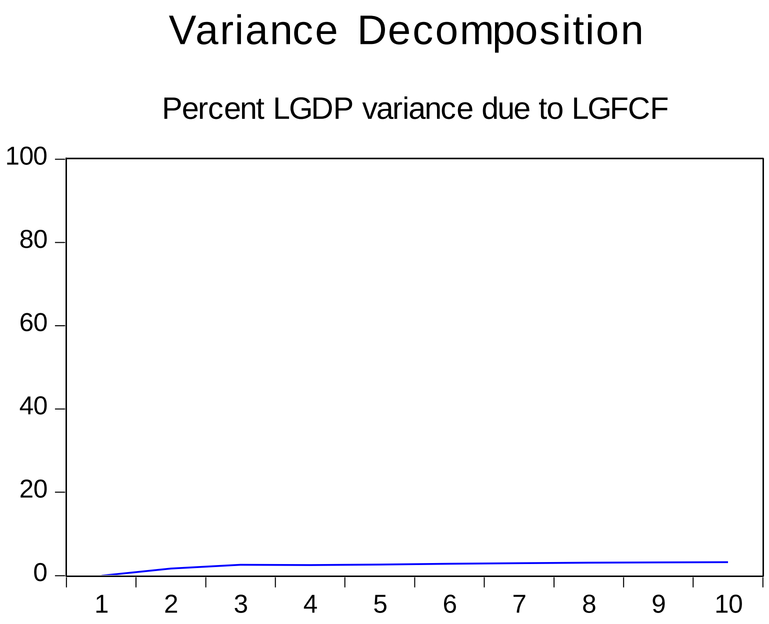


Figure 11: Contribution of lgfcf Shocks to lgdp

4.9 A Robustness Check: The ARDL Model

Given the relatively small sample size for this study, an ARDL model, which performs reasonably well in small samples, was estimated to check the robustness of the results of the VECM. The Schwarz information criterion was used to determine the optimal lag lengths of the ARDL model specified in equation (2). In the end, an ARDL (1, 0, 1, 0, 1) was estimated. Its results are summarised below. The results show that in the short-run, the results of the ARDL model seem to contradict those of the VECM. For example, gross fixed capital formation now has a significant negative impact on real GDP growth. Surprisingly again, extractive royalty tax revenue is now found to have a positive impact on GDP growth.

Table 12: Estimated ARDL Model[2]

Variable	Coefficient	Standard Error	t-statistic
LGDP(-1)	0.334	0.191	1.753
LCIT	0.043*	0.015	2.890
LERT	0.018*	0.008	2.237
LERT(-1)	0.027*	0.011	2.492
LPAYE	0.186*	0.061	3.042
LGFCF	-0.052	0.037	-1.408
LGFCF(-1)	-0.056*	0.019	-2.990
Intercept	6.471*	1.857	3.484

Notes: (1) R-squared = 0.999, Adjusted R-squared = 0.999, F-statistic = 1916.75 (0.000); (2) * denotes significance at 5%.

The cointegrating form of the above estimated ARDL model is summarised below. As with the ARDL model, the speed of adjustment is negative and significant. This implies that the system converges to equilibrium in the long run.

Table 13: Cointegrating of the Estimated ARDL Model

Variable	Coefficient	Standard Error	t-statistic
D(LCIT)	0.043*	0.015	2.890
D(LERT)	0.018*	0.015	2.890
D(LPAYE)	0.018*	0.008	2.237
D(LGFCF)	-0.161	0.037	-1.407
Speed of Adjustment	-0.666*	0.191	-3.493

[2] Note: It is shown in the appendix that the estimated ARDL model satisfies all assumption made about the error terms. Hence, the results are relatively reliable.

Finally, the long-run coefficients of the estimated ARDL model are summarised in table 14 below.

Table 14: Long-Run Coefficients of the Estimated ARDL Model

Variable	**Coefficient**	**Standard Error**	**t-statistic**
LCIT	0.064*	0.027	2.381
LERT	0.0.67*	0.007	10.16
LPAYE	0.280*	0.034	8.131
LGFCF	-0.161	0.042	-3.818
Constant	9.720*	0.105	92.78

Before the above long-run coefficients can be interpreted, it was important to determine whether the long-run relationship among the variables was significant. For this purpose, the ARDL bounds test was applied. The null hypothesis for this test is that no long-run relationships exist. The null hypothesis rejected if the calculated F-statistic is greater than the upper bound. It is not rejected if the F-statistic is less than the lower critical bound. If the F-statistic lies between the two bounds, the test is inconclusive. The results of the bounds test are summarised below.

Table 15: ARDL Bounds Test

Significance	**Lower Bound**	**Upper Bound**
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06

The F-statistic was found to be 2.55. Thus, at the conventional 5% level of significance, the null hypothesis that no long-run relationships exist was not rejected. Therefore, the ARDL model indicates no significant long-run relationships among the variables included in the model.

4.10 Granger Causality Tests

Given the possible bi-directional causality between economic growth and various components of income tax revenue, Granger causality tests were performed to ascertain the direction of causality between income tax revenue and economic growth.

The null hypothesis for these tests is that a given variable does a given variable does not granger cause the other. The null hypothesis is rejected if the p-value of the test statistic is less than the 5% level of significance. The results of these tests are summarised in the table below.

Table 16: Granger Causality Tests

Null Hypothesis:	F-Statistic	Prob.
LCIT does not Granger Cause LGDP	6.021	0.013
LGDP does not Granger Cause LCIT	2.574	0.112
LERT does not Granger Cause LGDP	1.930	0.182
LGDP does not Granger Cause LERT	4.987	0.023
LPAYE does not Granger Cause LGDP	10.46	0.002
LGDP does not Granger Cause LPAYE	1.948	0.179
LGFCF does not Granger Cause LGDP	4.604	0.029
LGDP does not Granger Cause LGFCF	5.900	0.014

The table above shows that there is significant unidirectional from corporate income and PAYE tax revenue to real GDP. The causality between gross fixed capital formation and real GDP is bi-directional. However, real GDP granger-causes extractive royalty tax revenue and not the other way round.

4.11 Discussion of the Findings

From the results of the first estimated vector error correction term equal to the speed of adjustment, (table 9) has the expected negative sign, and is statistically significant at the 5% level of significance. The second error correction term is positive and significant. Going by Enders (1995), this ensures that the stability condition of the VECM is met. This implies that any short-run disequilibrium in the system will be corrected in the long-run at the speed of adjustment. For example, when there is disequilibrium in economic growth caused by a change in a variable within the system, it will adjust to its equilibrium level in the long-run.

From tables 9 and 10, corporate income tax revenue was found to have no statistically significant on economic growth in both the short- and long-run. The finding is contrary to predictions by Keynes (1936) who postulated that an increase in business taxes is likely to stifle economic growth. This is also inconsistent with priori expectations of a negative impact. It is also contrary to findings by Takumah (2014) who found a statistically positive impact, and Lee and Gordon (2004), OECD (2012), and Okoi and Edame (2014) who found a statistically significant negative impact.

Extractive royalty tax revenue was found to have a statistical significant negative impact on economic growth in both the short and the long run. In the long run, for example, a one (1) per cent increase in the extractive royalty tax revenue led to a 0.07% decrease in the economic growth in the long run, holding other variables constant. The estimated impulse response function rightly suggests that the negative impact of extractive royalty tax revenue on economic growth is not instantaneous, and in fact deepens over time. This finding is consistent with a priori expectations of a negative relationship between extractive royalty tax revenue and economic growth. In Zambia, this may be due to the fact that increases in extractive royalty taxes may reduce the incentive for investment in the mining sector. This finding is also consistent with findings by Okoi and Edame (2014).

Pay-as-you-earn tax revenue was also found to have no statistically significant impact on economic growth in the short-run. However, it was found to have a statistically significant negative impact on economic growth in the long run. Specifically, a one (1) per cent increase in pay-as-you-earn tax revenue led to a 0.24% decrease in economic growth in the long run, holding other factors constant. The negative impact of pay-as-you-earn tax revenue is not instantaneous and was found to increase over time. These results are consistent with Keynes'

(1936) proposition that personal taxes such as pay-as-you-earn stifle economic growth because they curtail consumption and deter savings. These findings were also consistent with findings by OECD (2012) who found that increases in personal taxes such as PAYE have a statistically significant negative impact on economic growth.

Gross fixed capital was included in the model specification as a control variable. It was found to have no significant impact on economic growth both in the short- and long-run. This finding is contrary to postulates of neoclassical and endogenous growth theories that see capital accumulation as a key driver of economic growth (Engen and Skinner, 1996).

Given the relatively small sample size adopted for the study, the ARDL model, which performs reasonably well in small samples, was employed as a robustness check for the findings of the VECM. The results of the ARDL model largely contradict those of the VECM. For example, the short-run results now indicate that extractive royalty tax revenue has a significant positive impact on economic growth. In addition, gross fixed capital formation was found to have a significant negative impact on economic growth contrary to the predictions of neoclassical and endogenous theories. Furthermore, the ARDL model failed the bounds test; indicating that there was no significant long-run relationship among the variables.

Furthermore, given the possible bidirectional relationship among the variables, Granger causality tests were used to ascertain the direction of causality between various components of income tax and economic growth. These tests largely support the view that causality is likely to run from income taxation to economic growth. However, it was found that there is significant unidirectional causality from real GDP to extractive royalty tax revenue and not the other way round.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1 Conclusions

The level of income taxation has huge implications for economic growth. As such, this study sought to determine the short- and long-run effects of four categories of income tax revenue (corporate income tax, extractive royalty tax, pass-as-you-earn and withholding tax) on economic growth over the period 1995 to 2015. The study applied a vector error correction model (VECM) using annual data for the study period. The study was not was not able to determine whether withholding tax revenue had a significant impact on economic growth. Due to extremely high correlation between withholding tax revenue and economic growth, the withholding tax revenue variable was dropped as it prevented the researcher from implementing the proposed methodology. Another control variable (the size of the labour force) was dropped for a similar reason.

The hypotheses for the study were that all forms of income taxation are likely to stifle economic growth. The results from the estimated VECM show that corporate income revenue had no significant impact on economic growth in both the short- and long run. PAYE revenue was found to have a significant negative impact on economic growth only in the long run. On the other hand, extractive royalty tax revenue was found to be retrogressive to economic growth both in the short and long run. The negative long-run impact of mining and PAYE tax revenue may be due to the view that an increase in these categories of income taxation can distort consumption, savings and investment decisions.

A related finding of this study is the effect of mining and PAYE taxation on economic growth was not instantaneous. Rather, economic growth responded to changes income tax revenue with a lag, over a number of years. Specifically, the negative impact of these categories of income taxation on economic growth deepens overt time.

The findings from the estimated VECM are strengthened by the fact that Granger causality tests largely support the view that causality runs from income taxation to economic growth and not the other way round. With the exception of extractive royalty taxation which was found to have bi-directional causality with economic growth, other forms of income taxation were found to have a unidirectional causality that runs from income taxation to economic growth.

Owing to the relative smallness of the sample size used in the study, the results of the VECM may not be very reliable. It is in view of this that an ARDL model was run as a robustness check. The results of the ARDL model largely contradict those of the VECM. Hence the findings from the VECM should be treated with caution.

5.2 Recommendations

Based on the findings of this study, a few recommendations are in order:

1. The mining sector is one of Zambia's key sectors. Since extractive royalty tax was found to have a statistically significant negative impact on economic growth, policymakers should ensure that the taxation of the mining sector is not excessive as this may be a disincentive for investment in the sector.
2. Furthermore, it was found that PAYE tax revenue is retrogressive to economic growth. Thus, there is need to refine the existing income taxation structure in a way that ensures that it promotes equity. This is important because excessive taxation of personal income can reduce incentives by economic agents to work save and invest.

REFERENCES

Adejare G T (2015) The Analysis of the Effect Of Corporate Income Tax (CIT) on Revenue Profile in Nigeria. *American Journal of Economics, Finance and Manegement* 1(4): pp. 312-319.

Adina M (2009) *The Impact of Taxation on the Investment Localization Decision in the Context of Globalization*. University of Iasa Working Paper No. 7207. Athens: University of Iasa.

Anguyo F L (2008) *Exchange Rate Pass-Through to Inflation in Uganda: Evidence from a Vector Error Correction Model.* Kampala: Research Department, Bank of Uganda.

Arltova M and Fedorova D (2016) Selection of Unit Root Test on the Basis of the Length of the Time Series and Value of the AR(1) Parameter. *Statistika* 96(3): 47-64.

Arnold C (2008) Do Tax Structures Affect Aggregate Economic Growth: Empirical Evidence from a Panel of OECD Countries. Paris: OCED.

Asteriou D and Hall S G (2011) *Applied Econometrics*. 2nd edition. Basingstoke: Palgrave Macmillan.

Bahl R W & Bird R M (2008) *Tax Policy in Developing Countries: Looking Back and Forward.* Institute for International Business Working Paper Series No. 13. Vienna: Institute for International Business.

Barro R J (1979) Model of Tax Smoothing On the Determination of Public Debt. *Journal of Political Economy* 87(5): pp. 940-971.

Bernanke B S & Blinder S (1988) *Credit, Money and Aggregate Demand*. Working paper No. 2534. Washington D. C.: National Bureau of Economic Research.

Burgess R (1993) *Public Revenue without Taxation.* London: Shepheard-Walwyn Publishers Ltd.

Central Statistics Office (2001). *Statistical Bulletin*. Volume 26. No. 1. Lusaka: Central Statistics Office.

Caporale G M and Pittis N (2004) *Robustness of CUSUM and CUSUM-of-Squares Tests to Serial Correlation, Endogeneity and Lack of Structural Variance: Some Monte Carlo Evidence*, Economics Series 157. Vienna: Institute for Advanced Studies.

DiJohn J (2010) *The Political Economy of Taxation and State Resilience in Zambia Since 1990.* Working Paper No. 78. London: Crisis Research Centre.

Easterly W & Rebelo S (1993a). Fiscal Policy and Economic Growth: An Empirical Investigation. *Journal of Monetary Economics* 32: pp. 417-458.

Easterly W & Rebelo S (1993b). Marginal Income Tax Rates and Economic Growth in Developing Countries. *European Economic Review* 37: pp. 409-417.

Edame E & Okoi W W (2014) *The Impact of Taxation on Economic Development in Nigeria: A Case of Small Scale Businesses in Calabar Metropolis (1980-2010).* Calabar: Department of Economics, Unpublished PGD Economics Thesis.

Enders W (1995) *Applied Econometric Time Series*. New York: John Wiley & Sons, Inc.

Engen E.M & Skinner J (1996) Taxation and Economic Growth. *National Tax Journal* 49(4): pp. 617-642.

Feld L P & Kirchgässner G (2001). *The Impact of Corporate and Personal Income Taxes on the Location of Firms and on Employment: Some Panel Evidence for Swiss Cantons*. Working Paper No. 455. Munich: Center for Economic Studies.

Fjeldstad H O and Heggstad K K (2011) *The Tax Systems in Zambia, Mozambique and Tanzania: Capacity and Constraints.* Bergen: Michelsen Institute.

Gale W G (2014) *Effects of Income Tax Changes on Economic Growth*. Washington D. C.: The Brookings Institution and Tax Policy Centre.

Galeotti G & Graham J (1994) *The International Handbook of Corporate and Personal Taxes.* London: Chapman & Hall.

Gorter J (2004) Reform the Zambian Tax System. Lusaka: DFIC Country Office.

GRZ (2017). *2018 Zambia National Budget.* Lusaka: GRZ.

Gujarati D N (1995) *Basic Econometrics*. New York: McGraw-Hill, New York.

Hampwaye G, Kaleng'a W and Siame G (2015) *Regional Mineral Value Chains: Implications for Zambia's Copper Sub-Sector Industrialization-Oriented Beneficiation.* In: Regional Industrialization, Regional integration. *TIPS Annual Forum*,14-15 July 2015, Johannesburg.

Harberger A C (1962) The Incidence of the Corporation Income Tax. *Journal of Political Economy* 70(3): pp. 215–40.

Hsieh C and Parker J A (2007) *Taxes and Growth in a Financially Underdeveloped Country: Evidence from the Chilean Investment Boom*. Working Paper 12104. Washington D. C.: National Burerau of Economic Research.

International Monetary Fund (IMF) (2011) *Zambia: 2009 IV Consultation*. Third Review. Washington D. C.: International Monetary Fund.

JCTR (2011) *Tax System in Zambia*. Lusaka: JCTR.

Keightley M P (2014) *The Corporate Income Tax System: Overview and Options for Reform.* CRS Report 7-7500. Washington D. C.: Congressional Research Service.

Keynes J M (1936) *The General Theory of Employment, Interest and Money*. London: Macmillan Cambridge University Press.

Kormendi K (2005) Government Debt, Government Spending, and Private Sector Behavior. *American Economic Review* 73: pp. 994-1010.

Lee Y & Gordon R H (2004) Tax Structure and Economic Growth. *Journal of Public Economics* 89, pp. 1027-1043.

Leibfritz W, Thornto J & Bibbee A (2006) *Taxation and Economic Performance*. Working Papers No. 176OCDE/GD (97)107. Paris: Organization for Economic Co-operation and Development (OECD) Economics Department.

Lewis S R Jr. (1984). *Taxation for Development: Principles and Application.* New York: Oxford University Press.

Marc P & Hall C (2006) *Economics: Texts and Application.* New York: Prentice Hall.

Mintz J M & Wilson T A (2000) *Taxes, Efficiency and Economic growth*. Toronto: Institute for policy analysis, University of Toronto.

Mulenga C (2005) *Broadening the Tax Base to the Informal Sector*. Lusaka: DFID Country office.

Musgrave R A & Musgrave P B (1989) *Public Finance in Theory and Practice*. Singapore: McGraw-Hill Bk Company.

Mwansa S and Chileshe C (2010). *Tax System in Zambia*. Lusaka: JCTR.

National Assembly of Zambia (2017). *The Income Tax Act No. 16 of 2017.* Lusaka: National Assembly of Zambia. Retrieved from: http://www.parliament.gov.zm/sites/default/files/documents/acts/The%20Income%20Tax%20%20Act%20No.%2016%20of%202017.pdf

OECD (2012) *Tax Policy Reform and Economic Growth*. OECD Tax Policy Studies No. 20. Paris: OECD.

Okafor E E (2012) The Impact of Income Tax Revenue on Economic Growth in Nigeria. *European Journal of Business and Management* 4(19): pp. 49-56.

Pesaran H, Shin Y &Smith R (2001) Bounds Testing Approach to the Analysis of Level Relationship. *Journal of Applied Econometrics* 16(3): pp. 289-326.

Renelt D (1991) *Economic Growth: A Review of the Theoretical and Empirical Literature.* Vol. 678. World Bank Publications. Washington D. C.: World Bank.

Slemord J (2003) The Truth about Taxes and Economic Growth. *Challenge* 46 (1): pp.5-14

Sloan (2013) *Economics*. Upper Saddle River: New Jersey: Prentice Hall.

Smith A (1776) An Inquiry into the Nature and Causes of the Wealth of Nations, ed. *Edwin Cannan* 1776: pp. 282-309.

Solow R M (1956) A Contribution to the Theory of Economic Growth. *The Quarterly Journal of Economics* 70(1): pp. 65-94.

Sorensen W E (2005a) *The Mechanics of Economic Development*. *Journal of Monetary Economics* 22: pp. 3-42.

Sørensen P B (2005b): Dual Income Taxation: Why and How? *Finanzarchiv* 61(4): pp. 559-586.

Takumah W (2014) *Tax Revenue and Economoic Growth in Ghana.* MPRA Paper No. 58532. Accessed: 28/05/2018. Retrieved from: http://mpra.ub.uni-muenchen.de/58532/

Truett L J & Truett D B (1987). *Macroeconomics*. St. Louis, Toronto, Santa Clara: Times Miller/ Mosby College Publishing.

World Bank (1991). *Lessons of Tax Reform.* Washington D. C.: World Bank.

Zambia Revenue Authority (ZRA) (2017). *The Tax System in Zambia*. Lusaka: Zambia Revenue Authority.

APPENDICES

A. VAR RESULTS

Vector Autoregression Estimates
Date: 05/31/18 Time: 19:54
Sample (adjusted): 1996 2015
Included observations: 20 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	LGDP	LCIT	LERT	LPAYE	LWTHT	LGFCF
LGDP(-1)	0.812981	6.398522	20.45138	0.516064	-1.013314	0.895626
	(0.25357)	(3.13359)	(8.39160)	(0.86112)	(1.59089)	(2.00626)
	[3.20619]	[2.04191]	[2.43713]	[0.59930]	[-0.63695]	[0.44642]
LCIT(-1)	0.019787	0.256484	-0.340952	0.046478	0.164307	0.067843
	(0.02659)	(0.32865)	(0.88010)	(0.09031)	(0.16685)	(0.21041)
	[0.74406]	[0.78043]	[-0.38740]	[0.51463]	[0.98476]	[0.32243]
LERT(-1)	0.010008	-0.097640	-0.024192	-0.092594	0.011927	0.014102
	(0.00966)	(0.11941)	(0.31978)	(0.03281)	(0.06062)	(0.07645)
	[1.03569]	[-0.81767]	[-0.07565]	[-2.82173]	[0.19673]	[0.18445]
LPAYE(-1)	0.084375	0.924274	0.014590	0.474462	0.370187	0.593363
	(0.03518)	(0.43480)	(1.16438)	(0.11948)	(0.22075)	(0.27838)
	[2.39813]	[2.12573]	[0.01253]	[3.97089]	[1.67699]	[2.13148]
LWTHT(-1)	0.033613	-0.375126	-0.084167	0.149490	0.227992	0.272002
	(0.03300)	(0.40776)	(1.09195)	(0.11205)	(0.20701)	(0.26106)
	[1.01873]	[-0.91998]	[-0.07708]	[1.33411]	[1.10134]	[1.04190]
LGFCF(-1)	-0.039134	0.185590	0.143547	0.145070	-0.557482	0.265344
	(0.02230)	(0.27557)	(0.73795)	(0.07573)	(0.13990)	(0.17643)
	[-1.75499]	[0.67349]	[0.19452]	[1.91572]	[-3.98482]	[1.50397]
LLF(-1)	-0.457420	-12.83281	-30.77732	0.972226	7.592779	-5.110777
	(0.46307)	(5.72265)	(15.3250)	(1.57260)	(2.90533)	(3.66389)
	[-0.98780]	[-2.24246]	[-2.00831]	[0.61823]	[2.61340]	[-1.39490]
C	8.561095	126.4735	254.1753	-18.65095	-101.0567	68.73831
	(5.22496)	(64.5705)	(172.916)	(17.7441)	(32.7817)	(41.3408)
	[1.63850]	[1.95869]	[1.46993]	[-1.05111]	[-3.08272]	[1.66272]
R-squared	0.998475	0.984455	0.955883	0.998349	0.994360	0.987687
Adj. R-squared	0.997585	0.975387	0.930148	0.997386	0.991070	0.980505
Sum sq. resids	0.004226	0.645446	4.628764	0.048742	0.166363	0.264576
S.E. equation	0.018767	0.231921	0.621072	0.063732	0.117744	0.148486
F-statistic	1122.068	108.5631	37.14318	1036.848	302.2479	137.5135
Log likelihood	56.24287	5.956683	-13.74435	31.79077	19.51441	14.87481
Akaike AIC	-4.824287	0.204332	2.174435	-2.379077	-1.151441	-0.687481
Schwarz SC	-4.425994	0.602625	2.572728	-1.980784	-0.753148	-0.289188
Mean dependent	11.14968	6.363210	4.255571	7.253933	5.576198	7.880093
S.D. dependent	0.381858	1.478274	2.349911	1.246660	1.246003	1.063457

Determinant resid covariance (dof adj.) 1.03E-18
Determinant resid covariance 2.89E-20

Log likelihood	251.2676
Akaike information criterion	-19.52676
Schwarz criterion	-16.73871

B. COINTEGRATION RESULTS

Date: 05/31/18 Time: 20:28
Sample (adjusted): 1997 2015
Included observations: 19 after adjustments
Trend assumption: Linear deterministic trend
Series: LGDP LCIT LERT LPAYE LGFCF
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.958510	130.0734	69.81889	0.0000
At most 1 *	0.883457	69.60945	47.85613	0.0001
At most 2	0.593839	28.76904	29.79707	0.0653
At most 3	0.281486	11.64992	15.49471	0.1745
At most 4 *	0.246166	5.369086	3.841466	0.0205

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.958510	60.46396	33.87687	0.0000
At most 1 *	0.883457	40.84041	27.58434	0.0006
At most 2	0.593839	17.11912	21.13162	0.1665
At most 3	0.281486	6.280833	14.26460	0.5775
At most 4 *	0.246166	5.369086	3.841466	0.0205

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

LGDP	LCIT	LERT	LPAYE	LGFCF
-63.86272	5.160363	3.863388	16.44305	-10.11761
19.11003	1.402014	-1.565564	-4.263996	-2.294611
40.91189	4.220402	-4.367952	-17.29546	7.355321
-15.29204	0.400888	1.546470	11.48228	-9.785364
-43.28418	2.964121	3.771970	10.23170	-6.983927

Unrestricted Adjustment Coefficients (alpha):

D(LGDP)	0.012491	-0.002203	-0.000367	-0.002611	-0.004789
D(LCIT)	0.042261	-0.017550	-0.145821	-0.038110	-0.040093
D(LERT)	-0.000388	-0.138967	0.089765	0.218200	-0.212285
D(LPAYE)	-0.009876	0.062935	-0.002250	-0.017475	-0.000325
D(LGFCF)	0.009118	0.147105	-0.057149	0.022691	-0.014837

1 Cointegrating Equation(s): Log likelihood 110.1536

Normalized cointegrating coefficients (standard error in parentheses)

LGDP	LCIT	LERT	LPAYE	LGFCF
1.000000	-0.080804	-0.060495	-0.257475	0.158427
	(0.00644)	(0.00161)	(0.00891)	(0.00857)

Adjustment coefficients (standard error in parentheses)

D(LGDP)	-0.797732
	(0.21009)
D(LCIT)	-2.698910
	(4.03579)
D(LERT)	0.024750
	(11.4781)
D(LPAYE)	0.630685
	(1.37728)
D(LGFCF)	-0.582319
	(3.33482)

2 Cointegrating Equation(s): Log likelihood 130.5738

Normalized cointegrating coefficients (standard error in parentheses)

LGDP	LCIT	LERT	LPAYE	LGFCF
1.000000	0.000000	-0.071726	-0.239473	0.012458
		(0.00287)	(0.02229)	(0.02641)
0.000000	1.000000	-0.138993	0.222782	-1.806462
		(0.03566)	(0.27654)	(0.32767)

Adjustment coefficients (standard error in parentheses)

D(LGDP)	-0.839836	0.061371
	(0.21516)	(0.01726)
D(LCIT)	-3.034298	0.193477
	(4.19904)	(0.33684)
D(LERT)	-2.630917	-0.196834
	(11.6787)	(0.93685)
D(LPAYE)	1.833369	0.037274
	(0.77464)	(0.06214)
D(LGFCF)	2.228857	0.253297
	(2.02572)	(0.16250)

3 Cointegrating Equation(s): Log likelihood 139.1334

Normalized cointegrating coefficients (standard error in parentheses)

LGDP	LCIT	LERT	LPAYE	LGFCF
1.000000	0.000000	0.000000	0.475213	-1.213043
			(0.23680)	(0.25796)
0.000000	1.000000	0.000000	1.607720	-4.181269
			(0.64647)	(0.70424)
0.000000	0.000000	1.000000	9.964064	-17.08577
			(3.07895)	(3.35408)

Adjustment coefficients (standard error in parentheses)

D(LGDP)	-0.854839	0.059823	0.053310
	(0.25231)	(0.02198)	(0.01948)
D(LCIT)	-9.000111	-0.421946	0.827687
	(3.66517)	(0.31923)	(0.28294)
D(LERT)	1.041538	0.182010	-0.176024
	(13.5521)	(1.18036)	(1.04618)
D(LPAYE)	1.741308	0.027777	-0.126853
	(0.90748)	(0.07904)	(0.07005)
D(LGFCF)	-0.109232	0.012103	0.054551
	(1.99606)	(0.17385)	(0.15409)

4 Cointegrating Equation(s): Log likelihood 142.2738

Normalized cointegrating coefficients (standard error in parentheses)

LGDP	LCIT	LERT	LPAYE	LGFCF
1.000000	0.000000	0.000000	0.000000	-1.171367
				(0.16542)
0.000000	1.000000	0.000000	0.000000	-4.040274
				(0.53662)
0.000000	0.000000	1.000000	0.000000	-16.21194
				(3.22843)
0.000000	0.000000	0.000000	1.000000	-0.087699
				(0.29230)

Adjustment coefficients (standard error in parentheses)

D(LGDP)	-0.814906	0.058776	0.049272	0.191149
	(0.24997)	(0.02140)	(0.01955)	(0.08414)
D(LCIT)	-8.417331	-0.437224	0.768751	2.854188
	(3.63019)	(0.31084)	(0.28391)	(1.22187)
D(LERT)	-2.295190	0.269484	0.161416	1.539095
	(12.8639)	(1.10150)	(1.00606)	(4.32981)
D(LPAYE)	2.008531	0.020771	-0.153877	-0.592469
	(0.83270)	(0.07130)	(0.06512)	(0.28027)
D(LGFCF)	-0.456226	0.021200	0.089643	0.771649
	(1.96572)	(0.16832)	(0.15373)	(0.66163)

C. VECM RESULTS

Table D1: Estimated VECM

Vector Error Correction Estimates
Date: 05/31/18 Time: 20:34
Sample (adjusted): 1997 2015
Included observations: 19 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1	CointEq2			
LGDP(-1)	1.000000	0.000000			
LCIT(-1)	0.000000	1.000000			
LERT(-1)	-0.071726 (0.00300) [-23.8915]	-0.138993 (0.03725) [-3.73164]			
LPAYE(-1)	-0.239473 (0.02328) [-10.2865]	0.222782 (0.28883) [0.77132]			
LGFCF(-1)	0.012458 (0.02758) [0.45163]	-1.806462 (0.34224) [-5.27837]			
C	-9.209397	6.804723			
Error Correction:	D(LGDP)	D(LCIT)	D(LERT)	D(LPAYE)	D(LGFCF)
CointEq1	-0.839836 (0.22472) [-3.73719]	-3.034298 (4.38576) [-0.69185]	-2.630917 (12.1980) [-0.21568]	1.833369 (0.80909) [2.26596]	2.228857 (2.11580) [1.05343]
CointEq2	0.061371 (0.01803) [3.40438]	0.193477 (0.35182) [0.54993]	-0.196834 (0.97851) [-0.20116]	0.037274 (0.06490) [0.57429]	0.253297 (0.16973) [1.49238]
D(LGDP(-1))	0.489228 (0.19587) [2.49778]	4.991031 (3.82255) [1.30568]	11.51644 (10.6316) [1.08323]	0.858533 (0.70519) [1.21745]	1.929142 (1.84409) [1.04612]
D(LCIT(-1))	-0.028819 (0.01842) [-1.56473]	-0.148984 (0.35945) [-0.41448]	0.977534 (0.99973) [0.97780]	-0.062020 (0.06631) [-0.93527]	-0.031823 (0.17341) [-0.18352]
D(LERT(-1))	-0.031496 (0.01054) [-2.98762]	-0.186470 (0.20574) [-0.90632]	-0.636248 (0.57223) [-1.11187]	0.034916 (0.03796) [0.91990]	0.153386 (0.09926) [1.54536]
D(LPAYE(-1))	-0.039048 (0.03800) [-1.02762]	0.541887 (0.74158) [0.73072]	-0.058241 (2.06255) [-0.02824]	-0.054258 (0.13681) [-0.39660]	-0.698569 (0.35776) [-1.95263]
D(LGFCF(-1))	0.040568	0.507015	-0.516597	-0.023340	-0.156557

	(0.02298)	(0.44852)	(1.24747)	(0.08274)	(0.21638)
	[1.76521]	[1.13041]	[-0.41411]	[-0.28207]	[-0.72353]
C	0.041733	-0.243028	-0.365470	0.191838	0.223239
	(0.01604)	(0.31312)	(0.87086)	(0.05776)	(0.15105)
	[2.60115]	[-0.77616]	[-0.41966]	[3.32107]	[1.47787]
R-squared	0.763421	0.233617	0.398877	0.862870	0.701358
Adj. R-squared	0.612870	-0.254081	0.016344	0.775605	0.511313
Sum sq. resids	0.002375	0.904684	6.998211	0.030789	0.210551
S.E. equation	0.014695	0.286782	0.797622	0.052906	0.138351
F-statistic	5.070865	0.479019	1.042726	9.887976	3.690482
Log likelihood	58.41761	1.963950	-17.47138	34.07790	15.81361
Akaike AIC	-5.307117	0.635374	2.681198	-2.745042	-0.822486
Schwarz SC	-4.909459	1.033032	3.078856	-2.347384	-0.424827
Mean dependent	0.057572	0.207997	0.284940	0.217953	0.175671
S.D. dependent	0.023617	0.256088	0.804221	0.111686	0.197909

Determinant resid covariance (dof adj.)	1.14E-11
Determinant resid covariance	7.39E-13
Log likelihood	130.5738
Akaike information criterion	-8.481453
Schwarz criterion	-5.996088

E. DIAGNOSTIC TESTS

Table E1: VEC Residual Normality Test

VEC Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: residuals are multivariate normal
Date: 05/31/18 Time: 20:43
Sample: 1995 2015
Included observations: 19

Component	Skewness	Chi-sq	df	Prob.
1	-0.777169	1.912641	1	0.1667
2	0.007446	0.000176	1	0.9894
3	0.587402	1.092630	1	0.2959
4	-0.131926	0.055115	1	0.8144
5	-0.121163	0.046488	1	0.8293
Joint		3.107050	5	0.6835

Component	Kurtosis	Chi-sq	df	Prob.
1	3.556627	0.245285	1	0.6204
2	2.541118	0.166703	1	0.6831
3	3.217521	0.037458	1	0.8465
4	1.741328	1.254201	1	0.2628
5	1.824623	1.093697	1	0.2957
Joint		2.797344	5	0.7312

Component	Jarque-Bera	Df	Prob.
1	2.157926	2	0.3399
2	0.166879	2	0.9199
3	1.130088	2	0.5683
4	1.309316	2	0.5196
5	1.140185	2	0.5655
Joint	5.904394	10	0.8232

Table E2: VEC Residual Serial Correlation LM Test

VEC Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 05/31/18 Time: 20:43
Sample: 1995 2015
Included observations: 19

Lags	LM-Stat	Prob
1	44.82263	0.0088
2	27.28761	0.3417

Probs from chi-square with 25 df.

Table E3: VEC Residual Heteroskedasticity Test

VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)
Date: 05/31/18 Time: 20:44
Sample: 1995 2015
Included observations: 19

Joint test:

Chi-sq	df	Prob.
212.1590	210	0.4453

Individual components:

Dependent	R-squared	F(14,4)	Prob.	Chi-sq(14)	Prob.
res1*res1	0.863134	1.801835	0.3012	16.39955	0.2896
res2*res2	0.818905	1.291992	0.4400	15.55920	0.3410
res3*res3	0.411561	0.199832	0.9898	7.819652	0.8985
res4*res4	0.871350	1.935156	0.2752	16.55566	0.2806
res5*res5	0.908866	2.849382	0.1609	17.26845	0.2422
res2*res1	0.563424	0.368729	0.9269	10.70505	0.7090
res3*res1	0.704166	0.680078	0.7364	13.37915	0.4969
res3*res2	0.701942	0.672873	0.7408	13.33691	0.5002
res4*res1	0.490109	0.274629	0.9690	9.312065	0.8106
res4*res2	0.766386	0.937306	0.5908	14.56134	0.4088
res4*res3	0.554812	0.356070	0.9334	10.54144	0.7216
res5*res1	0.747702	0.846733	0.6386	14.20634	0.4345
res5*res2	0.994313	49.95258	0.0009	18.89194	0.1691
res5*res3	0.755146	0.881160	0.6200	14.34776	0.4241
res5*res4	0.751085	0.862125	0.6302	14.27062	0.4298

F. ARDL MODEL

Dependent Variable: LGDP
Method: ARDL
Date: 05/31/18 Time: 21:03
Sample (adjusted): 1996 2015
Included observations: 20 after adjustments
Maximum dependent lags: 1 (Automatic selection)
Model selection method: Schwarz criterion (SIC)
Dynamic regressors (1 lag, automatic): LCIT LERT LPAYE LGFCF
Fixed regressors: C
Number of models evaluated: 16
Selected Model: ARDL(1, 0, 1, 0, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*

LGDP(-1)	0.334175	0.190633	1.752979	0.1051
LCIT	0.042528	0.014714	2.890355	0.0136
LERT	0.018073	0.008079	2.236935	0.0450
LERT(-1)	0.026687	0.010709	2.492046	0.0283
LPAYE	0.186148	0.061196	3.041841	0.0102
LGFCF	-0.051516	0.036592	-1.407852	0.1845
LGFCF(-1)	-0.055792	0.018660	-2.989860	0.0113
C	6.471722	1.857422	3.484250	0.0045

R-squared	0.999106	Mean dependent var	11.14968
Adjusted R-squared	0.998585	S.D. dependent var	0.381858
S.E. of regression	0.014363	Akaike info criterion	-5.359111
Sum squared resid	0.002476	Schwarz criterion	-4.960818
Log likelihood	61.59111	Hannan-Quinn criter.	-5.281360
F-statistic	1916.748	Durbin-Watson stat	2.427053
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

Cointegrating and Long Run Form

ARDL Cointegrating And Long Run Form
Dependent Variable: LGDP
Selected Model: ARDL(1, 0, 1, 0, 1)
Date: 05/31/18 Time: 21:06
Sample: 1995 2015
Included observations: 20

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LCIT)	0.042528	0.014714	2.890355	0.0136
D(LERT)	0.018073	0.008079	2.236935	0.0450
D(LPAYE)	0.186148	0.061196	3.041841	0.0102
D(LGFCF)	-0.051516	0.036592	-1.407852	0.1845
CointEq(-1)	-0.665825	0.190633	-3.492716	0.0044

Cointeq = LGDP - (0.0639*LCIT + 0.0672*LERT + 0.2796*LPAYE -0.1612 *LGFCF + 9.7199)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LCIT	0.063873	0.026824	2.381165	0.0347
LERT	0.067225	0.006614	10.164298	0.0000
LPAYE	0.279574	0.034384	8.130964	0.0000
LGFCF	-0.161166	0.042211	-3.818124	0.0024
C	9.719853	0.104760	92.782130	0.0000

BOUNDS TESTING

ARDL Bounds Test
Date: 05/31/18 Time: 21:07
Sample: 1996 2015
Included observations: 20
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	K
F-statistic	2.554005	4

Critical Value Bounds

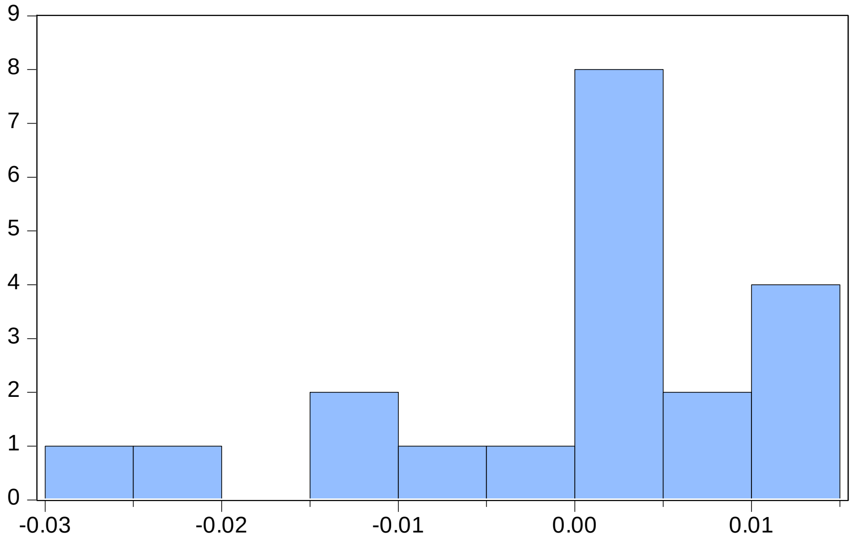
Significance	I0 Bound	I1 Bound
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06

Test Equation:
Dependent Variable: D(LGDP)
Method: Least Squares
Date: 05/31/18 Time: 21:07
Sample: 1996 2015
Included observations: 20

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LERT)	0.005725	0.008020	0.713884	0.4890
D(LGFCF)	0.027090	0.034466	0.786003	0.4471
C	2.749927	1.341776	2.049469	0.0629
LCIT(-1)	0.019493	0.024254	0.803681	0.4372
LERT(-1)	0.013051	0.010771	1.211688	0.2490
LPAYE(-1)	0.066320	0.035965	1.844010	0.0900
LGFCF(-1)	-0.018276	0.033544	-0.544841	0.5958
LGDP(-1)	-0.288351	0.137311	-2.099986	0.0575

R-squared	0.562033	Mean dependent var	0.057710
Adjusted R-squared	0.306553	S.D. dependent var	0.022996
S.E. of regression	0.019149	Akaike info criterion	-4.783938
Sum squared resid	0.004400	Schwarz criterion	-4.385645
Log likelihood	55.83938	Hannan-Quinn criter.	-4.706187
F-statistic	2.199907	Durbin-Watson stat	2.254050
Prob(F-statistic)	0.110039		

DIAGNOSTICS



Series: Residuals	
Sample 1996 2015	
Observations 20	
Mean	-2.31e-15
Median	0.003867
Maximum	0.013757
Minimum	-0.028566
Std. Dev.	0.011415
Skewness	-1.043358
Kurtosis	3.314544
Jarque-Bera	3.711103
Probability	0.156367

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.500073	Prob. F(2,10)	0.2693
Obs*R-squared	4.615557	Prob. Chi-Square(2)	0.0995

Test Equation:
Dependent Variable: RESID
Method: ARDL
Date: 05/31/18 Time: 21:10
Sample: 1996 2015
Included observations: 20
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGDP(-1)	-0.130512	0.212153	-0.615179	0.5522
LCIT	0.006849	0.015694	0.436395	0.6718
LERT	0.007981	0.009728	0.820398	0.4311
LERT(-1)	0.003460	0.010769	0.321287	0.7546
LPAYE	0.040539	0.066162	0.612721	0.5537
LGFCF	-0.030455	0.043560	-0.699146	0.5004
LGFCF(-1)	-0.001416	0.018247	-0.077603	0.9397
C	1.313127	2.084561	0.629930	0.5429
RESID(-1)	-0.328505	0.301337	-1.090157	0.3012
RESID(-2)	-0.581005	0.396455	-1.465499	0.1735

R-squared	0.230778	Mean dependent var	-2.31E-15
Adjusted R-squared	-0.461522	S.D. dependent var	0.011415
S.E. of regression	0.013800	Akaike info criterion	-5.421486
Sum squared resid	0.001904	Schwarz criterion	-4.923620
Log likelihood	64.21486	Hannan-Quinn criter.	-5.324297
F-statistic	0.333350	Durbin-Watson stat	2.437764
Prob(F-statistic)	0.943330		

Heteroskedasticity Test: White

F-statistic	0.510425	Prob. F(7,12)	0.8102
Obs*R-squared	4.588686	Prob. Chi-Square(7)	0.7100
Scaled explained SS	1.911728	Prob. Chi-Square(7)	0.9646

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 05/31/18 Time: 21:11
Sample: 1996 2015
Included observations: 20

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.022634	0.023287	-0.971974	0.3502
LGDP(-1)^2	0.000219	0.000224	0.981337	0.3458
LCIT^2	-1.06E-05	1.92E-05	-0.551896	0.5911
LERT^2	-1.23E-05	2.09E-05	-0.589085	0.5667
LERT(-1)^2	-2.22E-05	2.42E-05	-0.916722	0.3773
LPAYE^2	-8.43E-05	6.06E-05	-1.391168	0.1894
LGFCF^2	4.77E-06	2.60E-05	0.183288	0.8576
LGFCF(-1)^2	1.96E-05	1.86E-05	1.051557	0.3137

R-squared	0.229434	Mean dependent var	0.000124
Adjusted R-squared	-0.220062	S.D. dependent var	0.000193
S.E. of regression	0.000213	Akaike info criterion	-13.77752
Sum squared resid	5.47E-07	Schwarz criterion	-13.37922
Log likelihood	145.7752	Hannan-Quinn criter.	-13.69977
F-statistic	0.510425	Durbin-Watson stat	2.366484
Prob(F-statistic)	0.810189		

G. GRANGER CAUSALITY TESTS

Pairwise Granger Causality Tests
Date: 05/31/18 Time: 20:48
Sample: 1995 2015
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
LCIT does not Granger Cause LGDP	19	6.02136	0.0130
LGDP does not Granger Cause LCIT		2.57449	0.1117
LERT does not Granger Cause LGDP	19	1.93032	0.1818
LGDP does not Granger Cause LERT		4.98745	0.0232
LPAYE does not Granger Cause LGDP	19	10.4561	0.0017
LGDP does not Granger Cause LPAYE		1.94789	0.1793
LGFCF does not Granger Cause LGDP	19	4.60425	0.0291
LGDP does not Granger Cause LGFCF		5.89988	0.0139
LERT does not Granger Cause LCIT	19	0.20730	0.8152
LCIT does not Granger Cause LERT		5.50690	0.0172
LPAYE does not Granger Cause LCIT	19	1.62558	0.2318
LCIT does not Granger Cause LPAYE		0.22615	0.8005
LGFCF does not Granger Cause LCIT	19	1.89233	0.1873
LCIT does not Granger Cause LGFCF		1.37432	0.2851
LPAYE does not Granger Cause LERT	19	4.05146	0.0409
LERT does not Granger Cause LPAYE		1.70461	0.2175
LGFCF does not Granger Cause LERT	19	3.78722	0.0485
LERT does not Granger Cause LGFCF		0.29174	0.7514
LGFCF does not Granger Cause LPAYE	19	0.88315	0.4353
LPAYE does not Granger Cause LGFCF		7.95286	0.0049