ESSAYS ON THE SIZE OF KENYA'S INFORMAL SECTOR, TAX PRODUCTIVITY AND OPTIMAL TAX RATIO

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Thesis Submitted to School of Economics in Partial Fulfillment of the Requirements for the Award of the Degree of Doctor of Philosophy in Economics of the University of Nairobi, Kenya

August 2022

DECLARATION

This thesis is my original work and has not been defended for a degree award in any other university or institution of higher learning.

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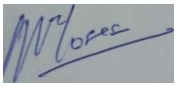
Signed: …  ……. Date: ……3rd …August…2022….

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DEDICATION

To my Mum, Wife and Children

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Despite all this support, the thesis's views exclusively belong to the author and do not exemplify the opinions of any individual recognized in this thesis. I, therefore, bear full responsibility for any errors.

ABSTRACT

The role of a sound tax system is yielding enough tax revenue. The ability of a tax system to raise adequate tax revenue directly influences the size of public goods provided by a given country's government. Kenya's tax revenue has recently failed to match public expenditure. This has resulted in a continued widening of the budget deficit from 4.2 percent of Gross Domestic Product (GDP) in 2014 to 7.8 percent in 2020. This failure to raise adequate tax revenue may be linked to Kenya's informal sector that is substantial in size, which in turn affects tax revenue, unresponsive tax system to GDP growth and tax ratio that is not optimal. However, these concepts are yet to be examined using Kenyan data. This thesis therefore seeks to fill this knowledge gap. The objectives of the thesis are to estimate the effect of the informal sector's size on tax revenue, estimate tax productivity of tax reforms, and estimate the optimal tax ratio in Kenya. The novelty of the study findings arises from the separation of informal sector's GDP from recorded country's GDP in the estimation of tax productivity of tax reforms using ARDL, VECM and VAR models. This study uses annual time series data for 1970 and 2018 period. The study established that Kenya's informal sector accounts for about 32 percent of national income. In estimating the effects the informal sector has on size of tax revenue, the study finds an inverse and statistically significant link between the two. This means that the informal sector negatively influences tax revenue in Kenya. In estimating the tax productivity of Kenya's tax reforms, a buoyancy coefficient of greater than one is found. For tax elasticity, the study finds a coefficient of less than a unit. These findings show that Kenya's tax system responds slowly to changes in GDP. The discretionary tax reforms are found to be effective in increasing tax revenue.

Further, the study finds an optimal tax ratio of 15.87 percent of GDP. From the thesis's findings, a number of policy implications have been made. First, since Kenya's informal sector might largely linked to poor governance, a good policy package could assist streamline regulatory and tax frameworks while at the same time improve efficiency of public revenue mobilization. In addition, there is need for regulatory enforcement that includes strengthening of public service delivery aimed at boosting tax morale. Further, Government of Kenya should encourage cashless transactions to track incomes earned by businesses in Kenya. Thirdly, to ensure the tax system responds to changes in GDP, the Government needs to embrace constant review of the tax system to remove some tax exemptions that may erode the effective tax base, widen tax coverage, and adjust the tax rate for inflation regularly. Fourthly, the Government should aim to reduce the tax ratio to attain an optimal tax ratio. This can be achieved by tapping more tax from the informal sector and reviewing current tax rates downwards.

TABLE OF CONTENTS

DECLARATION ..... **ii**

ACKNOWLEDGEMENTS ..... **iv**

ABSTRACT ..... **v**

TABLE OF CONTENTS ..... **vi**

LIST OF TABLES ..... **xi**

LIST OF FIGURES ..... **xii**

LIST OF ABBREVIATIONS AND ACRONYMS ..... **xiii**

OPERATIONAL DEFINITION OF KEY TERMS ..... **xiv**

CHAPTER ONE **1**

INTRODUCTION **1**

1.1 Background of Study 1

1.2 A Review of Tax Policy and Budget Deficits in Kenya 1

1.2.1 Informal Sector in Kenya 4

1.2.2 Tax Reforms Attempts in Kenya 5

1.2.3 Tax Revenue Productivity of Tax System in Kenya 7

1.3 Kenya's Optimal Tax Ratio 8

1.4 Statement of the Problem 1

1.5 Research Questions 11

1.6 Objectives of Study 12

1.7 Significance of Study 12

1.8 Contribution of the Study to Knowledge 12

1.9 The Organization of Study 12

CHAPTER TWO **14**

THE SIZE OF THE INFORMAL SECTOR AND TAX REVENUE IN KENYA **14**

2.1 Introduction 14

2.2 The Informal Sector and Tax Revenue Nexus 17

2.3 Overview of Informal in Kenya 18

2.4 Statement of Problem 1

2.5 Objectives of the Study 21
2.6 Significance of the Study 21
2.7 Literature Review 21
2.7.1 Theoretical Literature Review 21
2.7.2 Empirical Literature Review 23
2.8 Overview of Literature 27
2.9 Methodology 1
2.9.1 Theoretical Framework 27
2.9.2 Empirical Model 30
2.9.3 Description of the variables, their Measurement and the Expected Signs 31
2.9.4 Data Source and Type 32
2.9.5 Pre-estimation Test 33
2.9.6 Estimation Technique 36
2.9.7 Post-estimation Tests 37
2.10 Empirical Findings and Discussion 38
2.10.1 Estimation of Size of Informal Sector in Kenya 38
2.10.2 Estimating Effect of Size of Informal Sector on Kenya's Tax Revenue 43
2.11 Conclusions and Policy Implications 47
2.11.1 Conclusions 47
2.11.2 Policy Implications 48
2.11.3 Limitations of the Study 48
2.11.4 Areas for Further Research 49
CHAPTER THREE 50
TAX REVENUE PRODUCTIVITY OF TAX REFORMS IN KENYA 50
3.1 Introduction 50
3.2 Tax Revenue and Tax Structure in Kenya 51
3.3 Kenya Economic Performance From 1970 53
3.4 Tax Reforms in Kenya 53
3.5 Determinants of Tax Revenue 56
3.6 Statement of the Problem 50
3.7 Objectives of the Study 58
3.8 Significance of the Study 59
3.9 Scope of Study 59

3.10 Theoretical Literature Review 60
3.10.1 Measuring Tax Performance 60
3.10.2 The Benefit Principle 61
3.10.3 Ability to Pay Theory 61
3.10.4 Theory of Fiscal Policy 62
3.10.5 The Theory of the Cost of Service 62
3.11 Empirical Literature Review 62
3.12 Overview of Literature 65
3.13 Methodology 50
3.13.1 Introduction 62
3.13.2 Theoretical Framework 66
3.13.3 Empirical Model 68
3.13.4 Variable Description, their measurement and expected Signs 70
3.13.5 Type of Data and its Source 71
3.13.6 Pre-estimation Test 71
3.13.7 Vector Error Correction Model (VECM) 75
3.14 Empirical Results and Discussion 78
3.15 Conclusions and Policy Implications 86
3.15.1 Conclusions 86
3.15.2 Policy Implication 86
3.15.3 Limitations of Study 87
3.15.4 Areas for Further Research 88
CHAPTER FOUR 89
ESTIMATING THE OPTIMAL TAX RATIO FOR KENYA 89
4.1 Introduction 89
4.2 The Tax to GDP Ratio in Kenya 91
4.3 Budget Deficit in Kenya 93
4.4 Economic Growth and Taxation in Kenya 94
4.5 Distribution of Indirect and Direct Tax Burden in Kenya 95
4.5.1 Indirect tax 95
4.5.2 Direct Taxes 98
4.6 Statement of the Problem 89
4.7 Objectives of the Study 99

4.8 Significance of the Study 100
4.10 Literature Review 101
4.10.1 Theoretical Literature Review 101
4.10.2 Empirical Literature Review 107
4.10.3 Overview of Literature 110
4.11 Methodology 110
4.11.1 Introduction 110
4.11.2 Theoretical Framework 110
4.11.3 The Empirical Model 114
4.11.4 Variables Description, Measurement, Expected Signs and Source 115
4.11.5 Data Type and the Source 115
4.11.6 Pre-estimation Test 116
4.11.7 Estimation Technique-Vector Autoregressive (VAR) Model 120
4.11.8 Post-estimation Tests 121
4.12 Empirical Findings 123
4.12.1 Descriptive Statistics 123
4.12.2 Stationarity Test Results 124
4.12.3 Lag Length Selection 129
4.12.4 Johansen Cointegration Test 129
4.12.5 Unrestricted VAR Regression Results 129
4.13 Conclusions and Policy Implications 134
4.13.1 Conclusions 134
4.13.2 Policy Implications 135
4.13.3 Limitations and Areas for Further Research 136
CHAPTER FIVE 110
SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS 137
5.1 Introduction 137
5.2 Summary of the Thesis 137
5.3 Conclusions 138
5.4 Policy Implications 138
5.5 Limitations of the Study and Areas for Further Research 140
REFERENCES 141
APPENDIX 154

LIST OF TABLES

Table 2.1: A Description of Enterprise Informality 15
Table 2.1: A Description of Enterprise Informality Continued 15
Table 2.2: The Variables Definition, Measurement and Priori Expected Signs 31
Table 2.2 Variables Definition, Measurement and Priori Expected Signs Continued 32
Table 2.3: Descriptive Statistics 38
Table 2.4: Correlation Matrix 39
Table 2.5: ARDL Bounds Test (Cointegration Test) 40
Table 2.6: Short-run estimates 43
Table 2.7: Long-run estimates 41
Table 2.8: Descriptive Statistics 44
Table 2.9: Correlation Matrix 44
Table 2.10: ARDL Bounds Test 45
Table 2.11: ARDL Short Run Results 46
Table 3.1: Variables, Description, Measurement and Expected Signs 70
Table 3.2: Descriptive Statistics 78
Table 3.3: Correlation Matrix 79
Table 3.4: The Augmented Dickey-Fuller and Phillips-Perron Unit Root Tests 80
Table 3.5: Zivot Andrews Unit Root Test Results 81
Table 3.6: The Johansen Cointegration for Bouyancy Model 82
Table 3.7: The Johansen Cointegration for Elasticity Model 82
Table 3.8: Gregory-Hansen Cointegration Test 84
Table 3.9: VECM Results 84
Table 4.1: Description of Variables, Their Measurements, Expected Signs and their Source 115
Table 4.2: Descriptive Statistics 124
Table 4.3: The Augmented Dickey-Fuller and Phillips-Perron Unit Root Tests 125
Table 4.4: Zivot Andrews Unit Root Test 126
Table 4.5: Johansen Cointegration Tests 129
Table 4.6: Regression Results 130
Table A.1: The Augmented Dickey Fuller and Phillips-Perron Unit Root Tests 157
Table A.2: The Zivot -Andrews Unit Root Test 158
Table A.3: The Augmented Dickey Fuller and Phillips-Perron Unit Root Tests 159
Table A.4: Zivot Andrews Unit Root Test 160
Table A.5: Lag Selection for Buoyancy Model 161
Table A.6: Lag Selection for Elasticity Model 161
Table A.7: Selection-order Criteria 161

LIST OF FIGURES

Figure 1.1: Budget Deficits (% of GDP) Trends (1990-2018) 4
Figure 1.2: Trends in Kenya's Informal Sector Employment (1970-2018) 8
Figure 1.3: Kenya's Tax Ratio (1970-2018) Trends (Measured as a % of GDP) 10
Figure 2.1: Trends of Size of Informal Sector (1970-2018) 19
Figure 2.2: The Relationship between Tax Rate and Output in an Economy 28
Figure 2.3: The Computed Estimates of Size of Kenya's Informal Sector, 1970-2018 43
Figure 4.1: Trends in Kenya's Tax Ratio (1970-2018) 91
Figure 4.2: Trends in Kenya's Budget Deficit (1970-2018) 93
Figure 4.3: Lorenz and Concentration Curves for Market Income and VAT 96
Figure 4.4: Lorenz and Concentration Curves for Market Income and Excise Tax 97
Figure 4.5: Lorenz and Concentration Curves for Market Income and Direct Tax 98
Figure 4.6: The Laffer curve 103
Figure A.1: Currency Demand Function with Tax 154
Figure A.2: Currency Demand Function where Tax is Assumed to be Zero 154
Figure A.3: Currency Demand Function with Least Tax 155
Figure A.4: CUSUM of Squares Parameter Stability of Tax Function Model 155
Figure A.5: Model Stability for the Buoyancy Model 156
Figure A.6: The Model Stability for Elasticity Model 156

LIST OF ABBREVIATIONS AND ACRONYMS

AERC	African Economic Research Consortium
ARDL	Autoregressive Distributed Lag
ECM	The Error Correction Model
ETR	The Electronic Transfer Registers
GDP	The Gross Domestic Product
IMF	International Monetary Fund
ITMS	The Integrated Tax Management System
KES	Kenyan Shillings
KRA	The Kenya Revenue Authority
MIMIC	Multiple Indicators Multiple Causes
RARMP	Revenue Administration Reforms Modernization Programmes
SME	Small and Medium Enterprises
TMP	Tax Modernization Programme
UK	United Kingdom
USA	United States of America
VAR	Vector Autoregressive
VECM	Vector Error Correction Model

OPERATIONAL DEFINITION OF KEY TERMS

Ability-to-pay principle: this is the idea that taxpayers ought to contribute to the cost of providing public goods by the government according to their capability so that the tax burden is shared among the members of the society in a manner that is equitable.

Benefit received principle: the idea that tax paid by a taxpayer is a function of the benefits obtained from the public goods and services.

Budget deficit: this is a situation where government revenue is less than government expenditure.

Buoyancy: this is the response of a country's tax revenue to variation in a country's income following the government's intervention in the form of discretionary measures introduced during a given period.

Cointegration: this is a case of linear combination of non-stationary variables.

Deficit financing: government effort to get funds to finance budget deficit.

Domestic borrowing: the act of borrowing money by the government from within the economy.

Tax elasticity: this is the response of a country's tax revenue to changes in the country's national income without any intervention from tax authorities.

Equity of a tax: the idea that tax revenue is shared in a fair manner among taxpayers.

Informal sector: this is part of the economy which is neither fully taxed nor fully regulated by the government.

Laffer curve: a concave curve drawn by plotting tax revenue against tax rates.

Optimal taxation: tax level that reduces the distortion and inefficiency in the market under given economic constraints.

Private good: this is a commodity characterized by rivalry and excludability in consumption.

Productivity of a tax system: tax yield of a tax system per unit base.

Public good: a commodity that is characterized by non-rivalry and non-excludability in consumption.

Stationary series: time series data where the mean, variance and covariance are time-independent.

Tax: Involuntary payment to government for which payer does not obtain direct benefits.

Tax base: is legal description of object regarding which tax applies.

CHAPTER ONE
INTRODUCTION

1.1 Background of Study

A fundamental aim of any tax system is to mobilize adequate tax revenue that can support the increasing needs of the citizens. However, this objective has not been met by the tax systems of many countries in the world. The failure to meet the required tax revenue implies that nations resort to sources of financing such as borrowing (both within and internationally) to finance budget deficits. However, as remedial strategy over time, a number of economies have restructured their tax systems to increase tax revenue from the reform process (Muriithi and Moyi, 2003).

The response to whether economic growth leads to increased tax mobilization and therefore reduction in budget deficit relies on a vital component of the tax system known as tax elasticity. Economic growth may, however, fail to increase tax revenue naturally, and therefore government may be forced to intervene through implementation of various tax legislation or reforms. Tax elasticity is a natural reaction of tax revenue to variations in a country's output, while tax buoyancy is its response to variations in GDP after the intervention of the tax authorities through tax reforms (Wawire, 2006; Moyi and Muriithi, 2003; Wawire, 2017).

In Kenya, the prominence of tax revenue in determining economic prosperity is shown by the attention placed on problems facing the country's tax system. The Tax Management Administration (TMA) Guidelines of 1986 and the Kenya long term strategic plan (commonly known as the Vision 2030) include tax and related reforms touching inclusively most aspects of the county's tax policy. These documents emphasize the need to realize increased taxes that are not a burden to taxpayers. Further, there are suggestions of making the tax base broad by tapping additional income generating activities into the tax net and having a solid tax administration (Wawire, 2017).

The government uses tax revenue to perform its functions, including expenditures on security, property protection, energy, waste management, and infrastructural development. Tax revenue is also crucial in funding the education system and health sector in Kenya (Nyaga et al., 2016). The

challenge faced by the Kenyan government is the inability to mobilize adequate tax revenue to service the country's annual budget. For many years, KRA has not been able to meet tax targets. For example, during the 2016/2017 fiscal year, KRA ran short of KES 60 billion from its target. The factors contributing to this dismal performance in tax revenue include tax evasion, a slow-growing economy and corruption (Republic of Kenya, 2018). To remedy sluggish tax revenue mobilization, the government proposed to amend the tax rate. One of the proposals was to raise tax rate from 30 to 35 percent for individuals who earn KES 750,000 and above per month. The main aim of this model was to make high-income earners contribute more to the exchequer while cushioning low-income earners (The National Treasury, 2018). But this measure presents another challenge in terms of meeting its intended objective. In Kenya, the proportion of individuals in the income bracket in question is very small, indicating that the measure can yield meagre tax revenue. The average income of an employee in the Kenyan private sector is KES 56,624 per month, while in the public sector it is KES 57,915 per month. The figure implies that the tax measure is leaving out a large population of income earners (Republic of Kenya, 2018).

1.2 A Review of Tax Policy and Budget Deficits in Kenya

Several government documents such as Kenya's long term plan (i.e.Vision 2030) or specific guidelines (i.e. TMA) clearly pointed out on the then shortfalls of Kenya's tax structure to raise targeted or desired tax revenue as the key influencer of establishment of the country's tax policy. Failed tax targets collection remains a key influencer of the vicious cycles of government budget deficit resulting to over reliance on un-sustained government borrowing (internal or/and external) and deficit financing.

The widening fiscal gap has also made the government seek financial assistance from donors. Again, this approach is not sustainable since donors place conditions that should be met before they advance such assistance (Omondi et al., 2014). Equally, there is a risk associated with deficit financing through sources such as grants. For example, scholars such as Wawire, (2017) have not only pointed out on a country's reduced economic and political independence resulting from over reliance on grants, but have also revealed that grants are un-sustainable and hence, tax revenue remains the certain and sustainable source of government revenue.

Stylized facts reveals that the Kenyan's fiscal performance exhibit a mixed fortune of budget position. For instance the country's budget deficit, for a long period, has been associated over-expenditures (Menjo and Kotut, 2015). This has led to weak overall economic performance and increased public debt. The Kenyan government, just like most developing countries, has for the past several years been a perpetual victim of poor fiscal performance by recording increasing budget deficit persistently. According to the work by Ouma, (2019) and that of the Republic of Kenya, (2020) records, Kenya's budget deficit stood at 6.85 percent of GDP in financial year 2017/2018 to about 7.8 percent preceding year (2019/2020) reflecting a steady increase of about one percent.

This steady increase in the country's budget deficit and its associated impact of being unable to support the ever expanding Kenya's fiscal policy had led to raising public debt. Statistic from the Republic of Kenya, (2020) records shows that in a span of about six years (from 2014 to 2020), the share of public debt rose by about 17.6% of the GDP (i.e, from 48% in 2014 to 65.6% in 2020). Figure 1.1 shows a trend of stylized facts on Kenya's budget deficit.

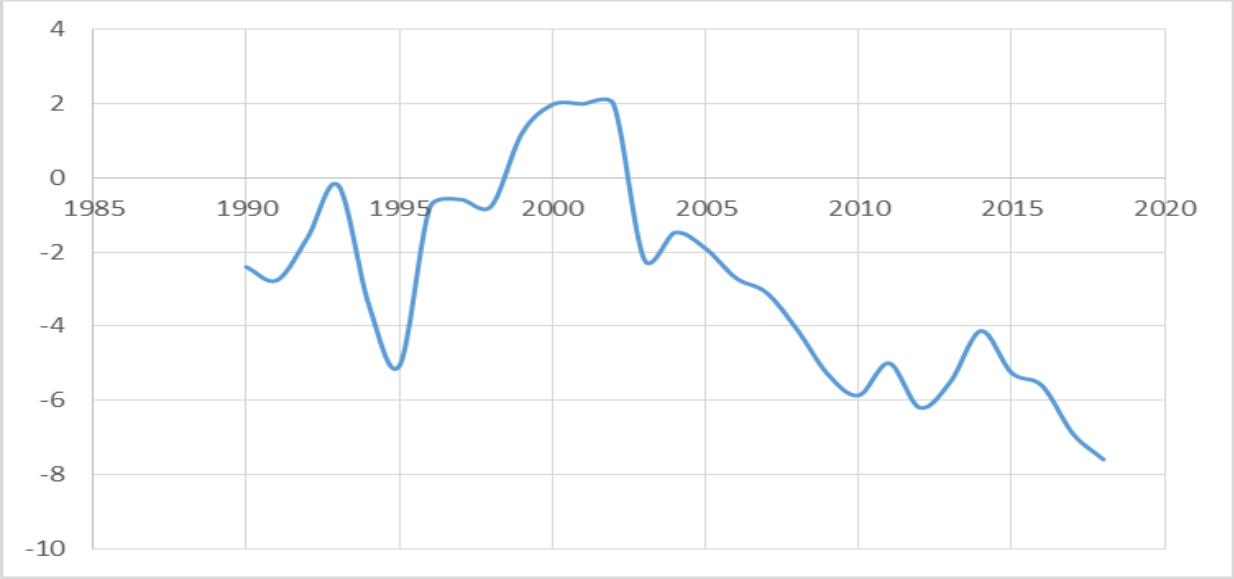

Figure 1.1: Kenya's Budget Deficits as a % of GDP Trends (1990-2018)
Source: International Monetary Fund (2019)

In Figure 1.1, points along the horizontal line (financial year) marked zero represent a balanced budget. Points above the 'zero horizontal line' represents a budget surplus while points below this line represent a budget deficit. It's evident that the Kenyan budget was a surplus between 1999 and 2003. Both before this period and after this period, the budget remained a deficit. Further, after 2003, the deficit has worsened to a tune of 6.91% and 7.62% of the Kenya's in 2017 and 2018, respectively. To counter increasing budget deficits, the Government of Kenya has constantly been reviewing its tax policy.

1.2.1 Informal Sector in Kenya

The informal sector commands a large share of Kenya's economic activities. However, the industry is characterized by tax evasion. Tax evasion mainly result from un-reasonably high tax rates with the characteristic "excess burden" on these informal taxpayer. In addition, if the probability of being detected is low and the penalty imposed on the defaulter is insufficient, individuals may take them as incentives to resort to the informal sector. Activities that generate income in informal sector are unrecorded by government, forming part of the country's GDP, but no tax revenue is obtained from them (Ahmed and Hussain, 2008).

Kenyan's informal economy sector dates back to early 1970s after the American government imposed a coffee trade embargo on Ugandan produced coffee. This embargo saw an emergence

of a boom in the commodity (coffee) smuggling across the border of the two countries as the Kenyan small scale traders took the opportunity. Over time, the informal economy has revolved with the current involving a sector with unrecorded businesses most of which are made of a segment that are self-employed population. Most common business under informal sector include, but not limited to: those dealing with the retailing the used clothes "*Mutumba* or second-hand clothes as they are commonly known in the Kenyan Market"; mobile vender (commonly known as hawkers) selling small scale portable goods along the streets of major towns; roadside barbers and saloons; small scale dressmakers and shoe makers/shiners; waged works such as those working in construction sites; maids and housekeepers and those working in the Jua Kali sector (Masinde and Makau, 2010).

Majority of these informal sector economy are both profitable and meet the minimum threshold monthly statutory taxable revenue income set by the Kenyan government of about KES 11,135(IEA, 2012). These informal sector enterprises have been associated with employment of most of the informal employees with limited records and non-accounted income to the relevant authorities such as KRA. This lack of proper recording and un-accountability by informal sector economy has hindered the high tax potential of the KRA. Thus KRA's ability to penetrate and reduce the ever increasing informal sector has been partly be hindered by lack of proper record by informal sector and partly by the high administrative costs involved in their attempts to tax this group of person.

1.2.2 Tax Reforms Attempts in Kenya

Tax revenue is essential for sustainability of both developing and developed countries. Many countries in the world have been striving to restructure their tax systems to increase tax income revenue. The need to increase tax income revenue is geared towards meeting the increasing public sector needs (Menjo and Kotut, 2015). Tax reforms have been adopted in all countries to increase tax productivity of their respective tax systems. As early mid-1963, Kenya's main source of revenue- tax and fees. This mode of financing government spending was an inheritance from her colonial government. These tax and fee revenue was then supplemented by other revenue sources such as foreign direct Investment Inflows, which was reliable till the great depression of 1970s, when the major oil shock occurred, throwing the country into a major fiscal

crisis. In an effort to avoid further fiscal crisis, the country adoption some key tax revenue reforms in her tax system (Eissa and Jack, 2009).

Some of these tax reforms include, first a sale's tax, through the Kenya Sales Tax Act of 1973, which was a percentage of the total sales (currently, the sales tax in Kenya is approximately sixteen percent of the total sale value of large enterprises and about three percent for smaller business). The rationale behind the introduction of this type of tax being to generate more revenue as well as counter the then increase in government budget deficit resulting from higher fuel prices. However, the sales tax was later found to be among the "narrow-based" taxes that were not able to raise the expected revenue to solve the ever rising budget deficit.Then followed a trade tax that mainly aimed at correcting unfavorable trade by complementing both the import substitution policies as well as export-led growth strategies (Eissa and Jack, 2009). The trade tax was established in the period when both corporate and personal income taxes were specifically designated for the country's distributive role (Karingi and Wanjala, 2005). Despite hyped expectation of these reforms in the Kenyan's tax revenue collection, the reforms did not achieve much of their initial projections mainly due to insufficient personal income tax revenue from the higher paid tax schedule (Eissa and Jack, 2009).

A rise in the Kenya's public expenditure in 1980s further worsened the budget deficit position. In correcting this ballooning fiscal disequilibrium, the government turned to Tax Modernization Programme (and henceforth TMP) to increase the collection to slightly below a quarter (approximately 22%) of her total GDP annually. By 1992, the TMP targets were further increased to above quarter (approximately 28%) of GDP (Eissa and Jack, 2009). in almost in the same period (1990 to be specific), the narrow-based sales tax was then later replaced Value Added Tax (henceforth VAT) which was a broad-based tax that was applicable to both imported gods and services as well as domestically produced goods and services. A further rationalized income tax with a reduced number of taxable brackets (by 30 percent) and marginal tax rate (by 65 percent) was implemented (Mutua, 2012).

By 1995, a major administrative reform that saw the establishment of Kenya Revenue authority (henceforth KRA) under the then Ministry of Finance, with a sole goal of centralizing revenue collection (Eissa and Jack, 2009). The established KRA undertook several other in-house

reforms aimed specifically to seal the loopholes through which tax collection was lost among its staff and second, raise the tax payer's confidence (Omondi et al., 2014). By the financial year 1995/96 two tax reforms (KRA and TMP) were responsible of raised tax collection from about 16% to 25% of the total GDP- a great milestone in Kenyan's tax collection history. By 2000, the tax collection had stabilized to about 23% of the total GDP and fluctuating along the same value (Omondi et al., 2014). Further reforms aimed at increasing the tax collection include: the introduction of a PIN with self-assessment annul returns in 1997 (Mutua, 2012). In the financial year 2004/2005 KRA further introduced Revenue Administration Reform and Modernization Programme strategy to automate, integrate and modernize most of their processes, aiming to increase revenue collection and (Kondo, 2015). For instance, in 2005, the first automation processes started with an introduction of the "Simba system and Document Processing Centre (DPC)" (Atambo and Katuse, 2017). This saw over 90 percent of the KRA processes such as customs automated. In the same year, an Electronic Tax Register (ETR) reducing the tax loss resulting from enterprise's poor record-keeping was introduced and become operation in the same year. Later, in 20008, an Integrated Tax Management System (ITMS) aiming at automating both registration and filing of returns online was introduced (Omondi et al., 2014).

To raise more tax revenue, the government proposed reforms in income tax. Among these reforms was the imposition of tax on rental income, professional fees, royalties, rent and interest. The other reforms included imposition of tax on dividends received by the resident company that holds 25 percent of shares in a company. On a pension, the government proposed imposition of a lumpsum tax on benefits received by individuals from registered pension schemes upon retirement. Other reforms included the imposition of a 12 percent tax on mobile money transfer, 35 percent tax on imported vegetable oil, steel and iron sheets, textiles, footwear and second-hand clothing and Robin Hood tax of 0.05 on commercial banks and other financial institutions transactions of at least KES 500,000 (Republic of Kenya, 2018).

1.2.3 Tax Revenue Productivity of Tax System in Kenya

The tax system in Kenya has failed to raise enough tax revenue since independence, which is linked to the country's narrow tax structure. The country's limited tax sources include VAT, excise tax, income tax and trade taxes. Trade taxes and VAT are volatile sources of a country's

tax revenue because the traded products are prone to price fluctuations and, therefore, contribute to inadequate tax revenue (Wawire, 2017).

A continuous increase in a country's budget deficit due to inadequate tax revenue is associated with a tax structure that is not income elastic and not responsive to tax reforms (Wawire, 2017). The trends of Kenya's GDP and tax revenue (1970-2018) is illustrated below.

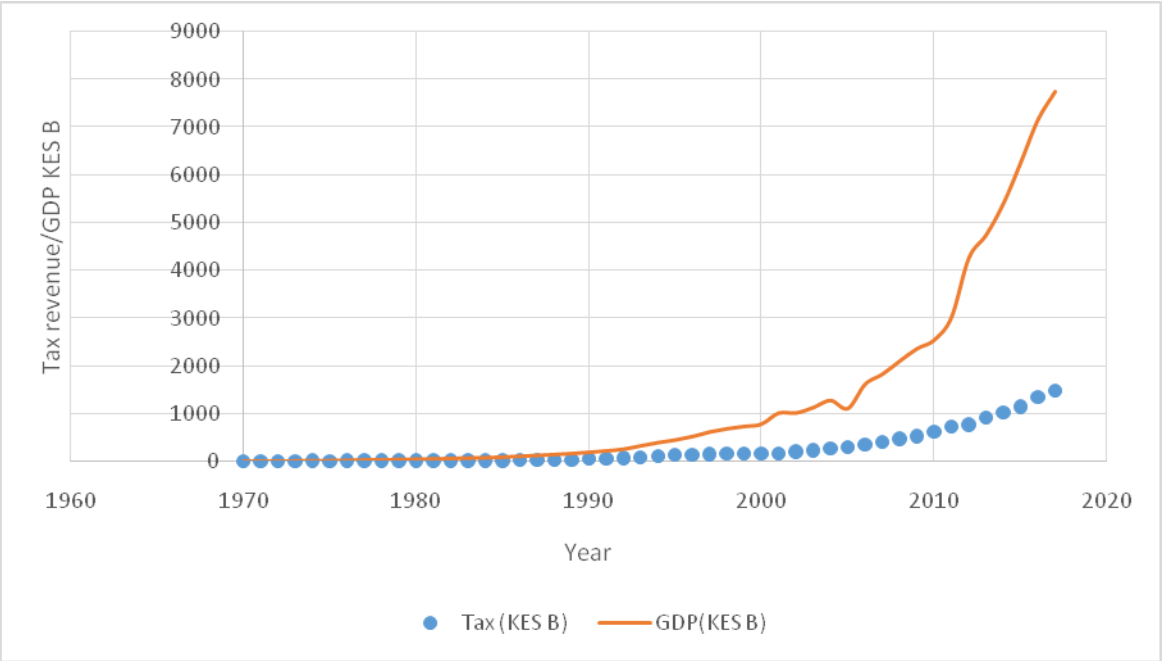

Figure 1.2: Trends in Kenya's Informal Sector Employment (1970-2018)
Source: Republic of Kenya (Various) KNBS economic surveys

From Figure 1.2, the trend of GDP and tax revenue was positive and proportional from 1970 to 1989. From 1990 to 2018, trends in both GDP and tax revenue were positive, but the former increased at a higher rate than the former.

1.3 Kenya's Optimal Tax Ratio

Tax revenue is essential for sustainability of both developing and developed countries. Government expenditure aims at providing public goods, for instance, social services, health, education and security. In a balanced budget setting, adequate tax revenue is needed in provision of these public goods to the public. One way to ensure there is sufficient tax revenue is finding the optimal level of taxes to optimize the economic growth while not interfering with the tax morale of the taxpayers. At the optimal tax level, economic growth of a country is maximized

and employment rises. This means that tax evasion is minimized at this optimal level of taxation. However, a level of tax rate more than this optimal level negatively influences economic growth and the morale of taxpayers. For instance, if the tax rates are high, economic activities and savings are reduced. These behavioural changes caused by high tax rates are usually due to the feeling of double tax effect. Besides paying their taxes, taxpayers also experience a decline in their living standards caused by lower growth rates. The tax rate beyond the optimal level thus results in a decrease in disposable income, which translates to reduced investment and consumption. This makes people engaged in economic activity to prefer leisure over their actions, resulting in a loss in hours for work and productivity (Hindriks and Myles, 2013).

For the government to get adequate tax revenue, different tax types impose a certain degree of distortion to the market. These distortions result in a departure from Pareto optimal because of deadweight losses. A sound tax system should therefore achieve adequate tax revenue and at the same time minimize deadweight loss or tax burden imposed on the society. The literature suggests that lumpsum taxes and income taxes are the most efficient, since they are not tied to any commodity. It is also recommended that for optimal commodity tax, the focus should be directed to commodities with low price elasticity of demand. This, however, gets in conflict with tax equity since such products are commonly used by low-income segments of the population (Ulbrich, 2013).

In Kenya, adequate tax revenue mobilization has been earmarked as a critical driver towards attaining a middle-income state status by 2030. The Kenyan government has therefore established a tax revenue to GDP target of 22 percent. According to the government, such a level of taxation will allow the provision of public goods and avoid tax evasion caused by a high tax burden Republic of Kenya (2008). Friedman (1997) showed that a country's tax revenue to GDP ratio should be somewhere between 15 and 50 percent for adequate economic welfare. Kenya's tax ratio has been fluctuating since 1970. The trend in Kenya's tax ratio in Kenya is as shown in Figure 1.3.

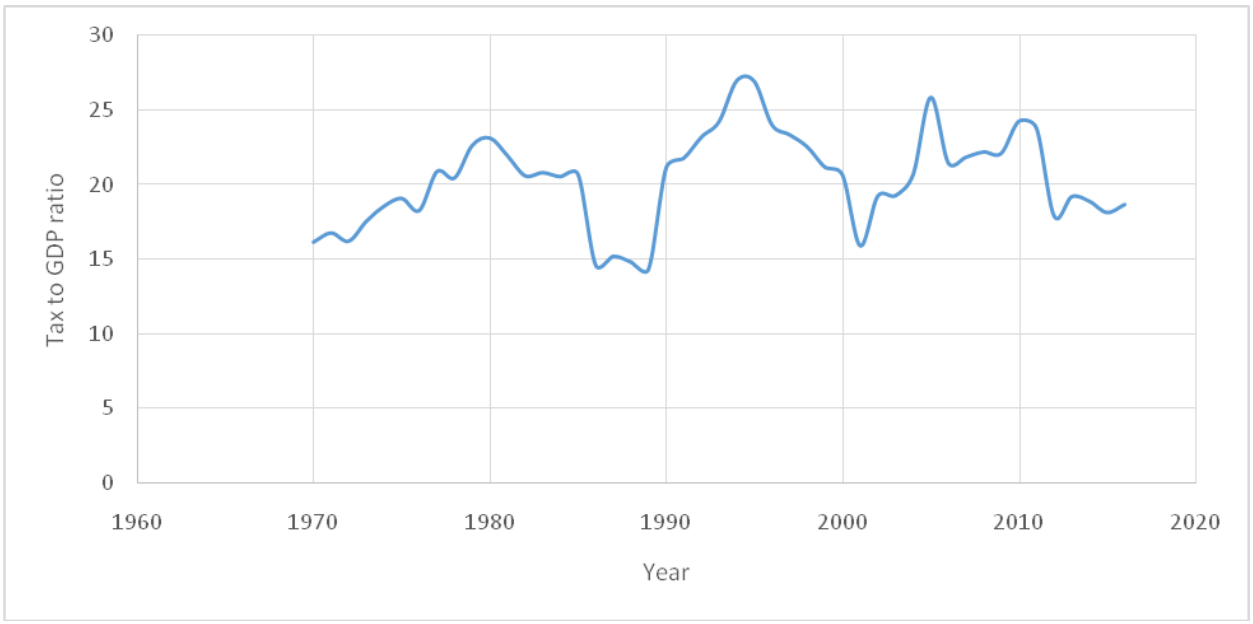

Figure 1.1: Kenya's Tax Ratio (1970-2018) Trends (Measured as a % of GDP)
Source: World Bank database

Kenya registered a higher tax ratio of 26.98 in 1994. The lowest tax to GDP ratio of 14.35 was in 1989. Generally, the period between 1970 and 2018 registered ups and downs concerning the tax to GDP ratio.

1.4 Statement of the Problem

The fundamental function of an efficient and/or effective tax system is production of adequate tax revenue. The power of an economy's tax system to mobilize sufficient tax revenue has a bearing on the public goods that the government can provide. Tax revenue collected in Kenya has been inadequate for decades and, as a remedy, the government has made several strides towards revitalizing its tax system. To strengthen the administrative capability of the tax system, for example, Kenya implemented tax management through incorporation of KRA. This was to centralize tax collection. The government has also implemented other reforms under TMP and RARMP. However, the country has been experiencing ballooning budget deficit due to a mismatch between government expenditure and tax revenue growth. From Figure 1.1, it is evident that the budget deficit has persisted for over a decade, running from 2003 to 2017. Failure to raise adequate tax revenue can be linked to substantive size of the informal sector, inelastic and less buoyant tax system, and high tax rates.

Generally, the informal sector and tax revenue, revenue productivity of tax reforms, and optimal tax ratio in Kenya have not been comprehensively examined. Concerning Kenya's informal sector and tax revenue, no precise estimates have been obtained. Studies have delved into the informal sector, but their focus is on determinants of informal sector (Onyango, 1990; Mbuthia, 1998; Ngui et al., 2014). The area of tax productivity has been investigated by Wawire (2006; 2017), Moyi and Muriithi (2003); Okech and Mburu (2011); Menjo and Kotut (2015). These studies measured the tax productivity of Kenya's system using tax buoyancy and elasticity. All these studies focused on the response of various tax components to GDP. However, the limitation of these studies is that they did not separate informal sector output from recorded GDP. This means that the estimates obtained by the studies may be unreliable in informing policy. This study, therefore, bridges this existing gap by investigating the reaction of overall tax and its components to official GDP. In addition, the coefficients of the earlier studies may be inadequate in informing fiscal policy due to shortcomings in methodological issues.

Concerning the optimal tax ratio, no clear evidence is available for the Kenyan economy. Further, Kenya is classified among countries that experience high levels of corruption globally, with a corruption perception index of 27 in 2018 and a decline from 28 in 2017 (Transparency International, 2019). High corruption is likely to reduce taxpayers' morale. This may make taxpayers resort to the informal sector, thus reducing tax revenue. Kenya has made milestones by embracing the judiciary's independence, implying that those who practice corruption can be prosecuted. This means it is essential for institutional quality (to capture attempts to fight corruption) to be incorporated in the tax models, which most of the earlier studies failed to consider. Based on these grounds, this study carries out a robust analysis of the informal sector and tax revenue, revenue productivity of tax reforms, and optimal tax ratio by incorporating institutional changes in the models.

1.5 Research Questions

The study answered the following research questions:

i. What is the effect of size of informal sector on tax revenue in Kenya?
ii. How productive are tax reforms in Kenya?

iii. What is the optimal tax ratio in Kenya?

1.6 Objectives of Study

This study's overall objective was to analyze the informal sector and tax revenue, revenue productivity and optimal tax ratio in Kenya. The specific objectives were to:

(i) Analyze the effect of size of informal sector on Kenya's tax revenue.
(ii) Analyze the extent of revenue productivity of Kenya's tax reforms.
(iii) Estimate optimal tax ratio in Kenya.

1.7 Significance of Study

The value addition of this thesis finding will be important in three folds: There is need to understand the size of the informal sector for purposes of proper government planning by the policy makers. Previous studies have focused on the physical measure of informal sector economy by using the labour quantity rather than the monetary value of products from the industry as the most effective measure of the informal sector. In addition, previous studies have focused on estimating tax productivity without separating the input of the informal economic sector with that of the recorded GDP. Lastly, the government has been implementing various tax reforms without exhaustive analysis of the optimal tax ratio. This could imply that the persistent failure to meet tax revenue targets could result from developing policies that have been informed by incorrect buoyancy and elasticity indices. In addition, implementing various policies to reduce the informal sector as informed by results arising from inappropriate methodology may be inadequate. Bridging this gap is essential for effective policy formulation. Secondly, this study will supplement the literature on estimating informal sector, tax productivity and optimal tax ratio. This is because the current study adds to already prevailing literature in taxation economics. Lastly, these findings might also be necessary to researchers in future, who may have an interest in the study of taxation economics in the future.

1.8 Contribution of the Study to Knowledge

The study offers quite a number of contributions. First, this study may be considered the first to apply the correct methodology based on the nature of Kenyan data in estimating, first, the size of Kenyan's informal economy and second, it's associated effects on tax income revenue.

Considering the inability of pervious empirical studies to separate the value input of the unofficial (or unrecorded) GDP from the official records GDP in their tax productivity estimation a country's tax system, our study takes this into account by separating this two components thus giving a different prospect with a frontier of knowledge. Separating the unofficial from official recorded GDP is important in countries such as Kenya where the size of informal sector is non-trivial like the Kenyan case where the size has been estimated to about 20% of the officially recorded GDP. Both buoyancy and elasticity are key in tax revenue projection and target attainment and hence require limited mis-measurement. This means that the recommendations of these previous studies may have compromised both the budget process and the country's development plans.

This study also stands out as the first to estimate the optimal tax ratio using Kenyan data. The results point out an optimal tax ratio to ensure that adequate tax is raised to meet the government providing public goods and services. The results also point out an optimal tax ratio, ensuring economic agents do not resort to the informal sector where they conceal tax from KRA.

1.9 The Organization of the Study

Following this introductory chapter are three essays. The subsequent chapters are on each of the thesis's three essays. Each of the three essays addresses each of the specific objectives, together with the related research question. The first essay is on "The size of the informal sector and tax revenue in Kenya". This essay mainly estimate the informal sector economy in Kenya which are then applied in tax function estimation. The second essay titled ''Revenue productivity of tax reforms" estimated tax buoyancy and tax elasticity. In the last essay titled "Estimating optimal tax ratio in Kenya", optimal tax ratio for Kenya is estimated using Scully (2000) model.

CHAPTER TWO

THE SIZE OF THE INFORMAL SECTOR AND TAX REVENUE IN KENYA

2.1 Introduction

Unlike the formal sector, the informal sector is concerned with the production of commodities, their distribution and sale of these commodities (Ndaka, 2017, Mpapale, 2014; Ngui, Muniu and Wawire, 2014). However, the informal sector is usually comprised of small and medium enterprises that are not well structured and primarily involves the activities of petty business people who operate in major urban areas. Some of the better-off urban professionals include lawyers, architects, doctors, and owners of larger businesses who also operate informally. This sector is mainly labour-intensive, and public authorities do not regulate its activities (Actionaid International, 2018; Ngui et al., 2014; IEA-Kenya, 2012; Simiyu, 2010). According to Joshi, Prichard and Heady (2012), firms consider remaining informally for them to evade taxes.

The concept of informality highlights many subjects that are relevant to taxation. First, though the informal sector was initially concerned with labour conditions, it presently includes informal and self-employed firms. Secondly, the informal sector is used to explain a dichotomy opposite the formal sector. Regarding this, two categories of firms are observed, namely informal or formal. However, in practice, this description of duality is misleading. Literature suggests that developing countries are comprised of both informal and formal business enterprises. Most firms start as informal but later decide to become formal after carrying out a cost-benefit analysis of informality and formality. Focusing exclusively on the issue of tax compliance, those that operate in the informal sector may evade national taxation (De Mel, McKenzie and Woodruff, 2010).

The literature points to the development of the private sector to link informal and formal sectors. The development of formal business enterprises depends on the inputs sourced from the informal sector. There are also sub-contractual agreements between formal and informal sectors through credit advancement in raw material. On the other hand, any small traders and street vendors may sell goods for medium and large size businesses (Joshi et al., 2012).

The major portion of workers in the informal sector receive low incomes and, therefore, should be directed to businesses enterprises, owners of the business enterprises, including self-employed and well-off professionals. This approach should be considered because earnings from this informal sector group may be within the taxable bracket. The more significant difference is among the three groups, namely the subsistence business enterprises, which would usually not attract tax liability; micro and small enterprises, which are mainly focused on particular informal sector aiming regime and medium enterprises, which are big enough that they can attract tax liability. A clear description of the types of firms in informal sector in an economy is presented in Table 2.1.

Table 2.1: A Description of Enterprise Informality

Characteristic	**Informal Sector**			**Formal Sector**
	Survival Enterprises	**Micro & Small Enterprises**	**Small & Medium Enterprises (SMEs)**	**Small, Medium & Large enterprises**
Level of informality	Wholly informal for most of their operations	A large portion of income was not declared; the workers are not registered	Some portion of income is not declared, and the workers are not registered	Workers and firms are registered and regulated by government agencies
Nature of activity	Street vendors, micro-enterprises and small-scale farmers	Small-scale service providers, small-scale manufacturers, contractors, small-scale distributors	Small and medium scale manufacturers, small-scale service providers	Comprised of a range of manufacturers and service providers
Technology (The Know-how)	Fully labour-intensive	Majorly labour-intensive	Use both labour and capital in their operations	Use both labour and capital in their operations
Owner education profile	Low level of education, poor or low skills level	Poorly educated but high skills level	Likely educated and skilled	Highly educated and high skills level
The markets	Free entry, competitive; the product is homogeneous	Free entry and competition. There is some product differentiation	Markets are well established. There are some barriers to entry	There are significant barriers to entry; there is also a product niche

Table 2.1: A Description of Enterprise Informality…

Financial requirements	Employed capital	Operational capital, financial capital and supplier credit	Capital for operations, supplier credit, letters of credit, and financial capital	Capital for operations, letters of credit, financial capital and supplier credit
Additional requirements	Social protection, Individual insurance and security	Individual insurance and sometimes an insurance for the business; there is sometimes support services for the business and security	Individual insurance, insurance for business, and development services for business	Individual insurance, insurance for business, and development services for business
The implication of business orientation to tax liability	There is no bookkeeping, returns to businesses can be less than the minimum tax threshold; transactions occur in cash form	Incomes high enough to attract tax liability; there is difficulty in detecting and assessing because of poor or sometimes no bookkeeping; again most transactions occur in cash form	Incomes high enough to attract tax liability. However, these firms use loopholes to escape. They also under-declare earnings	They pay tax based on the formal tax assessment
The tax design and desired characteristics	Tax liabilities are not applicable	Reduced administration costs; reduced tax rates to incentivize them to become formal; there are also minimum compliance costs	Moderate tax rates to incentivize them to become formal	Formal tax regime

Sources: Adapted from Djankov et al., (2002)

The informal economy contribution to employment opportunities among the developing countries is enormous. Individuals may have options of joining both formal and informal sector. One of the reasons they may consider the latter is to evade taxes. Though this sector provides employment opportunities, its expansion may deny government the needed tax revenue thus curtaining development projects in a country (De Soto, 1989). For government to raise adequate tax revenue in such situation, tax rates are raised. The high tax rates led to a disutility among some formal economy due to over taxation and made them resort to informal sector furher worsening the tax revenue collection and target meeting (Gunes, Starzec and Gardes, 2013).

Taxation of the informal economy among the developing countries is an issue that has been debated for many decades. The debates have focused on equity and revenue implications.

Concerning revenue implications, it is argued that taxation of the sector will result in increased tax revenue, since the informal sector share in GDP among these countries is rising (Dreher and Shneider, 2010). However, since the sector is made up of many small firms, it may not be easy to bring all of them into the tax net and monitor them efficiently. In addition, most of these firms earn low incomes, meaning collection and administrative costs may be higher than tax revenue obtained from them. However, proponents of the revenue implication assert that low tax revenue is obtained in short- and medium-terms. It is argued that higher tax revenue is mobilized in the long-term, since the firms become tax compliant as they expand with time.

Regarding equity implications, it is argued that the informal sector must be brought into tax net to increase the morale of the formal sector taxpayers. Failure to obtain the informal sector into the tax net makes those paying taxes treat the tax authority as unfair in tax administration. This reduces the level of tax compliance, which translates to decreased tax revenue (Joshi et al., 2012).

According to Koto (2015), the informal sector is not still at the periphery of developing countries. The industry has proved to be an essential ingredient in these countries' economic growth by providing job opportunities for the ever-increasing population.

2.2 The Informal Sector and Tax Revenue Nexus

The specific attributes that characterize the informal sector in many countries make it difficult to apply formal sector tax rules directly. Occasionally, the industry is captured by the conventional tax regimes indirectly. One way in which this sector is captured is in the case of VAT.

Firms in the informal sector are less regulated and, therefore, are less taxed than firms in the formal sector (Ordonez, 2014). Consequently, formally established firms sometimes act informally to increase profit margins and improve flexibility. Very high fiscal regulations and bureaucracy constraints used by governments impose high financial costs on established companies and firms who want to enter the formal sector, thus encouraging informality. Individuals should consider their economic relationship with the state as a relationship of reciprocal rights and duties. It is thought that government has a right to collect taxes and the responsibility to provide public services. People then should pay their taxes correctly and share

the genuine belief of receiving certain public services and transfer payments if some conditions are met.

Davoodi and Grigorian (2007) focused on the implication of informal segment/sector on tax revenues. The fact that agents decide to be formal and pay taxes is related and influenced by the state's quality and several public goods. At the same time, a vicious circle can be created between the lack of motivation to remit taxes and government's incapacity to provide adequate quality or quantity of public goods.

From a revenue view, the large size of the informal sector makes it very difficult, especially in developing nations, to finance sustainable economic growth from broad-based taxation. However, taxing the sector requires tax authorities to carry out cost and benefit analyses. Improved formalization can assist add additional tax contributors into the government tax net, since business enterprises that intend to profit from the formal (officially recognized) economy finally register with tax authorities in an economy (Besley and Persson, 2014).

On theoretical approach to the informal sector and revenue collection, Frey and Weck (1983) in Castro and Aranda (2018) argue a deficiency of a theoretical structure to stimulate the link between the informal sector and tax revenue. It also alludes that it is problematic to establish the linkage between the private sector, state and informal sector to establish the informal economy's main because factors and effects. Thus, taxing the informal sector is fundamentally associated with good governance, because both tax morale and compliance are influenced by the accountability of government (Joshi, Wilson and Heady, 2012; Castro and Aranda, 2018).

2.3 Overview of Informal in Kenya

Approximately 77% of the country's workforce is engaged in the informal sector. Majority of the participants being younger generation (18 and 35 years old) (GoK, 2017). The rise of this sector in Kenya is attributed to some policies such as the privatization and to some extent liberalization that greatly had an impact on employment in the public sector. Majority of the individuals who couldn't find job opportunities in the public sector were absorbed by this sector. From the inception of these policies, the sector has been a source of employment to fresh graduates who exit training institutions (Muchiri, 2014). Although this sector is a key source of employment to many Kenyans, government could be losing tax revenue since incomes are not

reported. Thus bringing individuals in this sector whose incomes are within the taxable brackets would lead to increased tax revenue. However, taxing this informal economy sector is not easy due to tax compliance challenges. One of the notable participants in the informal sector in Kenya are the motorbike operators who ferry people from one destination to another. It is argued that rich individuals who could be in formal sector divert their incomes to this sector by buying many motorbikes. Since mode of payment is cash, these individuals' incomes are not accounted for thus making the government to lose tax revenue (Wawire, 2020). It can be observed that although the sector is good for provision of employment, its expansion results to insufficiently limited tax revenues (Peters, 2017). See the trends of Kenya's informal economy sector in Figure 2.1.

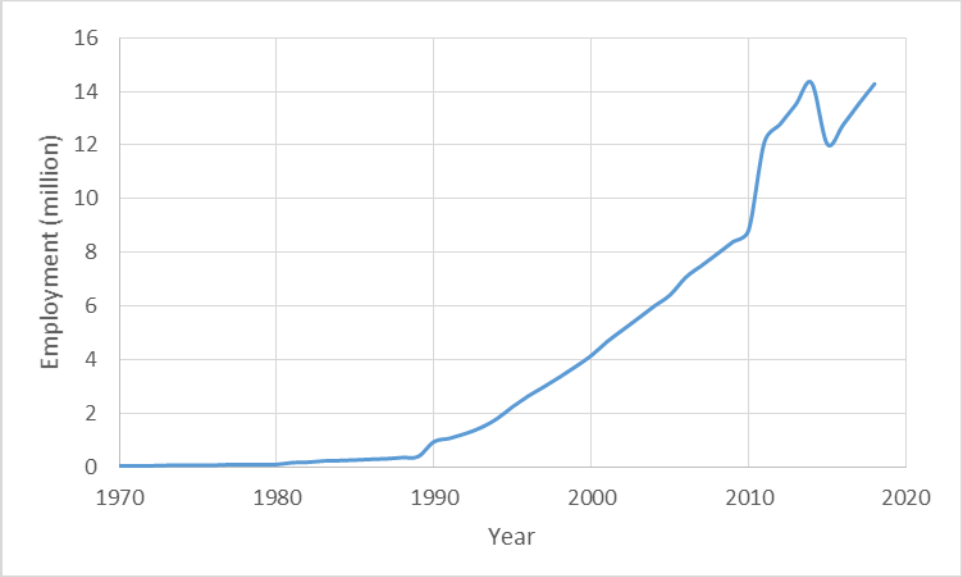

Figure 2.1: Informal Sector in Kenya (1970-2018)
Source of data: Republic of Kenya , Various, Economic Surveys

From Figure 2.1, it is observed that the employment in this was low between 1970 and 1988. Employment in the sector is observed to increase from 1989 same time the Kenyan government embraces Structural Adjustment Programmes (SAPs). A high employment in the sector increased much in the years between 2010 and 2018. This increase can be attributed to high number of fresh graduates from the Kenyan universities joining the sector after failing to secure opportunities in the Kenyan formal sector.

2.4 Statement of Problem

Kenya depends heavily on tax revenue to finance the government's expenditure. The presence of informal sector poses challenges in tax revenue mobilization. The Kenyan government made efforts to formulate policies aimed at formalizing the firms in the industry, thus bringing them into the tax net, but her objective has not been fully achieved, as evidenced by the failure of KRA to meet her annual tax targets. The inability to raise adequate tax revenue has resulted in the ballooning budget deficit. For instance, Kenyan government borrowed a further KES 600 billion during financial year 2019/2020. This increased total public debt to about KES 5 trillion. High public debt is not good for economic performance of a country. This is because during repayment, exchange rate depreciates as government demand for dollars increase. Depreciation of the exchange rate eventually leads to inflation as importers shift high cost of importation to consumers. In addition, using dollars to services external debts deprives the country US dollars. This means the country lack dollars to buy machine needed for production process. This retards country's economic performance.

Thus, external debt is not the best option to finance ballooning budget deficit. The sustainable way of financing the budget deficit is improving tax revenue collection. To avoid increasing tax burden, tax revenue can be increased by use of the untapped tax base; that is, the informal sector. From Figure 2.1, though tax revenue is increasing, the corresponding rise in size of informal sector points to the potential of raising more tax revenue. Ouma et al. (2007) showed that revenue lost by the government in 2005 was KES 55 billion. Wawire (2020) also asserted that the informal sector is growing in Kenya, as evidenced by the wealthy Kenyan people diverting their wealth into the informal sector. For appropriate action to be taken, there is a need to understand the informal sector's effect on performance of tax revenue in Kenya. The size of sector and tax revenue nexus remains not investigated. The studies that have attempted to investigate this relationship include Peter (2017) and Muchiri (2014). This study differs from these two in terms of context and methodology used respectively. The former studied underground Zimbabwean economy and her tax revenue. The former studied informal sector and tax revenue but used population of persons employed in the informal sector as a measure of the size of the sector. Use of population of persons employed in the sector deviates from the definition of the informal sector, where economic output is emphasized. In addition, this

approach of measuring size of informal sector excludes some economic activities, for example, goods produced by households for their use and the employed domestic workers. Therefore, this study measures the informal sector's size by considering the monetization of informal economic activities. A currency demand approach was adopted in calculating the informal sector's output in Kenya.

2.5 Objectives of the Study

The general objective of this essay was to analyze the effect of the size of the informal sector on tax revenue in Kenya. The specific objectives were to:

i. Estimate the size of the informal sector in Kenya.
ii. Estimate the effect of size of the informal sector on tax revenue in Kenya.

2.6 Significance of Study

The significance of this study cannot be gain said due to the fact that it is touching on one of the major goal of macroeconomics that is the elimination of the dual economy in Kenya. The study also examines the link between the Kenya's informal sector and its tax revenue. Thus, findings of this informal sector study offer the needed information for fiscal policy formulators in Kenya. Also, through Kenya's Vision 2030, the government aims to ensure the country becomes a middle-income country by 2030. To achieve this, tax revenue is critical, and therefore any study that seeks to suggest ways of increasing tax revenue is essential. The study is also vital because it adds to already existing literature on the informal sector in Kenya. Further, this study also opens room for future research on the informal sector in Kenya.

2.7 Literature Review

Discussed below are the theories and evidence related to this study.

2.7.1 The Theoretical Literature Review

There are essentially four schools of thoughts which explain development of informal sector. These four schools include structuralists, dualists, legalists and voluntarists. The dualist school of thought believe the informal sector is characterized by marginal activities that generate income

for the poor. The sector also provides a safety net to the poor during crisis moments. In addition, the sector offers a source of employment to those not absorbed by the formal sector. This is built on the idea of a mismatch between economic growth and population growth.

Further, the roots of the related concepts of informality and economic segregation have been explained in dual economy theories of the 1940s-1950s. Reiterating the works of Arthur Lewis, Julius Boeke, John Harris, Albert Hirschman and Michael Todaro, other socio-economists of that time argue that one of the reasons for the existence of the informal sector in developing countries is the dualism in institutional structures that leads to segregation of some social groups and their further exclusion from the formal economic activities. To support the theory of dualist, De Soto (1989) studied informality in Peru. The study findings showed that the informal sector occurs because of poverty and marginalization. Therefore, advocates of the dualist school of thought believe the informal sector should be exempted from taxation since it is made up of poor and marginalized individuals. Thus, this school of thought implies that the informal sector negatively affects the tax revenue, since those who engage in this sector do so just for survival. However, this may not be true because some businesses within the informal sector have incomes within a taxable bracket.

The structuralist school, put forward by Castells and Portes (1989), believes that firms unregulated by government characterize the informal sector. The participants in informal sector include sub-contracted workers, petty artisans, petty traders, casual workers and informalized wage workers. According to structuralists, the informal sector occurs as the formal sector reacts to punitive state regulation. The punitive state regulation, in this case, is the imposition of high taxes. Therefore, this school of thought suggests that the large size of the informal sector causes loss of tax revenue.

The legalist school of thought founded by De Soto (1989) asserted that the informal sector occurs not only due to hostile reception from the legal system but also because of punitive taxes imposed by the state. De Soto (1989) argued that firms decide to remain informal to avoid taxes and labour laws. The legalists, just like the structuralist's, imply that the large size of the informal sector has a negative effect on tax revenue.

The voluntarists' school of thought, put forward by Maloney (2004), link the informal sector to self-employed micro-entrepreneurs that voluntarily decide to operate in the sector. According to proponents of this school of thought, firms that operate in the informal sector carry out a analysis of both costs and benefits (CBA) of formality vis-a-vis informality. According to them, the cost of formality is paying taxes, while the benefit of informality is earning while avoiding taxes. According to this school thought, the large informal economy sector has indirectly influenced tax revenue.

2.7.2 Empirical Literature Review

Schneider and Enste (2002) studied taxation and informal sector development among the OECD member countries in the 20th century. The study linked the increased informal sector's output among the OECD nations to rising tax burden, combined with reducing tax morale and loyalty towards the governments. The author suggested that two strategies should be adopted for governments to avoid increase in the informal sector. The first strategy ensures that governments reduce factors that attract firms to move from formal to informal sectors. The study suggests that one way of achieving this is by making the tax system simple and reduce tax rates. The second strategy of avoiding the informal sector is to allow first to have an opportunity to influence the decision made by the government. Following Schneider and Este (2002) assertion, it can be observed that high tax rates incentivize individuals to consider the informal sector, thus enhancing tax evasion implying an inverse relationship.

Concerning developing countries, Dharmapala, Slemrod and Wilson (2011) argued that these countries should decide on a tradeoff between reducing the administrative tax costs by exempting firms below a specific size from paying taxes and formal firms dipping the size and joining the informal economy. The authors point out that though exemptions of certain firms from the tax net may be an optimal solution to minimizing administrative costs, limitations by informal sector in tax system must be considered. In another study, Kristoffersen (2011) argued that the risk of a growing informal sector limits the possible extent of taxation among the developing economies. Following Dharmaphalia et al. (2008) and Kristoffersen (2011), it can be revealed that though the government could hindered from raise sufficient revenue from taxation due to an increase in the informal sector, there could be some business activities in the informal sector that exist just for survival. Therefore, this means that tax authorities should identify this

category of business activity to avoid putting in more resources concerning administration compared to the tax revenue received.

Using time-series methods, Teera (2002) studied determinants of Uganda's tax share in GDP for the period between 1970 and 2000. Other than informal sector, the study also considered, share of agriculture in GDP, per capita GDP, ratio of manufacturing sector in GDP, imports and ratio of foreign aid to GDP. The error term originating from regressing nominal currency on GDP was used as a measure of informal sector. The implications of a positive residual can be loosely be interpreted as individuals of a country are holding more than expected cash. The finding reveals that informal economy sector negatively influence Uganda's tax revenue. It was also revealed that the ratio of agricultural sector in GDP, per capita output and ratio of import to country's output negatively influence Uganda's tax revenue. The share of manufacturing sector in output positively influence Uganda' tax revenue. The drawback of this study lies in the measurement of informal sector. Using only one explanatory variable, that is the GDP in estimation currency demand may not be adequate. The economic theory considers inflation, interest rate and GDP as determinants of currency demand.

In another study, Muchiri (2014) utilized an eleven-time series dataset (1980-2011) to investigate informal sector's effect tax revenue collection in Kenya. Where informal sector was proxied by employees in the sector. The findings showed the country's tax revenue was negatively influenced by size of the informal sector. However, according to Alfredo (2001), use of number employee was mis-measurement of informal economy sector. The author recommends use of the monetary value of the activities performed by the participants in the sector. Using similar methodology, Peter (2017) studied how tax revenue performance was influenced by Zimbabwe's informal sector using a 35-year time series dataset. The study's results showed a positive correlation between this variables. The use of OLS to estimate the model of this study is suspected to be inconsistent due to non-stationary of variables at all level (some variables were stationary at first difference).

Dioda (2012) in another study based in Caribbean and Latin America, investigated determinants of tax revenue using a 19-year time series data. The findings revealed that the female labour participation; per capita output, trade openness and worker's education influenced Caribbean's

and Latin America's tax revenues. The results also revealed shadow economy as a negative determinant of the region's tax revenue. Using the similar methodology, Tedika and Mutascu (2013) investigated shadow economy and tax revenue in Africa including Kenya for period between 1999 and 2007. The shadow economy was found to result to dwindling tax revenue in the continent the study included other regressors in the model. Those that were found to positively affect tax revenue performance include share of agricultural sector in GDP and Import share in GDP. Though the study used monetary value of the informal sector's economic activities, it was misleading to base policy recommendations on aggregated data.

Medina, Jonelis and Cangul (2017) investigated the determinants of informal sector's size in SSA countries using MIMIC approach. A panel data of 24 years was used. The study finding showed that informal sector account for between 20 and 25 percent of Mauritius economy. In South Africa, Benin, Tanzania, Nigeria and Namibia, the sector was found to account for between 50 and 65 percent of their economies. The sector was found to account for between 25 and 40% of the Kenya's GDP. In related study in terms of methodology, Castro and Aranda (2018) investigated informal sector's size and tax revenue among Latin American countries and member of OECD. The period of study was 1995 and 2016. The study incorporated GDP per capita, government integrity index, and government expenditure on education as the control variables. This study's findings showed a negative link between informal sector and tax revenue. Through the panel, data may help overcome cross-section or time-series data challenges, a potential misleading policy evaluation founded based on aggregated data was a possible outcome.

Phiri and Kabaso (2012) empirically investigated the relationship between informal sector and taxation in Zambia for period between 1973 and 2010. The sector was found to account for 42 percent of Zambian economy. Hassan and Schneider (2016) used currency demand approach to study Egyptian shadow economy between 1976 and 2013. The study found that the sector accounts for 20 percent of Egyptian GDP. The study illustrated that though the sector was declining; such magnitude was still substantial for a developing country like Egypt and therefore could impede country's economic performance. Although the wide application of this currency model informal sector's estimation, there are other methods. These methods include direct ones for example survey based on questionnaires. This study used same currency demand in

estimating the size of the informal sector due to Ouma et al. (2007) assertion that the variation between the estimates obtained using these two approaches may not vary so much.

MIMIC is another approach suggested for the estimation of informal sector (Ouma et al., 2007). Dell'anno (2007) used the approach to estimate informal sector in Portugal between 1997 and 2004. The study considered ratio of employment in public sector to total labour force, tax burden, share of subsidies in GDP, share of social benefits in GDP, the self-employment as a ration of the total labour force and unemployment as causes of informal sector. labour force participation and real GDP were considered as the indicators in the study. The study's showed informal sector decreased from 30% in 1978 to 18% of GDP in 2004. The same MIMIC approach was adopted by Hassan and Schneider (2016) to estimate Egyptian underground economy using over 30-year time series data (1976- 2013) using SEM models. Self-employment, agricultural sector share in GDP, institutional quality were considered as causes of shadow economy. The indicators considered include real GDP, total employment and currency outside banks. The study found that informal sector accounted for 30 percent of Egypt's economy during the study period. Although SEM is superior to currency demand model, its requirement of large sample size could a limitation in countries with limited stylized facts such as SSA.

Castro and Aranda (2018), another study that used MIMIC approach estimated the Latin American countries and OECD members' size of informal economy between 1995 and 2016. The study's finding showed that for Latin America countries, informal sector accounted for 34 percent of region's GDP while for OECD the sector accounted for 19 percent of GDP. The differences in informal sector in the 2 regions under study was linked to differences in their institutional quality and their economic performance. The study adopted corruption, tax burden, and unemployment and government integrity as key determinants of informal economy sector. The considered indicators included, but not limited to GDP growth, public expenditure on education and labour freedom. Result revealed that developing countries have larger size of informal sector than the advanced economies, forming partly the rational to study the informal economy sector in a developing country like Kenya.

2.8 Overview of Literature

The reviewed literature showed an inverse relationship between the growing informal economy sector, in one hand and tax revenue performance in all countries, whether developing or developed. Apart from the independent variable, other determinants of tax revenue included per capita GDP, manufacturing sector, trade openness, agriculture sector, external debt, foreign aid, foreign direct investment (FDI) and institutional quality. It was also established that most studies used currency demand and MIMIC methodological approaches in estimation how large the informal economy sector is. In all these methodological approach, result indicates that the informal economy sector is high among less advanced economies compared to more advanced economies. Most of the studies attributed the variation in size of the informal sector to differences in institutional quality and level of economic development.

2.9 Methodology

This chapter presents different stages and phases followed in the completion of the study. It involves an analytical framework, empirical model, data source and type, variable description, and measurement and general estimation tests to achieve the intended objectives. Estimation of the informal sector is as difficult as getting the appropriate definition of sector. The sector is generally made up of unofficial activities of the economy that are difficult to observe. This implies that the approaches used only make an attempt of estimating size of informal sector but not actual one. Methods used in estimating informal sector include macroeconomic and microeconomic techniques. The macroeconomic methods, also known as indirect approaches, include the currency demand method, Multiple-Indicators and Multiple-Causes (MIMIC) method, physical input or electricity demand method, expenditure approach and labour force participation discrepancy (Bajada and Schneider, 2005).

2.9.1 The Theoretical Framework

The study adopted theoretical framework suggested by Hibbs and Peculescu (2013) in estimating informal sector in Kenya. These authors argue that the informal argued that high tax rates encourages individuals to practice tax evasion and by considering to operate in informal sector. Figure 2.2 below illustrates the relationship between output and tax rate in an economy.

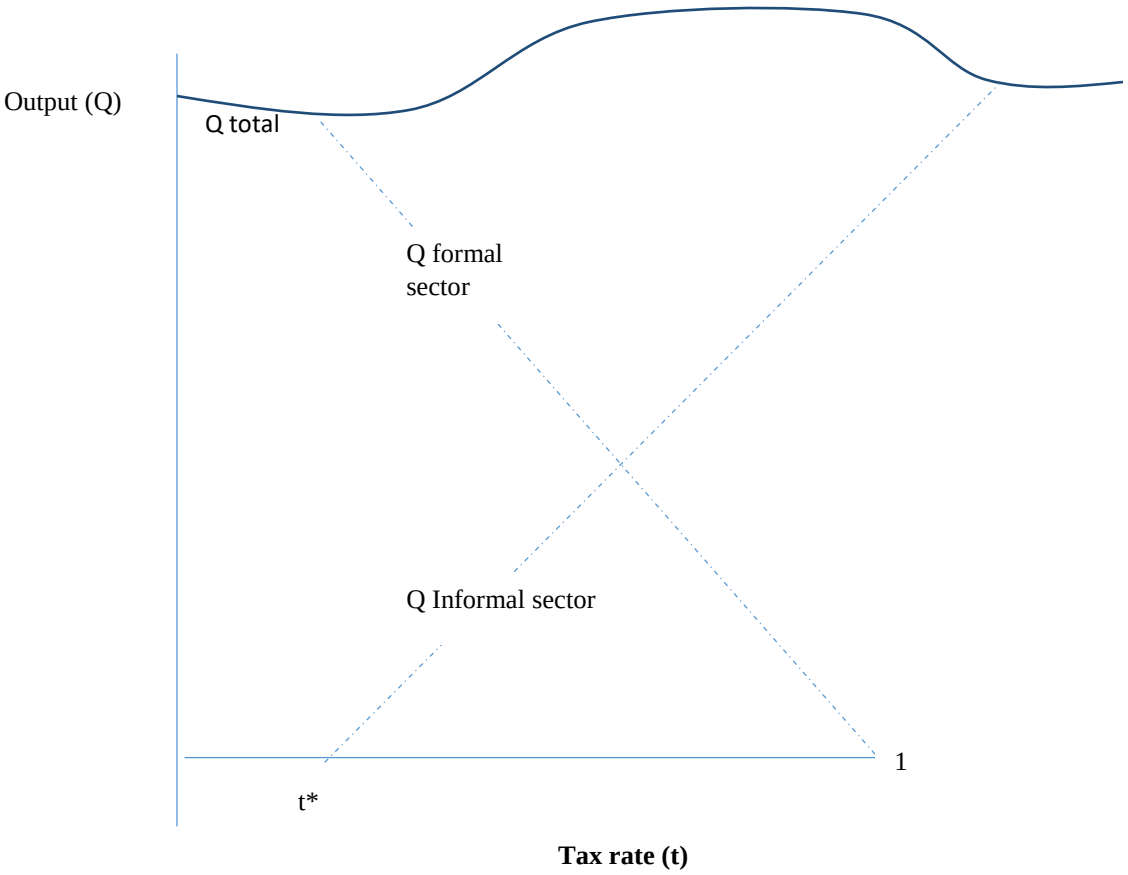

Figure 2.2: Tax Rate and Output in an Economy
Source: Hibbs & Peculescu (2013)

Figure 2.2 above shows total output (Q total) shows production in both informal and formal sectors of the economy. From the figure, it is observed that when t < t*, all economic activities are formalized. For tax rates beyond t*, it is observed that production in the formal sector begis to decrease and production in the informal sector begis to increase. This continues and reaches point where t is equal to 1. At this point, it is observed that production in the formal sector is zero while that in the informal sector is maximum. In other words, when t is equal 1, the whole production in the economy takes place in the informal sector.

Currency demand model borrows heavily from Hibbs and Peculescu (2013) concept. Hindriks & Myles (2013), avers that cash is the major form carrying out transactions in informal sector. Thus cash can be used to represent informal sector GDP. Thus bring in the tax rate as suggested by Hibbs and Peculescu (2013), we can argue that informal sector is a function of tax rate. The Keynesian also links output, interest rate as determinants of currency demand (Blanchard, 2013).

This therefore means that currency demanded is not influenced by tax rate but also output and inflation rate.

From Figure 2.2, currency outside bank will be high when tax rate is high as individuals consider carrying their transactions in cash. When tax rate is minimum, currency outside bank will be low since individuals will have part of their currency in banks. To estimate currency in the informal sector, estimation is carried out in two steps. In the first step, currency demand model that has all the explanatory variables and tax rate high is estimated. The estimated currency is denoted as Cur1 is then obtained. The same model is then re-estimated when least tax rate is considered and currency denoted as Cur2 obtained. From the above discussion, it means. When tax rate is least, individuals are will hold little currency. This means Cur1 is higher than Cur2 as individuals are hold more cash outside banks as a way of evading taxes. The difference between Cu1 and Cu2 informal sector's currency ($Cur_{informal}$), as shown in equation 2.1.

$$Cur_{informal} = Cur_1 - Cur_2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2.1$$

If velocity of money in circulation in informal sector denoted as $Cur_{informal}$ is assumed to be as that of formal sector, informal sector's output is obtained as equation 2.2 illustrates.

$$GDP_{informal} = Velocity * Cur_{informal} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2.2$$

To estimate informal sector and tax revenue, this study considered theory of tax evasion expected utility. This theory indicates that choice for tax evasion decision is made by considering the gains attained against the losses to be incurred if detected by tax authorities. The individual chooses the option with highest utility (Sebbora, 1995). Thus, the theory indicates that participants in the informal sector make rational decisions. Their principal goal is to maximize expected benefit from their economic activities. Sanjo and Ahal-Nowaihi (2006) put this theory into practice while studying why individuals evade taxes. The study showed that taxpayers would opt for tax evasion if the benefit expected per unit on avoiding tax is positive. This theory directly bears the current study because if the desired return from a unit on evading tax is positive and individuals choose to evade taxes, the government will not raise adequate tax revenue.

2.9.2 Model Specification

The study adopted currency-demand to estimate size of informal sector. Similar model was used by Tanzi (1983) while estimating united states' underground economy. MIMIC model is an alternative to this model but the study didn't consider it needs a large pool of observations that are not available in Kenya. The chosen approach involves specification of currency equations that incorporates tax effect on demand for currency. In this case, it is assumed that too high tax rate incentivize individuals to consider informal sector so as to practice tax evasion. In the empirical model shown in equation 2.3, the dependent variable cur is the natural log of currency outside banks while tax ratio to GDP, the independent variable is denoted as $taxr$. The control variables considered in study included interest, per capita GDP, financial innovations and inflation. These variables are captured in regression model as inter, $pGDP$, $finnova$ and also infl respectively.

$$lncur_t = \pi_0 + \pi_1 ln(1 + taxr)_t + \pi_2 \ln(pGDP)_t + \pi_3 \text{infl}_t + \pi_4 \text{inter}_t + \pi_5 finnova_t + \varepsilon_t \ldots 2.3$$

Subscript t, ln and ε represents time components, natural logarithms, and error terms. The π_0, π_1, π_2, π_3, π_4 and π_5 are coefficients for estimation. The study added 1 to tax ratio to GDP for estimation to be done when tax rate was considered least, that is zero tax rate.

Estimating occur in two stages. In first stage, model 2.4 was estimated when tax ratio t GDP was allowed to assume the observed values. The estimated currency outside banks was then obtained. In the second stage, tax ratio to GDP of zero was considered and estimation was done. The estimated currency outside banks was then obtained. Subtracting the second estimate from first estimate gives currency in the informal sector. This currency was then multiplied by money velocity to obtain informal sector's GDP. Other variables as suggested by Teera (2002), Muchiri (2014), and Peter (2017) were included in the model. The specified model for estimating effect size of informal sector and tax revenue in Kenya is illustrated in the following equation 2.4.

$$\text{lntaxrevnue}_t = \alpha_0 + \alpha_1 \text{lninfsectorgdp}_t + \alpha_2 agricshare_t + \alpha_3 lnmanushare_t + \alpha_4 lnfaidshare_t + \alpha_5 duminsq_t + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2.4$$

Where lntaxrevnue, $agricshare$, $lnmanushare$ shows natural logarithm of tax revenue, share of agricultural sector in country's output, natural log of share of manufacturing sector in Kenya's GDP respectively. $ln\text{infsectorgdp}$ shows informal sector's GDP converted to natural logarithm,

$lnfaidshare$ shows natural logarithm of ratio foreign-aid share to output, $duminsq$ shows dummy variable as a measure of quality of institutions aimed at curbing corruption, ε_t shows disturbance term, The coefficients for estimation are α_0 ……. α_5 .

2.9.3 Describing the Variables, Measurement and Priori Expected Signs

Table 2.2 presents the discussion of variables.

Table 2.2: Variable Definition, Measurement, Priori Expected Signs and Source

Variables & Abbreviations	Definitions and Measurements	The Measurement Unit	Signs expected by study and the Source
The currency-outside bank (cur_t)	Currency outside bank captures the amount of coins and notes in circulation	Ksh.	The dependent Variable
Per capita output/GDP ($pGDP$)	Per capita output GDP is individual contribution in country's GDP/output	Ksh.	+ Ouma et al. (2007), Greenidge (2010)
Tax ratio in GDP ($taxr$)	This is measured by tax revenue divided by country's output.	Ratio variable	+ Greenidge (2010), Ouma et al. (2007),
Financial innovation ($finnova$)	It measures the development in the monetary sector	Ratio variable	- Ouma et al. (2007),,Hassan and Schneider (2012)
Interest rateat time t ($inter$)	It measures the returns on ones deposits	Percentage	+ Greenidge (2010), Faal (2003)
Inflation ($infl$)	It measured by CPI. It measures the changes in price of a fixed basket of commodities over time.	Percentage	+ Greenidge (2010), Ouma et al. (2007),
Tax revenue ($taxrevnue$)	This is part of an economic agent's income that is submitted to government for provision of public goods.	Ksh.	The dependent Variable
Size of informal sector ($infsectorgdp$)	It measures to value of the informal sector's economic activities	Ksh.	- Amoh and Adom (2017), Castro & Aranda (2018)

Table 2.2 Continuation

Variables & Abbreviations	Definitions and Measurements	The Measurement unit	Signs expected by study and the Source
Agricultural sector output ratio in GDP ($agricshare$)	It measures the contribution of agricultural sector in country's GDP. Measured as value of agricultural products over GDP	Ratio variable	- Ahlerup, Baskaran and Bigsten (2015)
Manufacturing share in GDP ($manushare$)	It measures the contribution of manufacturing sector in country's GDP. Measured as value of manufacturing sector's products over GDP	Ratio variable	+ Murunga, Muriithi and Kiiru (2016)
Foreign aid share in GDP ($faidshare$)	It measures the contribution of foreign aid in country's GDP. Measured as amount of foreign aid sector's products over GDP	Ratio variable	- Teera (2002)
Institutional quality at time t ($duminsq$)	It is a dummy variable which take value 1 for periods there was positive structural changes in institutions and zero for the periods before these changes. The study considered the period for structural change to be from 2010 when 2010 constitution was promulgated	Dichotomous	+ Castro & Aranda (2018), Dioda (2012)

2.9.4 Data Source and Type

To achieve the study's objectives, yearly/annual data for 1970 – 2018 period was used since Kenyan government experienced dips in tax revenue following oil shocks of 1970s and widening size of informal sector. In addition, data used in the study was consistently recorded during this specified period. Further, the period is adequate for use of time series methodology. The source of data for tax revenue, currency outside banks, per capita GDP, interest rate on deposits, financial innovation and inflation was KNBS Abstracts and Economic Surveys of various years. Source of data on manufacturing sector's output, agricultural sector's output, and foreign aid was WDI database. Data for informal sector's GDP was calculated in this current study.

2.9.5 Pre-estimation Test

(a) Unit- Root Test

The unit root-test is used in revealing presence of stationarity. Presence of a stationary series avoids econometric problems of spurious regression and inconsistent estimates (Verbeek, 2004). The presence of unit root signifies presence of a non-stationary series. Equation 2.5 is the starting point in testing for presence of unit root.

$$X_t = \alpha + \rho X_{t-1} + \mu_t \quad \text{.....2.5}$$

Where X_t represents a variable whose stationarity status is to be checked, X_{t-1} represents the lag one of the variables of interest while μ_t is error term is independent and identically distributed. Equation 2.5 can be manipulated further by subtracting lag one of X_t from both sides to give;

$$\Delta X_t = \alpha + \delta X_{t-1} + \mu_t \quad \text{.....2.6}$$

Where $\delta = \rho - 1$ 2.7

The unit root test, Dickey-Fuller (DF) was used to test for unit root presence. To achieve this, equation 2.6 is estimated, and the coefficient of the regressor is examined. If δ is found to be equal to zero, the given variable is said to be non-stationary. If it is negative, it is said to be stationary (Dickey and Fuller, 1979). However, the shortcoming of the DF test is that the error term is not serially correlated. If this assumption is violated, Augmented Dickey-Fuller is the most appropriate where at least a lag of dependent variable is introduced in the model as a regressor. The introduction of the lag serves as a remedy for serial correlation among disturbance terms, as shown in equation 2.8

$$\Delta X_t = \alpha + \delta X_{t-1} + \sum_{n=1}^{n} \alpha_k \Delta X_{t-k} + \mu_t \quad \text{.....2.8.}$$

Where *n* in the equation is selected so that it is large enough to ensure the absence of serial dependence of the error term.

Another alternative to the ADF-test is Phillips-Perron, abbreviated as PP test. Unlike former test, which incorporates lags of dependent variable to remedy problem of serial correlation, PP test estimate equation 2.9 but use some form of the student *t* statistic correcting serial correlation problem. The PP test is a non-parametric statistical method, which makes it robust in the presence of serial correlation (Gujarati, 2003). The study, therefore, used the Phillips Perron test in checking the existence of unit root. However, though the Phillips Perron test is superior to ADF, both tests may give wrong conclusions when there is a structural break. The two tests favour acceptance of the null hypothesis. The null hypothesis in these two test state presence of unit root. To remedy this drawback, the study used the Zivot-Andrews test. This test was introduced by Zivot and Andrews (1992). One structural break is considered by this test while testing for unit root possibility.

(b) Testing Long-Run Relationship (Cointegration)

In an analysis involving two variables, two series are cointegrated if the variables under study are integrated of order greater than zero; i.e nonstationary but the variables linear combination turns out stationary. Cointegration tests seek to determine whether two series have a long-run relationship or not. Under the ARDL framework, ARDL bounds test tests for cointegration. This test is based on Wald statistic/F-statistic. The null hypothesis denoted as H_0 under the ARDL bounds test is that there is no long-run relationship. Pesaran and Pesaran (1999), and Pesaran et al. (2001) report two critical values. The assumption made by the first set of critical values is that all variables in a model are 1(0). The second set assumes the variables are 1(1). The authors suggest that if Pesaran and Shin (1999) is less than F test, critical values of 1(1) bound, null hypothesis (H_0) are rejected, implying a long-run relationship. However, the F statistic lies between the necessary bounds; the results are inconclusive. The ARDL bounds tests are shown in equations 2.9 and 2.10 to estimate the informal sector's size and tax function, respectively.

$$\Delta lnc_t = \beta_0 + b_{1i} lnc_{t-i} + b_{2i} ln(1+tax)_{t-i} + b_{3i} lngdp_{t-i} + b_{4i} lninf_{t-i} + \beta_{5i} lnintr_{t-i} + \beta_{6i} lnfinnov_{t-i} + \sum_{i=1}^{q} \beta_{1i} \Delta lnc_{t-i} + \sum_{i=1}^{q} \beta_{2i} \Delta ln(1+tax)_{t-i} + \sum_{i=1}^{q} \beta_{3i} \Delta lngdp_{t-i} + \sum_{i=1}^{q} \beta_{4i} \Delta lninf_{t-i} + \sum_{i=1}^{q} \beta_{5i} \Delta lnintr_{t-i} + \sum_{i=1}^{q} \beta_{6i} \Delta lnfinnov_{t-i} + \varepsilon_t \quad \ldots\ldots 2.9$$

$$\Delta \text{lntaxrev}_t = \alpha_0 + r_{1i} lntaxrev_{t-i} + r_{2i} ln\text{infsectorgdp}_{t-i} + r_{3i} agricshare_{t-i} + r_{4i} lnmanushare_{t-i} + r_{5i} lnfaidshare_{t-i} + \sum_{i=1}^{q} \alpha_{1i} \Delta lntaxrev_{t-i} + \sum_{i=1}^{q} \alpha_{2i} \Delta ln\text{infsectorgdp}_{t-i} + \sum_{i=1}^{q} \alpha_{3i} \Delta agricshare_{t-i} + \sum_{i=1}^{q} \alpha_{4i} \Delta lnmanushare_{t-i} + \sum_{i=1}^{q} \alpha_{5i} \Delta lnfaidshare_{t-i} + \sum_{i=1}^{q} \alpha_{6i} Duminsq + \varepsilon_t \quad \ldots\ldots 2.10$$

The long-run relationship test, (ARDL- bounds test) for equation 2.9 is as shown in equation 2.11.

$$\left.\begin{matrix} H_0 : b_{1i} = b_{2i} = b_{3i} = b_{4i} = \beta_{5i} = \beta_{6i} = 0 \\ H_a : b_{1i} \neq b_{2i} \neq b_{3i} \neq b_{4i} \neq \beta_{5i} \neq \beta_{6i} \neq 0 \end{matrix}\right\} \ldots\ldots 2.11$$

The long-run relationship test, (ARDL-bounds test) for equation 2.10 is as shown in equation 2.12.

$$\left.\begin{matrix} H_0 : r_{1i} = r_{2i} = r_{3i} = r_{4i} = r_{5i} = 0 \\ H_a : r_{1i} \neq r_{2i} \neq r_{3i} \neq r_{4i} \neq r_{5i} \neq 0 \end{matrix}\right\} \ldots\ldots 2.12$$

Where cointegration was revealed, Error Correction Model denoted as ECM was estimated. The ECM presents both the speed of adjustment from short-run to long-run stability. Where cointegration was absent, the short run ARDL model was estimated.

2.9.6 Estimation Technique

The study estimated size of the informal sector. The study later estimated the effect of this size of informal sector on tax revenue. The regression technique adopted was Autoregressive Distributed Lag (ARDL). ARDL was introduced by Pesaran and Shin (1999) and later eexpounded by Pesaran et al. (2001). The model contains lags of dependent variable, current and lags of current independent variables as explanatory variables. ARDL is preferred over Vector Error Correction Model (VECM) because variables that integrated of order zero and one. It also takes into consideration the possibility of reverse causality. The estimates obtained while using this model are unbiased and consistent (Harris and Sollis, 2003).

ARDL model is advantageous over OLS because it corrects for both endogeneity and serial correlation when correct lags are chosen. The model stands out as the best for cases of small sample sizes. Lastly, Athe model tests for cointegration while including the short-run and long run effects. The general ARDL models emanating from above equations 2.3 and 2.4 are illustrated in equation 2.13 and equation 2.14 respectively. This choice of each of these model was informed by manifestation of long-run relationship for model 2.3 and lack of long-run relationship for 2.4.

$$\Delta lnc_t = \beta_0 + b_{1i} lnc_{t-i} + b_{2i} ln(1+tax)_{t-i} + b_{3i} lngdp_{t-i} + b_{4i} lninf_{t-i} + \beta_{5i} lnintr_{t-i} + \beta_{6i} lnfinnov_{t-i} + \sum_{i=1}^{q} \beta_{1i} \Delta lnc_{t-i} + \sum_{i=1}^{q} \beta_{2i} \Delta ln(1+tax)_{t-i} + \sum_{i=1}^{q} \beta_{3i} \Delta lngdp_{t-i} + \sum_{i=1}^{q} \beta_{4i} \Delta lninf_{t-i} + \sum_{i=1}^{q} \beta_{5i} \Delta lnintr_{t-i} + \sum_{i=1}^{q} \beta_{6i} \Delta lnfinnov_{t-i} + \lambda ECT_{t-i} + \varepsilon_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots 2.13$$

$$\Delta \text{lntaxrev}_t = \alpha_0 + \sum_{i=1}^{q} \alpha_{1i} \Delta lntaxrev_{t-i} + \sum_{i=1}^{q} \alpha_{2i} \Delta ln\text{infsectorgdp}_{t-i} + \sum_{i=1}^{q} \alpha_{3i} \Delta agricshare_{t-i} + \sum_{i=1}^{q} \alpha_{4i} \Delta lnmanushare_{t-i} + \sum_{i=1}^{q} \alpha_{5i} \Delta lnfaidshare_{t-i} + \sum_{i=1}^{q} \alpha_{6i} Duminsq + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2.14$$

2.9.7 Post-estimation Tests

(a) Serial correlation

Serial correlation is one of the econometric problems that are common in time series. It is a situation where the current error term and preceding error term are related. Mathematically, it is expressed $E(\mu_t, \mu_{t-j}) = 0;\ j \neq 0$, meaning that at least some off-diagonal elements are non-zero. Unbiasedness of estimates are not affected by autocorrelation. It affects the variance-covariance matrix, thus giving wrong t values. Breusch Godfrey test was used in testing for auto-correlation. Durbin-Watson d-test and Breusch Godfrey(B-G) tests are commonly implemented in checking serial correlation. However, Durbin-Watson d-test is autoregressive AR (1) process and, therefore, cannot reveal the presence of autocorrelation in the case AR(p) process where p is 2 and above. Breusch-Godfrey test overcomes this challenge since it tests for the existence of autocorrelation in the case of the AR(p) process. This study used the BG test in checking for presence of serial correlation because of its superiority over the Durbin Watson test (Wooldridge, 2016).

(b)Normality Test

The study carried out a normality test using Jarque Berra test that compares the variables' skewness and kurtosis coefficient. A normality test was necessary for this study to validate the significance of the tests. The decision to carry out this test was informed by the small sample size of the used data. The null hypothesis (H0), under Jarque Berra test, is that a variable is normally distributed. Where the data passes the normality test, then the goodness of fit of the data is guaranteed, and therefore the study would adopt the linear regression model suggested.

(c) Model Stability Test

ARDL model used in the study assumes that all the model coefficients remain constant across all the observations. If these coefficients change with the observations, then the model would be said to be unstable. To test for ARDL model stability, the study generated and observed the plot of recursive residuals from the ARDL model was developed, and the graphical plot of the CUSUM was observed (Wooldridge, 2016).

2.10 Empirical Findings and Discussion

2.10.1 Estimating Kenya's Informal Sector

The size of informal sector's GDP was first estimated and later its effect on tax revenue estimated.

(a) The Summary-Statistics

Measures of central-tendency for variables included in model 2.4 were investigated. These summary statistics was computed so as to check the quality of study's variables. Table 2.3 shows these measures of location.

Table 2.3: The Descriptive Sstatistics

Variables	Observations	Average	Standard Deviation for degree of spread	Minimum-Value	Maximum-Value
Log oaf currency outside the banks	49	011.020	1.920	7.550	014.210
log of GDP per capita	49	9.510	1.52	6.820	12.060
Inflation (CPI)	49	11.760	8.080	1.550	45.980
Interest rate for Deposits	49	9.300	6.240	2.430	39.30
log of tax to –GDP-ratio	49	00.160	00.0470	00.0110	00.240
Financial-innovations	49	01.980	00.420	01.380	03.050

From the above Table 2.3, it was evident that the study used 49 observations. Natural log of currency outside the banks had highest standard deviation. This implied that individual observations were far from away from each other. Natural log of tax ratio was found to have the smallest standard deviation meaning the observed annual values were close to each other. The findings showed that minimum value of natural log of tax GDP ratio was 0.011 while the highest was 0.24. The findings further illustrated that natural log of GDP per capita deviated from its average 9.510 by 1.520.

(b) Correlation matrix Analysis

The correlation matrix presents the Pearson Product Correlation between explanatory variables at a go. Table 2.4 illustrates correlation coefficients.

Table 2.4: Correlation Matrix

Variables	log of GDP per capita	Inflation - (CPI)	Interest rate for- Deposits	Natural log of tax to GDP ratio	**Financial Innovations**
Natural log of GDP per capita	1.000				
Inflation (CPI)	-0.140	1.000			
Interest rate for Deposits	0.0670	0.600	1.000		
Natural log of tax to GDP ratio	0.680	0.150	0.400	1.000	
Financial innovations	0.470	-0.10	0.440	0.650	1.000

Correlation means the association between variables. It points out the possibility of variables moving in the same direction or opposite direction. There was evidence of a fair positive correlation between natural log of tax to GDP ratio and financial innovations from the correlation results. Inflation and deposit interest rate had a weak positive association. Inflation and financial innovation had a weak negative correlation. Lack of strong correlation because of all correlation coefficients being less than 0.8 implied that variables were not highly associated.

(c) Stationarity Test Results

The study used PP, ADF and Z-A tests to check for presence of unit roots among the variables. The results were as presented in Table A.1 and Table A.2 in the Appendix section. The three tests revealed that some variables were stationary while others were stationary in first-difference. Structural breaks were revealed by ZA test. Murunga (2014) attributed the breaks due to variation in macroeconomic variables caused by trade liberalization, economic, political shocks and poor climatic conditions. The study adopted ARDL model which is most recommended for such nature of variables.

(d) Cointegration Results

The bounds test revealed presence of long-run linkage for both study models as shown in Table 2.5 below.

Table 2.5: ARDL Bounds Test (Cointegration Test)

Bounds -test	**Function with tax**	**Function with least tax**
F-statistics	08.38	6.47
I(0)- at- 5%	2.6	2.9
I(1) –at- 5%	3.8	4.0

(e) Long -Run ARDL Results

The study estimated model 2.13 and results are shown in Table 2.7. The results consist of not only long run ARDL results but also short run ARDL results. The results for current variables illustrate the long-run results. The results for lagged independent variables illustrate the short-run results.

Table 2.6: Long-run Estimates

Variables	Currency model With Tax	Currency Model With Least Tax
log Currency outside Banks (-1)	-0.570***	-0.376***
	(0.131)	(0.133)
Natural log per capita GDP	1.237***	1.285***
	(0.018)	(0.023)
Inflation	-0.005	0.002
	(0.004)	(0.007)
Interest Rate	0.002	0.004
	(0.006)	(0.010)
log of tax ratio to GDP	3.056***	
	(0.811)	
Financial- Innovation	-0.440***	-0.352**
	(0.091)	(0.143)
Natural log per -capita GDP (-1)	0.011	0.039
	(0.163)	(0.172)
Inflation, (-1)	0.002	-0.00021
	(0.002)	(0.002)
Interest Rate,(-1)	-0.00029	-0.001
	(0.003)	(0.003)
log of tax- ratio- to- GDP (-1)	-0.101	
	(0.487)	
Financial- Innovation (-1)	0.021	-0.044
	(0.057)	(0.062)
Constant	-0.123	-0.126
	(0.137)	(0.164)
Observations	48	48
R-squared	0.642	0.4651
Bgodfrey statistic	0.1968	0.0275
Durbin Watson	2.2	1.82
White General Test	0.7400	0.6264
Jarque-Bera test	0.2999	0.2394

Standard errors of estimates are shown in brackets
*** p<0.01, ** p<0.05, * p<0.1

The results showed valid results for model with tax as illustrated by R-squared impying the regressors explained about 64 percent variation in currency outside banks. In addition, both models were found to be normally distributed as suggested by Jarque-Bera results that were above 0.05. The *t* values for both values were valid due to absence of autocorrelation and heteroscedasticity. The Godfrey tests were greater than 0.05 for both models and the Durbin watson models were close to 2, suggesting absence of autocorrelation. In addition, the scatter

plots as shown in Appendix A.1 and A.2 for current error term against previous error term were found not to have any pattern, thus corroborating the earlier two results of autocorrelation. The P value for white general test was greater than 0.05, implying failure to reject null hypothesis (H_0) of no heteroscedasticity. Recursive residuals from long-run ARDL-ECM regression were computed and used in testing stability of model. Cumulative sum of squares, abbreviated as CUSUM were obtained. The graph of CUSUM was as presented in Figures A.3 and A.4 in the Appendix section. From these graphs, it was revealed that the models were stable as the CUSUM were within 5 percent boundary. The results of the model stability imply that structural breaks as suggested by Z-A test do not have an influence on results.

The ARDL model does not display the ECT explicitly. The adjustment speed was captured from coefficient of lag of log of currency outside-bank. The mean lag measures the speed with which currency outside banks responds to changes in independent variables. The mean lag is obtained by getting the quotient of rate of decline (λ, the coefficient of lag one of currency outside banks) and rate of adjustment (1- λ). The study obtained 1.33, meaning that currency outside bank takes more than one period to respond to changes in the regressors. The coefficients of GDP per capita, financial innovations and tax to GDP ratio were found to be significant and in agreement with economic theory for currency model with tax.

Specifically, the results showed that increase in per capita GDP by one percent leads to an increase in currency outside banks by 1.237 percent, *ceteris paribus*. This result agrees with the Keynesian theory of transaction motive for holding cash. According to this theory, the higher the output, the higher the amount of cash individuals will hold to carry out day to day transactions. The results also revealed that increasing tax ratio by one percent leads to increase in currency outside banks by 3.056 percent, ceteris paribus. These results conform to economic theory that people shift to informal sector if tax rate is high and a burden to them. Also, the study noted that a rise in financial-innovation by a unit results in a a 44 percent decline in currency-outside bank. The results agree with economic theory because individuals will tend to hold less money if there are other forms of buying commodities without necessarily carrying cash. One of financial innovations that can lead to reduced use of cash is use of plastic money. The study found inflation and interest rate to be unimportant determinants of currency-outside-banks in Kenya.

This study used coefficients in Table 2.6 to estimate informal sector in Kenya. The procedure involved is explained in the theoretical framework section. The estimates of Kenya's informal sector are as illustrated in Figure 2.3.

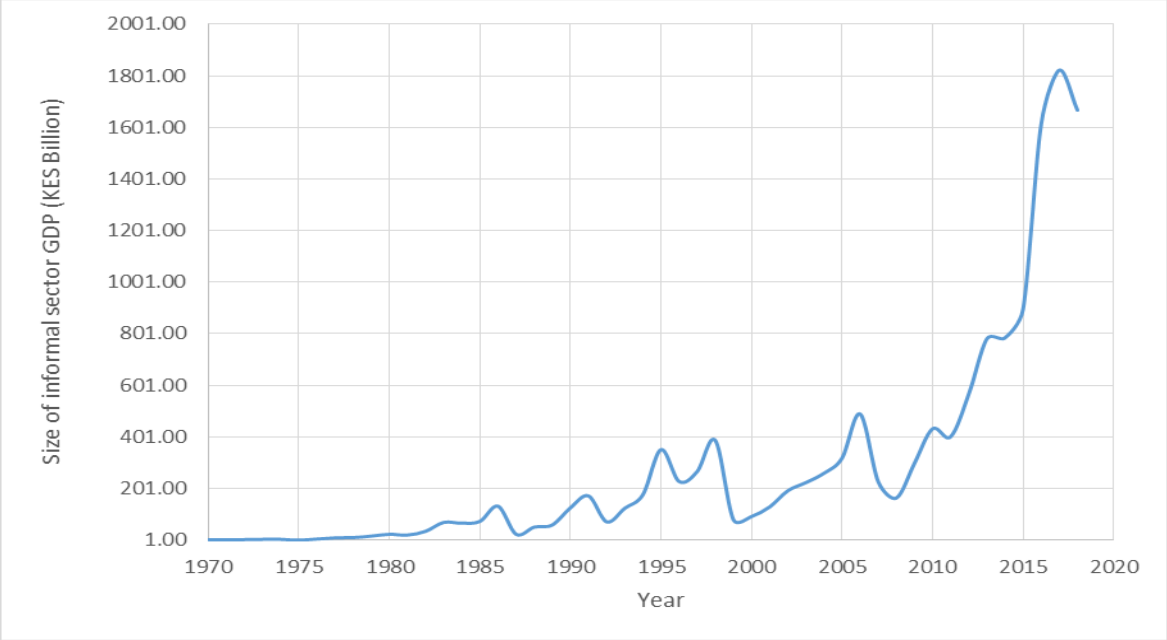

Figure 2.3: The Informal Sector in Kenya (1970-2018)

Figure 2.3 showed that size of informal sector fluctuated between 1970 and 2018. The results showed that informal sector accounted for Kshs. 2.35 in 1970. And it increased to about KES 1.7 trillion in 2018. The findings showed that the size of informal sector shrunk in 1996. The study linked this drop to implementation of tax reforms for instance establishment of KRA in 1995.

The findings showed that for the period under study, informal sector accounted for 32 percent of Kenya's GDP. The finding corroborates earlier finding by Medina et al. (2017). This earlier study used MIMIC method and found that sector was in the range of 20 and 40 percent of output.

2.10.2 Estimating Kenya's Informal Sector and Tax Revenue

Empirical analysis of informal sector's output and tax revenue is discussed below.

(a) Summary Statistics

Summary statistics show measures of location and measures of variability. These measures are illustrated in Table 2.7.

Table 2.7: Summary Statistics

Variable	Observation	Mean	The Standard Deviation	The Minimum Value	The Maximum Value
Tax revenue (log)	49 (Forty nine)	+10.9	+2.290	5.620	+14.300
informal sector's GDP (log)	49 (Forty nine)	+11.3	+1.990	5.620	+14.420
Manufacturing share in GDP (log)	49 (Forty nine)	-2.2	+0.170	-2.620	-1.870
Ratio of Agriculture output and GDP	49 (Forty nine)	0.3	+0.040	0.240	+0.370
Foreign-aid share in GDP(log)	49 (Forty nine)	-2.9	+0.430	-3.630	-1.840

Source: Computed by the study

The study used 49 (Forty nine) observations. Agricultural sector output to GDP ratio had lowest standard deviation meaning the sector's output changes by small margins. Minimum value for informal sector's GDP in logarithm was 5.62 while maximum was 14.42.

(b) Correlation Analysis

The correlation matrix is shown in Table 2.8.

Table 2.8: Correlation Matrix

	Size of informal sector (log)	Manufacturing share in GDP(log)	Agriculture output to GDP ratio	Foreign- aid share in GDP (log)	Dummy variable for quality of Institutions
Size of informal sector (log)	1.00				
Manufacturing share in GDP(log)	-0.04	1.00			
Agriculture output to GDP ratio	-0.24	0.19	1.00		
Foreign- aid share in GDP (log)	+0.03	-0.10	-0.43	1.00	
Dummy variable for quality of Institutions	0.74	0.28	0.0019	-0.46	1.00

Source: Computations based on KNBS data

The results show that there is no strong correlation, since all pairwise correlations are less than 0.6. The results further showed a positive association between n Size of informal sector (log) and institutional quality. The correlation coefficient between agricultural sector's contribution in national output and Foreign- aid share in GDP (log) was negative. This suggested that agriculture share in GDP and the natural log of the percentage of the foreign aid move in the opposite direction. This may imply that foreign aid was used to set up industries that relied on imported raw materials. Those in the agricultural sector may have been opting to work in these industries, thus resulting into decrease in agricultural productivity.

(c) Pre-estimation Tests Results

(i) Results for Unit Root

The study used three unit root tests namely PP, ADF and Z-A. The unit root test results for these tests are illustrated in Table A.4 and Table A.5 in the Appendix section. From these results it was revealed that the three tests revealed variables that itegrated of order zero and one. This informed study to adopt ARDL which is suitable for such nature of variables. Before the adoption of ARDL model, there was need to test for model stability, serial correlation and cointegration. The study adopted ARDL bounds test to test for presence of cointegration. These cointegration results are presented in section (ii) below.

(ii) The Cointegration Results

Table 2.9 shows the results for ARDL bounds test.

Table 2.9: The Bounds Test (Cointegration for ARDL)

ARDL Bounds Test	
F-statistic	0.72
I(0)- at- a 5%	2.93

Cointegration was revealed thus informing the study to estimate both long run ARDL and short run ARDL.

(d) Regression Results of ARDL Model

Table 2.10 shows the short-run Autoregressive Distributed model results for model in equation 2.14.

Table 2.10: ARDL Short-Run Results

Natural logarithm of tax revenue (-1)	-0.6*** (0.14)
Natural logarithm of tax revenue (-2)	-0.19* (0.11)
Log of Informal sector's GDP	-0.51*** (0.08)
Log of Informal sector's GDP(-1)	0.33*** (0.09)
Log of Manufacturing share in GDP	-0.130 (0.34)
Agricultural sector's output share in GDP	-0.170 (1.56)
Log of foreign-aid share in GDP	0.070 (0.19)
Dummy variable for quality of institutions	-0.0090 (0.33)
The Constant	0.15 (0.99)
The Observations	46
The R-squared	98%
The Jarque Bera Test	0.093

The Standard errors are in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

The ARDL incorporates lagged dependent variable among the explanatory variables. This may lead to endogeneity which may render the estimates inconsistent (Gujarati and Porter, 2009). To ensure the efficiency of the estimates, a scatter plot between the current error term and the previous error term was obtained. This plot is shown in Figure A.3 in the Appendix. The study did not identify a consistent pattern, meaning that autocorrelation was absent, and the ARDL estimates obtained were efficient. Recursive residuals from long-run ARDL-ECM regression were computed and used in testing for stability of model. CUSUM were obtained. The CUSUM

graph was as presented in Figures A.4 in the Appendix section. From these graphs, it was revealed that the models were stable as the CUSUM were within 5 percent boundary. The results of the model stability imply that structural breaks as suggested by Z-A test do not have an influence on results. The JB test finding of 0.09 meant that H_0 of variables being normal was not rejected at 95 percent confidence level.

Study findings showed that coefficient of lag one and lag two of log of tax revenue were statistically different from zero. The coefficient of log of informal sector's output was negative(-) and also significant. This implied natural logarithm of size of informal sector is important determinant of Kenya's tax revenue. The results showed that holding all factors constant, an increase in the size of the informal sector by one unit on average leads to an increase in tax revenue by 0.511 percent. This finding can be linked to tax evasion which common in informal sector. Muchiri (2014), Teera (2002) and Dioda (2012) found similar findings.

The coefficient of manufacturing sector's share in GDP was found to be negative but statistically not different from zero. Amoh and Adom (2017) found similar findings. This results make sense for Kenya since manufacturing sector nosedived from the time Kenya embraced liberalization policy in 1992.

The short-run coefficient of agricultural sector in GDP was negative and statistically not different from zero. The results revealed that ceteris paribus, an increase in agricultural sector by one unit leads to reduction in natural log of tax revenue by 17 percentage points. These results conforms to economic theory. According to Musgrave and Musgrave (1989) agricultural sector does not contribute to tax revenue due to poor titling among the developing countries. This makes it difficult to tax agricultural products.

2.11 Conclusions and Policy Implications

2.11.1 Conclusions

Kenya's economic performance has recently been applauded. However, KRA has persistently missed tax targets in recent years. In addition, Kenya's budget deficit has been widening for a while, standing at 8 percent of GDP in 2018. An economy that is seen to perform better regarding GDP but poor in terms of revenue mobilization could point to the presence of a

substantial informal sector. Literature links the informal sector to a high tax burden (Hassan and Schneider, 2016). On this grounds, current study sought to estimate size of informal sector and established its effect on tax revenue in Kenya.

To achieve this study's objectives, Autoregressive Distributed Lag (ARDL) modelling method was adopted. The study used time series data for period between 1970 and 2018. The presence of both stationary and non-stationary variables informed choice of this ARDL model.

Estimation of the size of the informal sector in Kenya entailed two currency demand models, namely one with- tax and another one with-minimum tax as regressors. Cointegration test results presence of long-run link from regressors (explanatory variables) to regressed for both models. The coefficients of natural logarithms of GDP per capita, interest rate on deposits, inflation, financial innovation and natural logarithm of tax to GDP ratio for both models were revealed to be statistically different from zero. The coefficient of the natural logarithm of tax ratio was positive and statistically different from zero. Using these coefficients, the study estimated size of informal sector in Kenya. The sector was found to be fluctuating from 1970 to 2018, averaging 32 percent of GDP.

In estimating informal sector and tax revenue, lack of cointegration revealed while implementing ARDL bounds test. The study found coefficient of size of informal sector coefficient to be negative and statistically not different from zero. This implies that informal sector is essential determinant of tax revenue in Kenya. Thus, dismal performance of Kenya's tax revenue can be arising from increasing size of informal sector.

2.11.2 Policy Implications

The results have shown that Kenya's informal sector averaged 32 percent of GDP. It was also found that the increase in the size of the negatively affect tax revenue mobilization. Thus, to overcome the challenges of this informal sector, there is need combined policies that are custom-made to economy's-specific cases. Since the Kenya's informal may predominantly be an indication of poor governance. This means a proper policy set would assist in streamlining both regulatory, and also tax frameworks while ensuring efficiency of tax revenue mobilization. The government should also ensure high quality of public service delivery since such actin can boost tax morale.

2.11.3 Limitations of the Study

Estimation of the effect of the size of the informal sector on Kenya's tax revenue relied on macroeconomic approach, currency demand model. The literature suggests that a microeconomic approach or direct method for example-survey based on structured questionnaire, though biased, gives a clear indicator of informal sector. This study could not use a study based on a questionnaire due to budget limitations. Nonetheless, the variation between the estimates obtained using the two approaches may not vary so much.

2.11.4 Areas for Further Research

Future studies can consider using other estimation methods, for instance, electricity, labour participation, and compare their results with the current study's results and existing Multiple-Indicators and Multiple-Causes (MIMIC) approach results.

CHAPTER THREE

TAX REVENUE PRODUCTIVITY OF TAX REFORMS IN KENYA

3.1 Introduction

Public revenue is essential for economic growth in a country. In Africa, public revenue has been downward due to reduced prices of natural resources for the resource-rich economies (Wawire, 2017). For the non-resource-rich countries, the situation is not different, since tax which is the primary source of public revenue has not increased proportionately with an increase in government expenditure. This has, therefore, resulted in increased budget deficits for most economies in Africa. This situation has made many African countries resort to public debt to finance deficit in the short-run. This alternative form of deficit financing is conspicuous in African nations, since a more significant proportion of their populace is poor and relies on the government to provide public goods. However, financing budget deficit through borrowing is unsustainable (Okech and Mburu, 2011). Gituku (2011) argued that this source of deficit financing has partly resulted in inflationary conditions in many countries. It implies that governments must put in place a tax system that can mobilize enough tax revenue. In addition, the 2008 global financial meltdown showed the need to emphasize domestic resource mobilization. This is because the financial crisis and COVID-19 pandemic indicated the uncertainty and volatility that characterizes international sources of development finance (World Bank, 2020; Thomas and Trevino, 2013).

On the tax revenue side of fiscal operations, the response to whether economic growth leads to increased tax mobilization, and hence reduction in budget deficit relies on an essential component of the tax system known as tax elasticity (Muriithi and Moyi, 2003). An ability of a particular tax system to raise tax revenue has a direct bearing on the public goods that a government can provide. Thus, for taxation to be an effective tool for resource mobilization, the tax system should be productive or elastic. Tax buoyancy is the responsiveness of tax revenue to variations in GDP and changes in the discretionary measures, for instance tax bases and tax rates. It is expected that both the income elasticity and buoyancy of a given tax system is equal or greater than unity (Bonga et al., 2015). The investigation of tax elasticity and buoyancy is essential when there is a need to evaluate whether future revenues can be sufficient in meeting a

country's resource requirements without varying the bases or rates of existing taxes (Koatsa and Nchake, 2017).

Further, investigating tax elasticity and buoyancy allows one to establish whether tax collection is kept in line with the country's economic activity and if individual tax elasticities and buoyancies are of great importance to identify weak and strong areas of a country's tax system. These analyses permit the fiscal bodies to establish a need to put more effort into mobilizing taxes and focus more on raising tax revenue from the tax components that react well to a continued rise in the output (Dudine and Jalles, 2018).

3.2 Tax Revenue and Tax Structure in Kenya

Tax reforms are essential in achieving the Pan-African objective of improving domestic resource mobilization (OECD, 2018). This objective is one of the global targets in the African Union (AU) Agenda 2063 and regional economic community's strategic priorities (African Union, 2015; United Nations, 2015). According to Wawire (2020), tax reforms in Kenya sought to catalyze tax revenue mobilization, but this effort has not borne fruit. Despite putting in place various tax reforms, an increasing fiscal deficit has continued to be witnessed in the country. For instance, tax ratio declined by 0.1 percent to 18.2 percent in 2017 from 18.3 percent in 2016 (OECD, 2018). Specifically, VAT, income taxes, trade taxes and excise taxes have not been doing well for the last two decades. For instance, trade taxes accounted for 2.5 percent of GDP in 2000 and then increased to 3 percent in 2001. It later decreased to 1.8 percent in 2006, where it remained constant until 2014. It then reduced to 1 percent of GDP in 2018.

Excise taxes showed a decreasing trade during the same period. These taxes decreased to 2 percent of GDP from 3.5 percent in 2018 (Wawire, 2020). Again, compared to the other 25 countries studied by Revenue Statistics in Africa, Kenya experienced a decrease in tax ratio of 0.7 percent between 2008 and 2017 while the countries experienced an increase in tax ratio of 1.5 percent (OECD, 2018). Egwaikhide (2020) showed that Nigeria's government had performed dismally in tax mobilization for the last two decades. The tax ratio decreased from 5.8 percent of GDP between 2000 and 2002 to 3.9 percent of GDP between 2014 and 2017. The VAT ratios also remained at 1 percent of GDP during the same time. The decline in tax revenue was linked to uncoordinated and sweeping tax exemptions, multiple taxes and insufficient infrastructure.

Mabugu and Rakabe (2020) showed that the Zambian government had undertaken unfruitful tax reforms in Zambia for the last two decades. According to the author, the most critical driver of the country's tax policy instability is exemption of the mining sector. Attempts by the tax authority to tax the sector has not been fruitful due to lack of political will.

Kenya's tax structure is VAT, corporate income tax, excise tax (sometimes referred to as taxes from other commodities), personal income tax, and international trade transactions. The VAT accounted for 27 percent of Kenya's tax revenue; personal income tax accounted for 25 percent of the tax revenue. Corporate tax accounted for 22 percent, respectively. These tax categories were significant contributors to tax revenue in Kenya for the last decade. Taxes from other goods and services contribute about 15 percent of overall tax revenue in Kenya. Taxes on international trade transactions are still very low in Kenya, accounting for 9 percent of total tax revenue (Republic of Kenya, 2018).

Regarding contribution to consolidated revenue, income tax, VAT, and corporate taxes accounted for 24.6 percent, 23.5 percent and 20.3 percent, respectively. The excise taxes and trade taxes account for 10.7 percent and 8.8 percent (Wawire, 2020). According to Ouma (2019), this can be attributed to the government increasing import duty on commodities that compete with locally produced commodities and cumbersome customs procedures. Though the action served a protective effect, it had a negative impact on taxes from international transactions.

The performance of these taxes can be attributed to fiscal reforms, which were implemented in the 2000s. The performance of VAT and corporate taxes can be attributed to economic recovery strategy for 2003 and 2007, commonly known as Economic Recovery Strategy (ERS) for wealth and employment creation. This strategy aims to improve infrastructure, the country's governance, and uphold the rule of law. This resulted in a friendly and conducive environment for doing business in Kenya. The government realized improved efficiency and productivity in agriculture, trade, industry, mining, tourism, thus translating into increased value added tax and corporate tax (Republic of Kenya, 2003). By mid 2000s, when ETR was being launched, another reform for RARMP took place. The key purpose for the launched ETR being mitigation of VAT tax loss resulting from the large scale poor record-keeping by the business people. Notably, one of the reforms introduced during this period was the integration of KRA into a modern and focused

customer body. This led to increased tax compliance and efficiency in tax administration (Atambo and Katuse, 2017).

3.3 Kenya's Economic Performance Since 1970

The political instability brought about the failed attempted coup in early 1980s as well as other key shocks such as a one-year prolonged drought of 1983/4 as well as in 1997/98 led to Kenya economy's dismal performance. The El-Nino that followed the prolonged drought of 1997/8 and yet another one in 2000 did worsen the situation with the country registering its first long power rationing hours. In addition, the economy had not fully recovered for other large scale shocks such as the 1991 aid freeze and gulf war-oil related shock and a further aid freezes of 1993 to 2000. (Wawire, 2006). Both inflation and average interest rates increased to a higher rates of 46% and 30% respectively (Republic of Kenya, 1997). A further internal shocks created by domestic tribal clashed of 1992 and 1997 all had a hand in the country's inability to meet her tax collection targets (Wawire, 2006). However, by late 2000s, the country had adopted a new environment of policy change especially on trade when it joined AGOA, boosting her EPZ export such as garments and textiles tax-free. The Kenyan government agreed to the AGOA, thus stimulating the already established Kenya's EPZs. This intervention on policy led to an increase in exports on garment from roughly USD 30 million to a tune of USD 240 Million in a span of five year period (from 2000 to 2005). Additionally, by 2005, Kenya as an economy was experiencing an increase efficiency in its legal system, an existence of a good political will (Murunga, Muriithi and Kiiru, 2016).

In addition, there was new face of government from 2003 after change in political regime. This led to steady increase in GDP, reaching 8.41 in 2007. The good performance was due to sound macroeconomic management, which resulted to high private and public investment. The 2003 to 2007 economic reforms were under the five-year plan commonly but were destabilized during the PEV of late 2000s that led to the Kenyan's economic growth dropping by the largest margine (from 6.4% to 0.23% in the period 2007-2008 (Murunga, 2014).

3.4 Tax Reforms in Kenya

Tax revenue is essential for sustainability of both developing and developed countries. Many countries in the world have been striving to restructure their tax systems. The objective of this

action is to ensure they raise adequate tax revenue to meet government operations. The failure to meet the required tax revenue implies that the countries should resort to domestic and international borrowing to increase budget deficits. Even though economic growth can lead to increased tax mobilization and hence reduction in budget deficit, it may, however, fail to increase tax revenue naturally, and therefore the government may be forced to intervene through implementation of various tax reforms with more significant consideration of the critical component of the tax system (Ndiaye, 2017).

Tax reforms have been employed in many countries to increase revenue productivity of their respective tax systems. As early as when Kenya got her independency as self-governed state, its main or primary source of government revenue was through taxation (Eissa and Jack, 2009). Other sources, such as FDI and levied fees mainly remained supplements. With all this revenue sources, the government budget deficit was a common experience but turned to a major government fiscal crisis during the 1970s oil shock. This fiscal crisis then initiated several tax reforms in the revenue collection system such an introduction of the sales tax and trade tax (Eissa and Jack, 2009). Notably, the trade tax mainly targeted import substitution and hence was a fiscal policy geared toward correcting trade imbalances between Kenya and her major trading partners. This trade tax later become an instrumental fiscal policy in perusing the much hyped export-led growth strategies in the country while the government's distributive role was mainly achieved through both corporate tax and personal income tax (Moyi and Ronge, 2006; Karingi and Wanjala, 2005). However, the government revenue seemed to have been constrained by either internal or external factors which saw higher rates to these distributive role taxes (corporate tax and personal income) beginning mid-1970s to around 1984. For instance, taking personal income tax alone, the lowest marginal rate charged was about 10% while the highest was 65% of the first shilling earned. The corporate tax was not spared either as both internal firms and external tax were taxed about 45% and 52% respectively. Despite these changes in both corporate tax and personal income, there was very little achievement in tax collected in personal income tax as those target were upper range who not only few in number but had decided to not to declare their income (Eissa and Jack, 2009).

As a result of these failures to collect targeted tax, the government introduced another tax reform in early 10980s with the introduction of Tax Modernization Programme (henceforth TMP)

whose expectations was target an annual tax revenue collection equivalent to between 22%-28% of the country's GDP by 1992 (Eissa and Jack, 2009). It also saw the replacement of the narrow-based Sales Tax with a more broad-based tax base called VAT mainly on consumption goods. A later personal income tax reform in which both reduction of tax brackets and marginal tax from a maximum of 65% to almost half (30%) improved reporting and tax collection. Further, some admistritative tax reform occurred in which KRA was initiated in 1995, centralizing all tax collection in the country (Eissa and Jack, 2009; Omondi et al., 2014; Mutua, 2012).

By 2004/2005, KRA took a bold step of boosting revenue through replacing the manual processes through RARMP (Kondo, 2015). To raise more tax revenue, the government proposed reforms in income tax. Among these reforms was the imposition of tax on rental income, professional fees, royalties, rent and interest. The other reforms included the imposition of tax on dividends received by the resident company that holds 25 percent of shares in a company. On pension, the government proposed imposing a lump-sum tax on the benefit received by individuals from a registered pension scheme upon retirement (Republic of Kenya, 2018). In reading Kenya's budget statement for the financial year 2018/2019, the Cabinet Secretary for the National Treasury elaborated how the government intended to meet her increased expenditure to meet the "Big Four" agenda. For instance, the government imposed a 12 percent tax on mobile money transfers. The government also imposed a 35 percent tax on imported vegetable oil, steel and iron sheets, textiles, footwear and second-hand clothing. Further, the government introduced a Robin Hood tax of 0.05 on commercial banks and other financial institutions' transactions of at least KES 500,000 (Republic of Kenya, 2018).

Corruption among taxpayers leads to a decrease in tax revenue due to tax evasion. The corruption among tax administrators could pose a significant challenge to tax fraud detection. The level of the probability of being detected by tax authorities is one of factors that cause tax evasion. Thus, taxpayers will still practice tax evasion if this probability is one, but the tax administrators can be bribed. Tax evasion can be rampant, especially when a bribe is less than the fine expected to be paid once caught.

Further, many authors assert that people decide to enter the informal sector to avoid corrupt tax officers (Huňady and Orviská, 2015; Friedman et al., 2000). Moreover, some taxpayers may lose

tax morale after realizing that corruption levels are high in the country. Wawire (2020) shows that efforts by tax authorities to enforce tax policies may face political interference. Kenyan government got a reprieve from such interference following the promulgation of the 2010 constitution that created an independent judiciary. This means taxpayers or tax administrators involved in corruption can be prosecuted and sentenced without interference from the politicians. This action is likely to have resulted in improved tax performance.

3.5 Determinants of Tax Revenue

(a) Change in Tax Base

The tax base is one of ways the government can broaden its tax collection ways. If a country's tax bases are narrow, the tax revenue capacity of the nation shrinks, and if it widens, the capacity of the tax revenue increases. Data from the Republic of Kenya (2017) indicate that its informal economic sector accounts for 77 percent employment. This means the country has the potential of broadening its tax base if the informal sector is reduced. Among the efforts that the government has recently taken to widen tax base was taxing members of parliament from the beginning 2012/2013 financial year, imposition of tax to landlords' income from rent collected in July 2012.

(b) Change in Tax Rates

Tax rates have been used as explanatory variables in estimating tax revenue (Wawire, 1991; Wawire, 2003). The history of impact of tax rate on tax revenue is drawn back to an era of classical economists. For instance, Smith (1776) argued that high tax rates could result in low tax revenue to the government than moderate tax rates would do. This assumed that high tax rates encourage the smuggling of commodities and reduce consumption of the commodities subjected to high tax rates. Laffer (2004) argued that the gradual rise in the tax rate would maximize tax revenue up to a certain point beyond which it would decline. Trade literature, as demonstrated by Caves and Jones (1973), showed the existence of tax maximizing tariff. In this study, tax rates (used discretionary tax measures proxy) were used to establish whether they increased tax revenue in Kenya.

(c) Gross Domestic Demand

Several studies have used Gross Domestic Product (GDP) as an explanatory variable in estimating tax revenue (Muriithi and Moyi, 2003; Wawire, 2006; Wawire, 2017). According to Teera (2002), GDP can be used to measure a country's economic prosperity. Musgrave (1969) showed inadequate tax handles exemplified by weak manufacturing, agricultural and mining sectors at low GDP levels limit revenue mobilization. Chelliah (1971) argues that an increase in GDP implies higher capacity for individuals to pay and thus greater capacity to impose taxes by the authorities. Further, Tanzi (1983) asserted that higher GDP makes countries more urbanized, which bring about increased demand for public goods, thus giving tax authorities' opportunity to tax more tax revenue. In this study, GDP was used as a critical determinant of tax revenue.

GDP was used as a tax base in this study. Taking GDP as the tax base, Sahota (1961) suggested that tax buoyancy and tax elasticity can be calculated using the Proportional Adjustment Method. The method involves isolating discretionary tax revenue from the data provided by the government. Prest (1962) also used this approach. The approach of using GDP as a tax base and was later exemplified by Mansfield (1972).

(d) Other Determinants of Tax Revenue

Wawire (2020) showed that political events, for instance, general elections constrain tax revenue. The decline in revenue is attributed to uncertainty about the incoming governments. Wawire (2006) showed that population influences tax revenue. This is because a majority of developing countries have a significant proportion of their population being employed, thus making it challenging to implement tax policies. To obtain an accurate value of the coefficient of GDP, the main goal of this study, political events in the country and population were considered.

3.6 Statement of the Problem

The size of the budget deficit measures the impact of fiscal policy in any country (Nwanna and Nkiruka, 2019). According to available data form the Republic of Kenya (2019), the country's fiscal deficit rose from an average of 2% to 8% between 2003 and 2018 partly due to government's desire to meet her citizen's needs as well as stimulate up her economic growth and development. However, for about a decade or so, Kenya's tax raisin system (the KRA) miss met

her tax revenue targets giving room for unsustainable external and internal borrowing as a means of raising government revenue in short run. The unsustainability arising from their character sic inflationary tendencies as well as unreliability resulting from world financial meltdown and numerous conditionality from the donors. This is the rationale behind the Kenyan government in design of a productive tax system which saw numerous tax reforms have also been initiated, as enshrined in multiple policy documents. Among these documents are the tax management administration of 1986, national development plan (NDP) of 2002 and the ERS of 2003-2007. In these policy documents, the government emphasizes increasing tax revenue without burdening those that are already paying. For example, fiscal policy on tax management administration emphasizes broadening the tax base and strengthening tax administration. Other measures contained in these policy documents include improvement of tax administration through abolishment of tax avoidance and evasion and designing a tax system that is buoyant and elastic. The design of a buoyant and elastic tax system ensured, which tax revenue increases at same speed as the GDP increases.

The subject of the reaction of tax revenue to variation in its base has not been widely studied with only a few studies by Wawire (2017), Muriithi and Moyi (2003), Menjo and Kotut (2015) and another by Okech and Mburu (2011) in existence yet doubts about their results on reliability based on their failure to separate informal sector GDP from the recorded GDP, is a major concern (Osoro, 1993). Previous studies that have estimated Kenya informal sector shows that it lies between 20% and 40% of GDP (see chapter two of this thesis, Medina et al., 2017; Ouma, Kamau, Khainga and Kiriga, 2007).

On the basis of the above setbacks, we sought to estimate, first the Kenya's tax buoyancy and second, the Kenyan tax elasticity on her tax system taking into account the separatability of the informal sector GDP from recorded GDP. The study adopted proportional adjustment method in estimating the revenue productivity of tax reforms in Kenya. The study used time series data between 1970 and 2018.

3.7 Objectives of the Study

The overall objective of this study was to carry out an analysis of the effect of the tax reforms on tax revenue mobilization in Kenya. The study's specific objectives were:

(i) To estimate tax buoyancy of Kenya's tax system.

(ii) To estimate tax elasticity of the tax system in Kenya.

3.8 Significance of the Study

The study is essential since it points to how the Kenyan tax system responds to changes in GDP and discretionary tax measures. This study thus provides the required information to fiscal policy authorities at National and County Governments regarding tax elasticity and buoyancy in Kenya. In addition, tax is critical in pushing the economy towards achieving the Kenya Vision 2030. This development blueprint aims to change Kenya into a newly industrializing middle income where the citizens enjoy quality life in a safe and tidy setting by 2030. This, therefore, implies that the attainment of Kenya's Vision 2030 relies much on adequate tax revenue. This study thus provides information to guide the government on whether to leave the tax system to respond naturally to an increase in GDP, or focus on discretionary tax measures.

Further, tax revenue mobilization is essential if the Kenyan government provides vital services, such as health, energy, infrastructure, education, water and sanitation, as enshrined in the Sustainable Development Goals (SDGs). The study is also essential since it is an addition to the existing literature on tax buoyancy and elasticity. Lastly, this study opens future research on tax elasticity and buoyancy in Kenya using different approaches.

3.9 Scope of Study

The focus of this current study was on productivity of Kenya's tax system. This is because the country's budget deficit continued to widen despite the initiation and implementation of various reforms (Oguso et al., 2018). The study considered a period spanning from 1970 to 2018. The choice of this period was motivated by the fact that it is long enough to meet the required time-series properties. Secondly, this period is characterized by the desire by government to increase the provision of public goods to meet the needs of the growing populace and stir the economy upwards. To achieve these goals, the government adopted various tax reforms that resulted in changes in tax design to ensure tax increases at same pace as growth in national income.

3.10 Theoretical Literature Review

This section considers various theories of tax and the determinants of tax revenue. Tax revenue determinants are the foremost vital concerns that influence tax collection. If these concerns are met, then there is a noticeable change in tax revenue. Theories of tax and determinants of tax revenue are discussed .

3.10.1 Measuring Tax Performance

Musgrave (1969) showed the part played by various tax handles in influencing tax effort expressed as actual tax collected divided by the potential tax. This ratio illustrates the extent to which a country is making use of its taxable capacity. The four main approaches for assessing tax performance. These approaches include the efficient use of resource approach, ability to give direction, comparison with the average performance and the ability to collect approach. The most generally used approach to estimate tax effort is running a regression of tax ratio on regressors that include major determinants of GDP (Bahl, 1971). These regressors serve as proxies for tax handles. The predicted tax ratio thus shows the ratio which a country would have had if it achieved average tax effort. Therefore, the tax ratio indicates the country's taxable capacity while the coefficients in the regression act as average effective tax rates on given base.

The use of tax effort method to measure tax performance is static, since it shows a country’s potential for realizing high tax at a particular point in time compared to other countries (Al-Freijat and Adeinat, 2020). However, to determine the efforts made by a government in increasing tax revenue over a given period, there is need to view tax performance in a dynamic sense. This means that there is need to measure tax performance in terms of the response of the tax system to variation in GDP due to the changes in tax structure by the authorities. Such measurement of the performance of the tax system is called tax buoyancy. A measure closely related to tax buoyancy is tax elasticity, which measures how tax revenue responds to changes in GDP without government intervention. Estimating tax elasticity is essential for illustrating the degree to which the tax system responds to fluctuations in tax composition and value of GDP (Teera, 2002). Suppose tax elasticity of tax system remains low, either due to tax evasion or avoidance or inadequate base. In that case, the governments mobilize additional tax revenue

through discretionary tax measures. In such a situation, tax revenue growth is through tax buoyancy and not through tax elasticity.

3.10.2 The Benefit Principle

The principle exemplifies that taxes be paid according to benefits received from government expenditure. In this regard, a truly equitable tax system will differ based on the expenditure structure. Under a strict regime of benefit taxation, an individual taxpayer would be subjected to tax based on his demand for public goods. Since each individual has his preferences, no general tax formula can be used for all individuals. Each taxpayer would be taxed based on his evaluation. The real mix of private goods bought is known to depend on consumer's income. The same applies to social goods. However, what matters for social goods is how much the various consumers are ready to pay for the same quantity. If the social goods are normal goods, consumers' value is expected to increase as their incomes rise (Musgrave, 1969). In the current study, the benefit received theory was thought to appeal to government to raise more taxes. This is because it allows the government to tax individuals who benefit from a service. For example, taxpayers who own or drive vehicles should pay more taxes for road maintenance than those who do not own or drive cars.

3.10.3 Ability to Pay Theory

Kendrick (1939) founded the theory of ability to pay, which considers tax liability in its true form, involuntary payment by an economic agent to the state without getting an advantage over the others in return. The theory assumes a lack of profitable or semi-profitable association between the nation and the country's population. Following the theory, an individual pays taxes since they are able and their relative share in entire tax liability obtained by their relative capability to pay. This principle has been in trend for many decades, just like the benefits principle. Socialist theorists backed the ability to pay theory because the theory conforms to ideas of equity and justice. However, the reasoning behind the ability to pay also received attention from non-socialist thinkers, making it welfare economics theory. The primary rationale behind this theory postulates that citizens should share tax liability on the doctrines of equity and justice and that this burden should be apportioned based on their relative ability to pay theory.

This theory applies to this study because, unlike a flat tax, the government can raise more tax revenue through imposition of higher rate of tax on high-income earners.

3.10.4 Theory of Fiscal Policy

The theory of fiscal policy was put forward by Prest (1985). It suggests that governments mobilize tax revenues, and the resources mobilized are used to fund public projects and provide public goods and services. The government should make policy decisions to ensure that the limited resources collected in the economy are allocated wisely among the government's competing needs (Battaglini and Coate, 2008). During the first decade after independence, the Kenyan government used its recurrent revenue receipts to fund its current expenditure and portion of development expenditure, thus translating to the least fiscal deficits. From the mid-1970s, after a sequence of economic shocks, the country experiences large fiscal deficits (Kariba, 2011). The fiscal deficits have continued to be experienced in Kenya. An elastic tax system can be said to be responsible for the continued fiscal deficits in Kenya.

3.10.5 The Theory of the Cost of Service

This theory was developed by Gordon (1959). It is about how the state relates with the citizens. The theory postulates that economic agents of a country are not tied to any service from the government, but if they were to get any service, they must pay for the cost of producing the service. According to this theory, the government should ignore its basic protection and welfare functions. The government is principally to recuperate the cost of providing public goods of the services. This implies that unlike the theory of benefits received, this theory suggests explicitly a policy where government expenditure equals tax revenue. This theory further suggests that in the processes of recovering the cost of the service, problems of income distribution should not bother the government. Therefore, the theory implies that no effort seeking to ensure income distribution should be taken. Further, no attention is required if the strategy of imposing taxes based on the cost of service theory worsens income distribution more.

3.11 Empirical Literature Review

Empirical evidence on nexus between tax productivity associated tax reforms are limited in Kenya. For instance, Ole (1975) studied the income elasticity of the Kenyan’s tax system,

making use of a 10-year time series data of 1962-1973. This study established that Kenya's tax system was inelastic. The study's results further illustrated that the various discretionary tax measures improved tax revenue collection as suggested by the buoyancy coefficient of 1.25. Though the methodology used separated tax revenue from two important component of tax revenue (discretionary and actual taxes), its few observations could not be relied upon. Yet in analysis zing Kenyan's tax elasticity, tax effort and tax ratio using a time series data (1958-1989), Wawire (1991)'s study finding revealed a less proportionate tax revenue increased on the country's GDP indicating an inelastic tax system. However, we challenge this finding given that the study relied on recorded GDP rather than official GDP that usually comprised of informal sector GDP. Later, Njoroge (1997) using a time series data from the fiscal year 1972/73 to 1990/91 to study Kenya's revenue productivity due to tax reforms. This study revealed a tax system that is insensitive to growth in GDP while discretionary tax measures was found to be effective in improving tax revenue. Though this study separated tax revenue that could be linked to discretionary tax measures, the observations used are not enough to handle econometric tests.

Equally, another study by Muriithi and Moyi (2003) focused on the impact of tax reforms on Kenya's tax revenue using a time series data of pre-tax and post-tax reforms. This periods were before tax reforms were embraced (1973-1985) and during the reform process (1986-1999). The result revealed that Tax buoyancy increased by 62% percent during the reform period, while elasticity increased by 400% intuitively implying that these reforms little or no significant role in tax mobilization. However, in this period, tax increased automatically in response to increase in GDP. This study focused on TMP but failed to incorporate RARMP, which started in 2004/05.

During the mid-2000s, fiscal reforms were initiated and implemented. One of the critical fiscal reforms was Kenya's ERS-WEC (Republic of Kenya, 2003). This strategy aimed to improve infrastructure, governance structure and upholding the rule of law. This led to a friendly environment for business in Kenya, thus translating into increased tax revenue. Studies investigating tax revenue productivity during this time include Kieleko (2006) and Wawire (2006). Kieleko (2006.

The post-election violence that occurred during 2007/2008, coupled with the 2008 global financial meltdown, led to a decline in Kenya's economic growth rate. The existing economic

conditions negatively impacted Kenya's tax collections, as shown by increased budget deficit. This forced the government to initiate and implement various tax reforms. The prevailing conditions of those times may have informed Omondi et al. (2014) to investigate impact of tax reform on the productivity of the tax system in Kenya. This study used a dummy variable approach for the period between 1963 and 2010. The study's results revealed that RARMP and TMP were significant in describing Kenya's tax systems. The Kenyan tax system was inelastic, meaning that there was need to formulate more discretionary tax measures. The study's strength is that it considered an adequate time span that allows testing of the required time series tests. The study's drawback is that the estimates may be biased because the study failed to separate the impact of DTM from the observed tax.

Focusing on specific tax components, Wawire (2017) explored the elasticity of VAT in Kenya using general equilibrium analysis. The study incorporated an economy's demographic, institutional, and structural characteristics to check how VAT reacts to variations in GDP. This study established an elasticity of greater than one, implying that growth in VAT is greater than that of GDP. The strength of this study is that it is considered an indirect tax (VAT) that affects every citizen of the economy. Implementation of this study's recommendation can result in increased tax revenue. Failure to include other variables, for instance, the nature of the products in terms of their response to variations in charges targeted by VAT, is the study's shortcoming.

In other Africa countries, Osoro (1993) and Kusi (1998) studied tax productivity in Tanzania and Ghana, respectively, using a proportional adjustment model using data covering the period between 1969 and 1990. Osoro (1993) revealed a buoyant but inelastic Tanzanian tax system. Kusi (1998), studying the tax system in Ghana between 1970 and 1993, showed that it was buoyant and elastic. The strength of these studies is that individual tax component was also investigated. Such analysis was necessary for Tanzania in identifying the weak and strong areas of the country's tax system.

In another study, Asaolu, Dopemu and Monday (2015) studied the effectiveness of tax reforms on tax revenue generation in Nigeria, Lagos State. OLS regression technique and quarterly data for a period running from 1999 to 2012 were used. The estimation results found that tax reforms and revenue performance exhibited a long-run association in Lagos State. From the study's

findings, tax reforms were observed to be an essential determinant of tax revenue. In conclusion, in Lagos State, reforms in the tax system enabled the state to offer public goods and services to the citizenry, with little dependence on the central government. Whereas the study estimates the association between tax reforms and the Nigerian tax revenue generation, the data used was collected from Lagos state, leaving out other states, hence the findings may not apply to Nigeria as a whole.

Bayu (2015) empirically studied tax buoyancy and its determinants in Ethiopia. The study used data running from 1974 to 2010. The double log function's VECM results revealed that direct and indirect domestic taxes were not buoyant. The study's results showed non-buoyant foreign trade tax revenue. On estimating the determinants of tax revenue of Ethiopia, services sector value-added, share of imports in GDP, and share government budget deficit in GDP were found to have a positive contribution. The share of official development assistance in GDP was found to have an adverse effect on tax revenue in Ethiopia. Though the study has revealed that the Ethiopian tax system is non-buoyant, the study did not exhaust the determinants of tax revenue. For example, incidences that contributed positively and negatively to economic performance could have impacted the country's tax revenue.

Dudine and Jalles (2018) studied the buoyancy of tax system for 107 countries using panel data running from 1980 to 2014. Using Fully Modified OLS and pooled mean group estimators, the study found that the tax system for advanced economies was buoyant both in the long-run and short -run. The individual taxes that were found to be buoyant were corporate taxes and taxes on goods and services for advanced and low-income economies, respectively. For emerging economies, personal income and social security contribution taxes were found to be buoyant. The results of this study are valid since the required checks for the robustness of the results were carried out.

3.12 Overview of Literature

The diverse literature on revenue productivity, tax reforms and their relationship (Wawire, 1991, 2003; Osoro, 1993; Kusi, 1998; Muriithi and Moyi, 2003; Omondi et al., 2014; Wawire, 2017) as reviewed has been hindered by not only being insufficient but also failed to have a vibrant theoretical framework on how, for example, the tax would increase government income given

respective and specific tax structures. On the other hand, Asaolu, Dopemu and Monday (2015) asserted that this could make it challenging to identify the appropriate empirical specification of the link between tax and revenue productivity. The literature reviewed in this sub-section elucidates essential measures of an effective tax system, such as tax elasticity and tax buoyancy (Wawire, 1991; Muriithi and Moyi, 2003; Omondi et al., 2014; Wawire, 2017). These studies agreed with the concept of tax revenue productivity of tax reforms regarding the buoyancy and elasticity. In ascertaining the productivity of the tax system of a country considering revenue collected, tax buoyancy and elasticity for overall and separate tax components can be calculated (Osoro, 1993; Kusi, 1998). Although most of these previous studies adopted the correct methodology, the findings may not be reliable in informing policy. This is because the studies did not separate informal sector GDP from the recorded GDP.

3.13 Methodology

3.13.1 Introduction

This segment presents different phases that were followed to complete the study. It involves the theoretical framework, empirical model, data sources and type, variable description, and measurement and general estimation tests to achieve the intended objectives. The roadmap of achieving the intended objectives is discussed in sections 3.12.2, 3.12.3 and 3.12.4.

3.13.2 Theoretical/Analytical Framework

Prest (1962) framework was adopted to estimate measures of how productive a tax system is. These measures include tax buoyancy, and also tax elasticity. The latter is obtained through getting proportionate change of country's tax-revenue over proportionate change in a nation's output. Although tax elasticity illustrated as an aggregate, it is actually weighted average of summation of tax elasticities for various taxes, that often have varied responses to GDP variations. Therefore, tax response to GDP/national output variations must be examined through examination of individual tax elasticities for various tax handles separately. In turn, response of the mentioned separate tax handles to GDP/national output changes can be studied into two parts namely response of tax to own base, and also, response of a specific tax base to variations in GDP. For illustration, let T_t be total tax-revenue, Tn be tax-revenue from n^{th} tax handle, Y be GDP, and also, Bn the base of n^{th} tax handle. From this illustration, we obtain elasticity of

overall-tax to GDP, elasticity of n^{th} individual tax handle to its base and elasticity of n^{th} individual tax base to national output/ GDP in equations 3.1; 3.2; 3.3 and 3.4.

$$E_{T_t,Y} = \frac{\Delta T_t}{\Delta Y} * \frac{Y}{T_t} \quad \text{.....3.1}$$

$$E_{T_n,Y} = \frac{\Delta T_n}{\Delta Y} * \frac{Y}{T_n} \quad \text{.....3.2}$$

$$E_{T_n,B_n} = \frac{\Delta T_n}{\Delta B_n} * \frac{B_n}{T_n} \quad \text{.....3.3}$$

$$E_{B_n,Y} = \frac{\Delta B_n}{\Delta Y} * \frac{Y}{B_n} \quad \text{.....3.4}$$

The above equations can be used to divide elasticity in individual tax components. For the case of whole tax system with *n* tax handles, overall tax-revenue is as illustrated in following equation 3.5.

$$T = T_1 + \cdots .. T_m + \cdots . T_n \quad \text{.....3.5}$$

Equation 3.5 shows that the elasticity of overall tax- revenue is stated as a weighted-sum elasticities of various tax -components as illustrated in following equation 3.6.

$$E_{T_t,Y} = \frac{T_1}{T_t}\left[\frac{\Delta T_1}{\Delta Y} * \frac{Y}{T_1}\right] + \cdots + \frac{T_m}{T_t}\left[\frac{\Delta T_m}{\Delta Y} * \frac{Y}{T_m}\right] + \frac{T_n}{T_t}\left[\frac{\Delta T_n}{\Delta Y} * \frac{Y}{T_n}\right] \quad \text{.....3.6}$$

In addition, elasticity of separate tax handle to GDP changes are expressed as a product of tax-elasticity to own base, and also base of elasticity to national output/GDP. Equation 3.7 illustrates this..

$$E_{T_m,Y} = \left(\frac{\Delta T_m}{\Delta Y} * \frac{Y}{T_m}\right)\left(\frac{\Delta B_m}{\Delta Y} * \frac{Y}{B_m}\right) \quad \text{.....3.7}$$

The above equation 3.7, shows that elasticity of overall tax-revenue to changes in GDP in system of *n* taxes is stated as:

$$E_{T_t,Y} = \frac{T_1}{T_t}\left[\frac{\Delta T_1}{\Delta Y} * \frac{Y}{T_1}\right)\left(\frac{\Delta B_1}{\Delta Y} * \frac{Y}{B_1}\right)\Big] + \cdots \frac{T_m}{T_t}\left[\frac{\Delta T_m}{\Delta Y} * \frac{Y}{T_m}\right)\left(\frac{\Delta B_m}{\Delta Y} * \frac{Y}{B_m}\right)\Big] + \frac{T_n}{T_t}\left[\frac{\Delta T_n}{\Delta Y} * \frac{Y}{T_n}\right)\left(\frac{\Delta B_n}{\Delta Y} * \frac{Y}{B_n}\right)\Big] \quad \text{.....3.8}$$

Where $\frac{\Delta B_m}{\Delta Y} * \frac{Y}{B_m} = 1$ for any *m* from 1 to *n*.

3.13.3 Empirical Model

Tax buoyancy and also tax elasticity were estimated by adopting equation 3.8. Muriithi & Moyi (2003) and Osoro (1993) and used similar model in estimating buoyancy and elasticity of tax system of Tanzania and Kenya respectively. The buoyancy of tax shows the response of tax revenue to both GDP changes and also Discretionary Tax Measures (DTMs). The relationship between tax revenue and GDP can be illustrated by use of a Cobb-Douglas (CD) function as shown in equation 3.9.

$$T = e^{\eta} Y^{\beta} e^{\mu} \quad \text{.....3.9}$$

In equation 3.9, the *T* represent tax revenue, GDP is represented by *Y*, a constant is repredsented by η. *e* is natural number.

In case of tax buoyancy, above equation 3.9 is linearized through the introduction of logarithms on both sides. Equation 3.9 is thus converted into an estimable equation as shown in equation 3.10.

$$\log T = \eta + \beta log Y + \mu \quad \text{.....3.10}$$

Tax buoyancy for overall tax revenue is illustrated in equation 3.10. The estimate β, characterized by $0 \trianglelefteq \beta \trianglelefteq 1$, gives the buoyancy index.

Tax elasticity, the response of tax revenue to GDP changes is obtained by separating tax linked to DTMs from the overall tax revenue. The expression for tax elasticity is thus given as shown in equation 3.11.

$$\log(T - \mathrm{D}) = \gamma + \rho log Y + \varepsilon \quad \text{.....3.11}$$

In this 3.11, tax revenue that is purely linked to GDP changes is represented by $(T - D)$. In this equation, ρ represents the tax elasticity index, γ is constant and μ, error term.

To achieve adjusted tax yield, Mansfield (1972) showed that the DTMs should be separated from observed/actual tax yield for every given-year. This adjusted-tax yield is then developed through the removal of continuing discretionary tax measure on the future year's tax revenue. This adjustment is shown in equation 3.12.

$$T_{ij} = T_{j-1} * \frac{T_{j-2,j-1}}{T_{j-1}} \dots\dots \frac{T_{2,3}}{T_3} * \frac{R_{1,2}}{T_2} \quad \text{.....3.12}$$

Where:

T_j represents the observed tax revenue in a j^{th} year.

T_{ij} represents j^{th} year's observed tax revenue adjusted to the existing tax structure in year 1.

$T_{j-1,\ j} = T_j - D_j$ Where D_j is the effect of on tax revenue effect in year j when there were changes in DTMs. D_j can be negative or positive.

The equations 3.10 and 3.11 do not take into account changes in quality of institutions, for example, independence of judiciary to check corruption and demographic factors. Taking cognizant that such factors could influence tax-revenue, equations 3.10, and also 3.11 should then be re-specified so that the mentioned factors are incorporated. Thus, respecifying these equations yield equations 3.13 and 3.14 for 3.11 and 3.12 respectively.

$$T = e^{\eta} \sum_{i=1}^{k} DumV_t^{\lambda_i} Y^{\beta_1} Pop^{\beta_2} e^{\mu} \quad \text{.....3.13}$$

$$\log(T - \mathrm{D}) = e^{\vartheta} \sum_{i=1}^{k} DumV_t^{\lambda_i} Y^{\omega_1} Pop^{\omega_2} e^{\mu} \quad \text{.....3.14}$$

Where institutional changes are captured by $DumV$. The demographic factors are captured by Pop. Equations 3.13 and 3.14 can be made linear for easy of analysis by introduction of natural logarithms. The new linearized equations are shown in equations 3.15 and 3.16, respectively.

$$\ln T = \eta + \sum_{i=1}^{2} \lambda_i DumV_i + \beta_1 lnY + \beta_2 lnPopu + \mu \quad \text{.....3.15}$$

$$\ln(T - D) = \vartheta + \sum_{i=1}^{2} \lambda_i DumV_i + \omega_1 lnY + \omega_2 lnPopu + \mu \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.16$$

In the above equation, *lnT* shows logarithm of tax-revenue, $\ln(T - D)$ shows logarithm of tax-revenue that has been adjusted, *lnY* shows logarithm of formal sector/official GDP (computed by getting the difference between recorded GDP and informal sector GDP), the dummy variable $DumV$ takes a value 1 for period from 2010 and 0 between 1970 to 2009. This is takes cognizant that promulgation of 2010 constitution led to independence of the judiciary. It is argued that independent judiciary can convict tax evaders without interference from the executive arm of government. The Pop represents the demographic changes.

The selection of official GDP followed Osoro (1992) study which showed use of recorded GDP in estimating tax productivity is appropriate for countries where size of informal sector is neglible. But in countries where the size of sector is substantive, estimation of tax productivity using recorded GDP might overstate estimates.

3.13.4 Variable Descriptions, measurement, Priori Expected Signs

Table 3.1 shows variable descriptions, measurement, study expected signs for every variable.

Table 3.1: The Description of variables, their Measurements and Expected Signs

The Variable	**Description and Measurements**	**Unit**	**The study's Expected Sign, and the source**
The Tax Revenue	This is the involuntary payment that an individual surrenders to government with guarantee of getting benefits	Ksh..	The Dependent Variable
The Official GDP	It measures value of economic activities in the formal sector	Ksh..	+ Osoro (1992)
The Recorded GDP	It measures value of economic activities in both the formal and informal sector	Ksh.	+ Wawire, (2006), Menjo and Kotut (2015), Muriithi and Moyi (2003).
The $DumV$	The variable takes value 1 for period starting from 2010 and value zero for period before 2010.	Dichotomous	+ Wawire (2017) Wawire (2006)
Pop	These are individuals that are productive between the age of 15 years and 64 years.	Absolute value	+ Wawire (2017) Wawire (2006)

3.13.5 Type of Data and its Source

The study used annual data for 1970 -2018 period characterized by implementation of various DTMs. In addition, the period is adequate for time series study. The study obtained data on actual tax revenue and recorded GDP was obtained from KNBS abstracts and Economic surveys. DTMs were sourced from budget speeches. Data on adjusted tax revenue was computed in this study as explained in section 3.13.3. Data on formal sector/official GDP was obtained through subtraction of informal sector GDP as calculated in chapter 2 from the recorded GDP.

3.13.6 Pre-estimation Test

(a) Unit Root Test

A time series is integrated of order one, I (1), or stationary if its statistical properties, namely the variance and mean, do not vary with the magnitude of the data. The diagnosis of the existence of a unit root problem in a time series is of great importance because it helps a researcher avoid spurious regression issues and inconsistent estimates (Gujarati, 2009).

According to Enders (2015), there are various unit root tests. These tests include the Dickey-Fuller test (DF), the Augmented Dickey-Fuller test (ADF), the Phillips Peron test (PP) and Zivot-Andrews Test. The hypothesis below was tested:

Ho: At least a unit root is present.

Ha: There is no unit root.

A decision is made by comparing the test statistic and critical values at 1 percent, 5 percent and 10 percent significance levels.

Equation 3.17 is the starting point in testing for the existence of a unit root.

$$Y_t = \beta + \alpha Y_{t-1} + \varepsilon_t \quad \text{.....3.17}$$

Where Y represents a variable whose stationarity status is to be checked, Y_{t-1} represent the lag one of the variables of interest while ε_t is disturbance error term that is independent and

identically distributed (IID). On subtracting Y_{t-1} from both sides of equation 3.18 equation, 3.19 was obtained.

$$\Delta Y_t = \beta + \delta Y_{t-1} + \mu_t \quad \text{...3.18}$$

Where $\delta = \alpha - 1$ ..3.19

To test for presence of a unit root using DF test, equation 3.8 is estimated, and the coefficient of the regressor is examined. If δ is found to be equal to zero, the given variable is said to be nonstationary. If it is negative, it is said to be stationary (Dickey and Fuller, 1979). However, this test is only applicable if there is no serial correlation, thus its shortcoming. If this classical linear regression model assumption is violated, Augmented Dickey-Fuller (ADF) is the most appropriate, where lags of dependent variable are introduced as regressors. This action is to remedy the problem of autocorrelation. The ADF equation is shown in equation 3.20

$$\Delta Y_t = \alpha + \delta Y_{t-1} + \sum_{n=1}^{n} \alpha_k \Delta Y_{t-k} + \varepsilon_t \quad \text{.3.20.}$$

Where n in the equation is large enough to guarantee the absence of serial correlation.

(b) Lag Length Selection Criteria

To be free from cases of spurious regression problems and achieve robust standard errors, a suitable lag length should be selected when applying cointegration tests. In addition, appropriate lag length selection helps in avoiding heteroscedasticity and serial correlation problems. To this end, the study investigated for appropriate number of lags using five lag length selection criteria. These include LR, HQIC, AIC, SBIC and FPE. The rule of thumb in selecting lag length is to choose one that is suggested by at least three of the five criteria (Asteriou and Hall, 2007).

(c) Cointegration

The econometric problem one may encounter when carrying out regressions on nonstationary time series is spurious regression. However, this is not the case when the nonstationary time series in a model exhibit the same stochastic trend (Verbeek, 2008). If this case is observed, then such a time series is to have a long-run relation or cointegrated. This allows running OLS regression on the model with the guarantee of obtaining reliable and valid estimates.

This concept of cointegration is the pioneering work of Granger (1981) and was later expounded by Engle and Granger (1987). The approach allows one to see sense in running a regression on nonstationary series. The method postulates that though two-time series may embrace stochastic trends if they exhibit a long-run relationship, they will tend to move closer together over time, eventually stabilizing and thus establishing a stationary series (Thomas, 1997). Therefore, this suggests that cointegration is the solution to the spurious regression problem. Following Verbeek (2008), think about two-time stationary series at the first difference, Y_t and X_t. Supposing a linear combination of the two series exists, their relationship can be modelled as shown in equation 3.21.

$$Y_t = \alpha_1 + \alpha_2 X_t + u_t \quad \text{.....3.21}$$

Taking residuals from equation 3.21, we get the following equation.

$$\hat{u}_t = Y_t - \hat{\alpha}_1 + \hat{\alpha}_2 X_t \quad \text{.....3.22}$$

If $\hat{u}_t$ is integrated of order zero, then Y_t and X_t are said to be cointegrated or have long-run relationship. Engle and Granger (1987) describe this concept by assuming time-series Y_t and X_t, which are integrated of order (p, q) where p≥q ≥0. In notation form, this is written as $Y_t, X_t \sim CI(p,q)$. If Yt and Xt are both I (p) and there happens to be another vector (α_1, α_2), that results in the linear combination of Y_t and X_t, in that $\alpha_1 Y_t + \alpha_2 X_t \sim (p-q)$. The coefficient vector (α_1, α_2) is called a cointegrating vector.

The Johansen cointegration test confirms all the series under study stationarity status via the unit root test. Once all variables are established to be integrated in same order, optimal lag length is chosen by a battery of lag length criteria discussed in section 3.13.6 (b). Thirdly, a suitable model concerning deterministic components in a multi-variate arrangement is determined; lastly, the rank of the cointegrating vectors using the likelihood ratio test is determined (Enders, 2015).

Johansen (1988) suggested trace and maximum eigenvalue likelihood ratio tests to establish the significance of the correlations. The tests are expressed as follows:

$$\mathcal{B}_{trace}(s) = -N \sum_{i=s+1}^{m} \ln(1 - \hat{\mathcal{B}}_i) \quad \text{.....3.23}$$

$$ß_{max}(s, s+1) = -Nln(1 - \hat{ß}_{s+1}) \quad \text{.....3.24}$$

Where $ß$ is the estimated value of i^{th} order eigenvalue emanating from the long-run coefficient matrix, N represents the number of observations used in the study in both equations. The null hypothesis (H_0) for $ßtrace$ statistic tests that a number of the cointegrating equations is less than or equal to s, the number of cointegrating relations. The $ßmax$ statistic test is a complementary way of looking at the eigenvalue. The Test's H_0 is that the number of cointegrating equations is s. The H_a states that there are s+1 cointegrating vectors. If eigenvalues are far away from zero (0), $ln\ (1-\lambda i)$ and the ln $(1-\lambda s+1)$ turn into significant negative consequently leading to large $\lambda trace$ and vital λmax statistics. However, the trace statistic test is said to be more superior to the max statistic since it can be corrected for the degrees of freedom and is more robust to the kurtosis and skewness.

The mathematical illustration of the Johansen test for cointegration is shown in equation 3.25. The assumption is that three endogenous variables are stationary at first difference or integrated of order one (1). These variables are Y_t, X_t and S_t, of which the matrix notation for $P_t = (Y_t, X_t, S_t)$ is:

$$P_t = A_1 P_{t-1} + A_2 P_{t-2} + \cdots + A_m P_{t-m} + \varepsilon_t \quad \text{.....3.25}$$

Where P_t represents an $m \times 1$ vector for endogenous variables, A_i is an $m \times m$ matrix estimate, and ε_t is a vector of error terms. The VECM formulation for P_t is as shown in equation 3.26.

$$\Delta P_t = \Gamma_1 \Delta P_{t-1} + \Gamma_2 \Delta P_{t-2} + \cdots + \Gamma_{k-1} \Delta P_{t-k+1} + \Pi P_{t-1} + \varepsilon_t \quad \text{.....3.26}$$

Where $\Gamma_i = -(1 - A_1 - A_2 - \cdots - A_K)$, $i = 1, 2, .., k-1$ and $\Pi = -(1 - A_1 - A_2 - \cdots - A_K)$

The specification in equation 3.26 has information on both short and long-run adjustments to variations in P_t. Therefore, Γi are 3 by 3 coefficient matrices illustrating short-run dynamic properties while Π represents the long-run multiplier containing long-run information. $\Pi = \rho\beta'$ where the coefficient ρ shows the rate of adjustment to equilibrium coefficients. β' shows a matrix of long-run coefficients so that the term $\beta' Pt-v$ inserted in equation (3.27) illustrates up

to $v-1$ cointegrating relationships that ensure P_t converge to long-run equilibrium. If the Π has a full rank meaning, that s is equal to m linearly independent columns, then Y_t and P_t are equal to zero. Secondly, If Π has a reduced rank, that is, r is less than or equal to $m-1$ linearly not related columns, then there exist $s \leq (m-1)$ cointegrating matches. Third, when rank Π is equal to zero (0), implying the absence of linearly independent columns, then cointegrating relationships are absent. Although widely used, Johansen test of cointegration faces some drawbacks. The drawback emanates from the fact that the parameter estimates in one equation are influenced by model misspecification in other equations (Harris, 1995).

3.13.7 Vector Error Correction Model (VECM)

The VECM, also known as restricted VAR, is a case of unrestricted VAR model, which inserts error correction mechanism (ECM) term. This model is one of most used econometric models. This can be linked to ECM's power to solve the econometric problem of spurious regression and the ability to fit into general and specific approaches to econometric modelling. The model also incorporates an adjustment mechanism that stops error in long-run relation from increasing. As discussed in section 3.13.6 (c), if Y_t and X_t demonstrate cointegration, there is a long-run association. According to Granger representation theorem, an effective error-correction illustration describes short-run dynamics of data that pushes equilibrium error to zero (Verbeek, 2008). Therefore, Johansen (1991) VECM methodology is used to estimate this.

To illustrate this, take note of a VAR model of variables integrated of order one (1) denoted by d.

$$d_t = \phi_1 d_{t-1} + \cdots + \phi_q d_{t-q} + \varepsilon_t \quad \text{.....3.27}$$

The VECM of equation (3.27) is given by:

$$\Delta d_t = \Pi d_{t-1} + \sum_{i=1}^{q-1} \phi_i \Delta d_{t-i} + \varepsilon_t \quad \text{.....3.28}$$

where d_t is k by 1 vector of the endogenous variables in the natural logarithm and Π is square matrix k by k long-run multiplier matrix. The parameter Φ_i is also a square matrix k by k matrix that describes dynamic effects in short-run, q is lag length, and the ε_t shows the vector of IID innovations with a mean of zero. Πd_{t-1} is a vector error correction mechanism (ECM) that shows both long-run relationship and short-run adjustments in line with the long-run relation. The short-

run adjustment illustrates the adjustment effect, showing how the system readjusts due to disequilibrium in the previous period. The estimated VECM models for tax buoyancy while using official GDP and recorded GDP is illustrated in equation 3.29 and 3.30, respectively. The estimated VECM models for tax elasticity while using recorded GDP and recorded GDP is illustrated in equation 3.31 and 3.32 respectively.

$$\Delta lnT_t = \beta_0 + b_{1i} lnT_{t-i} + b_{2i} ln\text{ofgdp}_{t-i} + b_3 DumV_t + b_4 DumV * lnofgdp_t + \sum_{i=1}^{q} \beta_{1i} \Delta lnT_{t-i} + \sum_{i=1}^{q} \beta_{2i} \Delta ln\text{ofgdp}_{t-i} + \lambda ECT_{t-i} + \varepsilon_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots 3.29$$

$$\Delta lnT_t = \beta_0 + b_{1i} lnT_{t-i} + b_{2i} ln\text{recordedgdp}_{t-i} + b_3 DumV_t + b_4 DumV * lnrecordedgdp_t + \sum_{i=1}^{q} \beta_{1i} \Delta lnT_{t-i} + \sum_{i=1}^{q} \beta_{2i} \Delta ln\text{recordedgdp}_{t-i} + \lambda ECT_{t-i} + \varepsilon_t \dots\dots\dots\dots\dots\dots 3.30$$

$$\Delta \ln(T-D)_t = \beta_0 + b_{1i} \ln(T-D)_{t-i} + b_{2i} ln\text{ofgdp}_{t-i} + b_3 DumV_t + b_4 DumV * lnofgdp_t + \sum_{i=1}^{q} \beta_{1i} \Delta ln(T-D)_{t-i} + \sum_{i=1}^{q} \beta_{2i} \Delta ln\text{ofgdp}_{t-i} + \lambda ECT_{t-i} + \varepsilon_t \dots\dots\dots\dots\dots\dots 3.31$$

$$\Delta \ln(T-D)_t = \beta_0 + b_{1i} ln(T-D)_{t-i} + b_{2i} ln\text{recordedgdp}_{t-i} + b_3 DumV_t + b_4 DumV * lnrecordedgdp_t + \sum_{i=1}^{q} \beta_{1i} \Delta ln(T-D)_{t-i} + \sum_{i=1}^{q} \beta_{2i} \Delta ln\text{recordedgdp}_{t-i} + \lambda ECT_{t-i} + \varepsilon_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots 3.32$$

Where T and $T-D$ represent observed tax revenue and tax revenue less discretionary tax measures. Represent official GDP, represent recorded GDP, $DumV$ represents dummy variable taking 1 for period from 2003 to 2020 and 0 from 1970 to 2002, DumV*lnofgdp is the interaction between dummy variable and natural log of official GDP and DumV*recordedgdp is interaction term between dummy variable and natural log of recorded GDP. ECT and ε represent the explanatory variables error correction term and the error term, respectively.

3.13.8 Post-estimation Test

To ensure the validity of the estimates, the study carried out the following post-estimation tests.

(a) Autocorrelation

Autocorrelation is one of the violations of OLS assumptions that mainly occurs in time series data. It is an econometric problem where the present error term is related to the preceding error terms. This relationship can be expressed mathematically as $E(\mu_i, \mu_j) = 0 \quad \text{where } i \neq j$. The presence of autocorrelation in time series violates the property of constant mean and variance of the OLS estimators (Wooldridge, 2016). Though violation of these properties does not affect the unbiasedness of the estimates, it hinders the accuracy of the coefficients. This study adopted the Breusch-Godfrey (BG) serial correlation Lagrange multiplier to test for auto-correlation. BG test hypothesis is shown below:

Ho: Autocorrelation is absent.

Ha: Autocorrelation is present.

BG test is superior to Durbin-Watson d test, which is an autoregressive AR (1) process and therefore cannot reveal autocorrelation in the case AR(p) process where *p* is 2 and above. Breusch-Godfrey test can show the presence of autocorrelation in cases where current error term is related to the error term of at least two previous periods (Dougherty, 2016).

(b) Normality Test

Normality can be tested using Shapiro Wilk and Jarque Berra tests. Jarque Berra is superior to the Shapiro Wilk test because it compares variables' kurtosis and skewness coefficient. The study adopted the Jarque Berra test to investigate the presence of normality. The normality test is essential because it determines whether the study should adopt a linear or non-linear model. The null hypothesis under the Jarque Berra test is that there is a normal distribution. Where the data is revealed to be normal, then the goodness of fit of the data is guaranteed, and therefore the study would adopt the linear regression model (Wooldridge, 2016).

(c) Model Stability Test

One of assumptions of the VEC model used in the study is that all the coefficients remain constant across all the observations. If the coefficients vary across the observations, then the study could face the problem of structural change. To test for VEC model stability, the study used eigenvalues of companion matrix of corresponding VEC (Wooldridge, 2016).

3.14 Empirical Results and Discussion

(a) The Descriptive Statistics

These statistics are concerned with measures of central tendency, measures of variability and normality of the variables. One of the measures of central tendency is the mean. Measures of variation include the range, standard deviation, skewness and kurtosis. Jarque-Bera (JB) test, which compares skewness and kurtosis coefficients of the variables, is used to measure the normality of the variables. The variables for which the study obtained their descriptive statistics are shown in model 3.13. The descriptive statistics of the variables considered by the study is illustrated in Table 3.2 below.

Table 3.2: The Summary Statistics

Variable	Average	Measure of spread/Standard Deviation	Minimum Value	Maximum Value
Actual tax	10.930	2.290	5.620	14.300
Adjusted Tax	10.700	2.690	1.990	14.290
Official GDP	12.430	2.000	8.950	15.740
Recorded GDP	12.740	1.960	9.240	16.0
Population	2.550	0.510	1.680	3.3400

The Natural logarithm of actual tax was found to have highest standard deviation, an indication that the observations were dispersed away from the mean. The minimum and maximum values were not far from each other. The variable with the lowest standard deviation was the natural log of population. This implied that Kenya's population between the years 15 and 64 do not change with a big margin from one year to another.

(b) Correlation analysis

The Pearson product moment correlation (r_{xy}) coefficients among the variables considered in this study are illustrated in Table 3.3.

Table 3.3: Correlation Matrix

Variables	Natural-log of recorded GDP	Natural-log of official GDP	Natural -log of population	Dummy variable
Natural logarithm of recorded GDP	1.00			
Natural logarithm of official GDP		1.00		
Natural logarithm of population	0.9982	0.9944	1.00	
Dummy variable	-0.0929	-0.1096	-0.1002	1.00

The correlation results revealed a strong positive correlation between natural log of official GDP and population between 15 and 64 years. These correlation results showed a strong positive correlation between the natural log of recorded GDP and population between 15 and 64 years. The relationship can be linked to the fact that people within this bracket are productive and significantly contribute to the country's economic growth. The results also showed an inverse correlation between natural logarithm of official GDP (recorded GDP minus informal sector's GDP) and dummy variable, taking value 1 when the country experienced adverse effects on its GDP and 0 otherwise (dummy variable 1). The results may point to the negative effects on Kenya's GDP. For instance, the coffee boom of 1978 led to increased inflation that led to unemployment, thus reducing aggregate demand. Again, the attempted coup and post-election violence led to the loss of morale among the investors and displacement of productive population in the economy. The results further reveal a positive association between official GDP and dummy variable, taking the value 1 when the country experienced positive effects on its GDP and 0 otherwise (dummy variable 2). The population between the ages of 15 and 64 was negatively and positively correlated to dummy variables for unhappy events and happy events, respectively.

Generally, the majority of the pairwise correlations are less than 0.6. A high pairwise correlation coefficient between the natural logarithm of official GDP and population between 15 and 64 years is sufficient for multicollinearity. To remedy the problem of multicollinearity, the population variable was dropped from the model.

(c) Stationarity Test

The study investigated integration status of variables considered in the study using PP, Z-A and ADF tests. Tables 3.4, 3.5 show the results.

Table 3.4: PP and ADF Unit Root Tests

The ADF					**The PP**		
		Test Statistic	The Critical - value (5%)	Integration Status	Test Statistic	The Critical - value (5%)	Integration Status
Natural-log of actual tax revenue	Level 1st difference	-1.056 -10.665	-2.936 -2.938	I(1)	-0.970 -13.045	-2.936 -2.938	One
Natural- log of adjusted tax revenue	Level 1st difference	-2.162 -10.636	-2.936 -2.938	I(1)	-2.319 -12.158	-2.936 -2.938	One
Natural- log of official GDP	Level 1st difference	-0.581 -7.399	-2.936 -2.938	I(1)	-0.594 -7.414	-2.936 -2.938	One
Natural- log of recorded GDP	Level 1st difference	-0.872 -8.960	-2.936 -2.938	I(1)	-1.059 -8.946	-2.936 -2.938	One

All variables were integrated of order one as per PP and ADF test results. These characteristics of the variables ruled out use of OLS. However, results of these two tests cannot be conclusive given that the tests are effective only if there is no structural break. This weakness informed the study to adopt a more superior test, that the Z-A unit root test whose results are shown Table 3.5 below.

Table 3.5: The Z-A Test for Unit-Root Results

Trend and- Intercept					
Variable	**The Structural-break period**	**Testing Level**	**t-statistic**	**Critical value at 5 %**	**The Order of Integration**
Natural logarithm of actual tax revenue	2010 2010	Level 1st Difference	4.828 -15.215	-4.80 -4.80	I(1)
Natural logarithm of adjusted tax revenue	2010 2010	Level 1st difference	-2.606 -7.421	-4.80 -4.80	I(1)
Natural logarithm of official GDP	2011 2010	Level 1st Difference	1.302 -7.713	-4.80 -4.80	I(1)
Natural logarithm of recorded GDP	2002	Level 1st difference	-4.766 -10.327	-4.80 -4.80	I(1)

Z-A results corroborated those of the first two unit root test that is te ADF and PP tests. Given that the variables were integrated of order one, I(1), the study tested for presence of long run relationship. The study chose Johansen test of cointegration to investigate presence of long- run relationship. Before implementing this long run test, the study investigated the optimal lag length and this is discussed in part (d).

(d) The Optimal Lag Length Selection

The five ptimal lag length criteria were used. They include FPE, LR, HQIC, SBIC and AIC. The optimal lag length results for tax buoyancy are shown in Table A.5 of the Appendix. Those for elasticity are shown in Table A.6 of the Appendix. The study adopted one lag for both models as suggested by SBIC, a stricter test.

(e) The Johansen Cointegration Test

The study tested for cointegration using this test after finding optimal-lag length. The results are discussed Table-3.6 below.

Table 3.6: Johansen Tests for Cointegration for Bouyancy Model

Number of observations = 48
Trend: constant
Sample: 1971 – 2018
Lags = 1

The maximum rank	The parms	Log Likelihood	The eigenvalue	The Trace Statistic	Critical value (5%)
0	3.0	-4.49	.	34.84	29.680
1	8.0	8.25	0.41	9.37*	15.410
2	11.0	12.72	0.17	0.42	3.760
3	12.0	12.93	0.0088		

Source: Computations based from KNBS data

From the Johansen cointegration test, one cointegrating equation was revealed for buoyancy model. This is because at maximum rank 1, the null hypothesis of one cointegrating equation was not rejected.

Table 3.7: Johansen Tests for Cointegration for Elasticity Model

Number of observations = 48
Trend: constant
Sample: 1971 – 2018
Lags = 1

The maximum rank	The parms	Log Likelihood	The eigenvalue	The Trace Statistic	Critical value
0	3.0	-41.63	.	35.89	29.7
1	8.0	-28.631	0.42	9.88*	15.4
2	11.0	-23.85	0.18	0.33	3.8
3	12.0	-23.69	0.0068		

Source: Computations based from KNBS data

From the Johansen cointegration test, one cointegrating equation was revealed for elasticity model. This is because at maximum rank 1, the null hypothesis of one cointegrating equation was not rejected.

The Z-A unit root test and literature points to possibility of structural break in Kenya's GDP. This, therefore, implied that there was need to implement a suitable cointegration test in the case

of structural break. The study therefore adopted Gregory-Hansen cointegration test. This is a test that is designed for cointegration test while controlling for structural breaks. Table 3.8 shows the results.

Table 3.8: Gregory-Hansen Cointegration Test

Model		**TestStatistic**	**Break point**	**Date**	**Asymptotic Critical Values**			**Conclusion**
					1%	5%	10%	
Break in the constant	ADF	-4.83	34	2003	-5.45	-4.99	-4.72	Cannot reject the null of no cointegration for ADF,Z_t,Z_α.
	Z_t	-4.64	34	2003	-5.45	-4.72	-4.72	
	Z_α	-31.39	34	2003	-57.28	-47.96	-43.22	
Break in the constant and Trend	ADF	-5.72	41	2010	-5.45	-4.99	-4.72	Cannot reject the null of no cointegration for ADF,Z_t,Z_α.
	Z_t	-5.78	41	2010	-5.45	-4.99	-4.72	
	Z_α	-40.39	41	2010	-57.28	-47.96	-43.22	
Break in the constant and slope	ADF	-10.27	27	1996	-5.47	-4.95	-4.68	Cannot reject the null of no cointegration for ADF,Z_t,Z_α.
	Z_t	-10.05	27	1996	-5.47	-4.95	-4.68	
	Z_α	-65.49	27	1996	-57.17	-47.04	-41.85	

The Gregory Hansen cointegration test results showed that a larger ADF statistic when compared to critical value at 90 percent level of confidence. This led to rejection of H_0 of no cointegration at the break point. The test corroborated literature, which had indicated 2003 as a year there was structural break in Kenya. This was attributed to change in the governments that led to free education, free medical services, among others. Thus, the Gregory Hansen cointegration test showed variables exhibited stable properties in long-run, but with structural breaks. Since the

variables were found to be integrated order one and had long run relationship, the study estimated VECM and results are as discussed in section 3.13 (f) below.

(f) The Vector Error Correction (VECM) Regression Results

The VECM was implemented and results are shown in Table 3.8 below. The estimated specified models are shown in equation 3.29 and equation 3.30 for tax buoyancy while using official GDP and recorded GDP respectively. The estimated equations tax elasticity while using official GDP and recorded GDP were 3.31 and 3.32, respectively. The results are shown in Table 3.9.

Table 3.9: Vector Error Correction (VECM) Results

Tax Buoyancy			**Tax Elasticity**	
Regressand: The log of actual tax- revenue			**Regressand:** The log of adjusted tax-revenue	
Natural log of official GDP	1.36*** (0.49)		0.91*** (0.13)	
Natural log of recorded GDP		1.35 *** (0.04)		0.89*** (0.098)
DumV	-15.87 (21.92)	5.799 ** (2.421)	2.82*** (0.60)	2.31*** (0.44)
DumV* Natural log of recorded GDP	0.4017 (1.522)	0.4723 (0.159)	-0.33 (0.995)	-8.00 (4.20)
Constant	4.767 (-)	5.37 (-)	3.52 (-)	0.73 (-)
Observation	49	48	49	48
$F(p>ch^2)$	0.00***	0.00***	0.00***	0.00***
Lagrange-multiplier test	0.98	0.95	0.24	0.97
Jarque-Bera Test	0.00***	0.00***	0.00***	0.00***

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Source: Author's Computations based on data from KNBS

From Table 3.9, the probability of F tests was significant. This indicated that the model fitted well. This suggested that the explanatory variables jointly influence the dependent variable for each of the models.

On testing for autocorrelation and model stability, the results showed that both models were stable and residuals were not related. Figures A.5 and A.6 in Appendix show the stability of the models since the roots lay within unit circles. For autocorrelation, Lagrange-multiplier test

Statitistics of 0.98 , 0.95, 0.24 and 0.97 were greater than 0.05 leading to failure to reject null hypothesis at 5 percent significance level for all models. The study further found buoyancy index that was larger than that of elasticity, thus, a revelation that DTMs that were implemented during the study contributed to improvement of tax revenue mobilization.

Kenyan tax system was found to be buoyant as indicated by buoyancy coefficient of 1.36 which is greater than one. This means for every one percent increase in GDP, tax revenue increase by 1.36 percent when government implements DTMs. These results are in agreement with earlier studies which showed the impotance of DTMs in leading to improved tax revenue. These studies consist of Ole (1975), Gituku (2011), Muriithi & Moyi (2003), Wawire (2006), and also Omondi et al. (2014).

In estimating Kenya's tax elasticity, estimate of 0.91 was obtained meaning Kenya's tax system is not elastic. It implied that an increase in GDP by one percent leads to an increase tax revenue collection by 0.91 percentage points. Failure of tax system to respond naturally to GDP increase is attributed to many tax exemptions among firms in the agricultural sector. This is a case where these firms contribute to GDP but no tax is obtained from them. Theis study's results are conformity with those of Ole (1975), Gituku (2011), and also Omondi et al. (2014).

This study established that whether recorded GDP or official GDP is used, the tax system is found to be buoyant and inelastic. This is suggested by the buoyancy coefficient of 1.35 and the elasticity coefficient of 0.89 when using recorded GDP as the independent variable. However, the use of recorded GDP underestimates the buoyancy and elasticity indices. Therefore, this study established that failure of previous studies to detach informal sector's GDP from observed/recorded might have underestimated the coefficients, thus leading to unreliable policies.

The coefficient for dummy variable included in the elasticity and buoyancy modesl for institutional quality had a positive sign and significant. This implied that by adopting independent judiciary that was as a result of promulgation of the constitution contributed positively in tax mobilization.

3.15 Conclusions and Policy Implications

3.15.1 Conclusions

Kenya has been experiencing ballooning budget deficits due to a mismatch between tax- revenue and government expenditure. The budget deficit has persisted for over a decade running from 2003 to date. Theoretically, failure to raise tax revenue is attributed to an inelastic and less buoyant tax system.

The econometric findings showed a buoyant tax system in Kenya, given that the coefficient was greater than one and significant. These results conformed to several previous studies whose findings showed the effectiveness of DTMs in improving tax-revenue mobilization in Kenya. These earlier researches consist of Muriithi & Moyi (2003), Wawire (2017), Kieleko (2006), Gituku (2011), and also Omondi et al. (2014). Though these studies used recorded GDP, current study has confirmed that identical results are obtained whether recorded or official GDP are used as independent variables.

In addition, the econometric findings showed that Kenyan tax system is not very sensitive to growth in official GDP. This study's conclusions conform to Wawire (2006), Njoroge (1997), Gituku (2011) and Omondi et al. (2014). However, this current study's findings contradict and Kieleko (2006) and also Muriithi and Moyi (2003) studies that found tax revenue sensitive to GDP growth. Though these studies used recorded GDP when estimating tax elasticity of Kenyan tax system, current study has confirmed that the same results are obtained whether recorded or official GDP are used as the independent variables.

3.15.2 Policy Implications

Empirical findings of current study have direct implication on Kenya’s tax-reform. Although these findings paint a promising tax reform experience, there is still a chance for the government to realize more tax revenue. For example, more tax revenue can be mobilized if tax rates are

reviewed and rationalized. Further, an elastic tax system is good for a developing country since tax will increase naturally without resorting to politically unpopular DTMs.

Failure of tax-system to proportionately respond to changes of country's GDP may be attributed to inadequate or poor tax administration and unnecessary tax exemptions. This means KRA has room to increase tax revenue collection through improving tax administration and abolishing unnecessary tax exemptions that erode the tax base. In addition, KRA should put more effort into taxpayer education, compliance. With complicated tax laws, taxpayers incur additional costs to interpret them and process tax returns.

The Kenyan tax system can be made responsive to GDP if KRA scales up the digitization of its services. This will improve efficiency and thus lead to increased tax revenue and a reduction in the cost of tax collection. Again, scaling up digitization of the services will simplify the tax processes, thus making it simpler for the taxpayers to conform and reduce opportunities for them to involve in tax fraud and evasions. Digitization will also improve the accuracy of the taxpayer accounting data, thus reducing the time the taxpayer takes to deal with KRA. Digitization will also increase the speed and accuracy of taxpayers' data using their login details. This improves the confidentiality of the system, thus boosting taxpayers' morale. Lastly, continued digitization will allow taxpayers to easily file returns, thus reducing taxpayers' and tax officials' interactions. This minimizes opportunities for tax fraud and evasion due to collusion between taxpayers and tax officials.

3.15.3 Limitations of Study

The focus of this study was to estimate tax buoyancy and tax elasticity of the overall tax system. There is need to carry out analysis of not only tax buoyancy but also tax elasticity of individual tax components. This is because the results of such a study will shed light on which individual tax component is more responsive to discretionary tax measures and which one responds naturally to an increase in GDP. Such analysis was not possible in this study due to the lack of consistently recorded discretionary tax measures for each tax category.

3.15.4 Areas for Further Research

Future studies can consider investigating tax buoyancy and elasticity for individual tax components once there is a consistent recording of the discretionary tax measures.

CHAPTER FOUR

ESTIMATING THE OPTIMAL TAX RATIO FOR KENYA

4.1 Introduction

The growth rates of tax revenue and government expenditure tend to surpass economic growth in many countries. For instance, Kenya's tax revenue grew by 9.5 percent and 10.6 percent in 2017 and 2018, respectively (Republic of Kenya, 2019). Economic growth of 4.9 percent and 6.3 percent was recorded during the same period. The growth levels in taxes have made Kenya feature a country with a relatively high level of taxation. An investigation of Kenya's tax system shows that a company in Kenya pays a total tax rate of 44.2 percent, on average higher than the 43.1 percent global average (Republic of Kenya, 2019 and PWC, 2014). However, Kenya, as a developing country, needs high tax revenue to provide public goods. This implies a need to weigh the merit of the high-level taxation phenomenon against the rising needs on the country's expenditure side (Heerden and Schoeman, 2009).

Finding the optimal average tax ratio allows the government to mobilize adequate tax revenue to provide public goods. The government expenditure consists of public goods, for instance, education, security and health. In a balanced budget scenario, adequate funding is needed for provision of these public services. The secret to this is to identify the optimal level of taxes that will, on the other side, optimize economic growth without distorting the morale of the taxpayers (Aydin and Esen, 2019). Economic growth is maximized at the optimal tax level, job opportunities increase, and reduced tax dodging. A tax ratio above the optimal level negatively affects economic growth by encouraging taxpayers to consider the informal sector or underreport incomes from their activities (Hassan and Schneider, 2016). For instance, high tax rates may lead to reduced productivity and savings. A double tax effect causes this behaviour change because taxpayers pay their taxes and experience a reduction in their standards of living because of reduced economic growth rates (Heerden and Schoeman, 2009). Too high a tax rate leads to reduced disposable income, thus translating to reduced consumption and investment. Working while much of the income goes to the taxman incentivizes workers to substitute leisure for labour leading to a loss in hours worked and labour productivity (Hendriks and Myles, 2013).

To obtain an optimal tax ratio, government expenditure should also be optimized. This can be achieved by improvement in the efficiency of the government expenditure. For instance, appointing more teachers would be a quantity solution in improving education, but increasing spending on the already employed teachers would possibly contribute more to improving the country's education, which is effective government expenditure (Heerden and Schoeman, 2009). Wawire (2020) argued that government could improve the provision of public goods not by increasing its expenditure but by reducing corruption. In addition, this author asserted that government expenditure could be efficient if the technocrats determine public goods to be produced, unlike the current situation where politicians are the primary decision-makers.

Optimal tax theory tries to derive a system of taxation that will yield enough tax revenue with the least inefficiency or welfare loss. The free market uses a price system to allocate resources to produce the product that society requires most. This implies that if there are distortions in the market, then the equilibrium is restored by forces of demand and supply. However, if the government levies a tax, the price paid by a consumer is different from that received by the producer because the government takes its share. If the demand is inelastic, consumers will continue paying a higher price. However, if the product subjected to tax has elastic demand, consumers will buy less at a higher price. In such a case, the equilibrium amount will decrease. Thus, the imposition of tax makes businesses less profitable, and producers may decide to consider leisure. This implies that an economy will no longer produce an optimal mix of products. As individuals substitute leisure for productive activities, sales do not occur, meaning that the government does not collect the tax revenue it had in mind by levying a tax. The imposition of such tax destroys the benefits for the consumer due to the reduced amount purchased because of the high price. The producer is affected by decreasing profits and, therefore, consider leisure. The government loses its original income by imposing the tax. This is what is called the deadweight loss due to tax (Hendriks and Myles, 2013).

However, the principle of tax efficiency contradicts the equity criterion. For instance, a non-distortionary retail sales tax may be desirable based on efficiency terms, but such tax turns out to be burdensome on low-income individuals (Osoro, 1993; Kusi, 1998). Certain kinds of trade tariffs may be burdensome on the consumer, but should be used by open economies to discourage the consumption of certain imports. Apart from settling on a tax system that

minimizes welfare loss, other principles of a tax system can be used in measuring efficiency of tax system. A sound tax system is one that is simple, certain, neutral, transparent, minimum noncompliance, cost-effective in the collection, and convenient payment (Howard, 2001).

4.2 The Tax to GDP Ratio in Kenya

Kenya's tax ratio has been fluctuating from 1970 to 2018. The average tax ratio between 2000 and 2002 was 19, while between 2014 and 2017 it was 17.8 (Murunga, Muriithi and Kiiru, 2016; Wawire, 2020). Kenya's economic development plan, the Kenya Vision 2030 avers that the tax ratio that will enable Kenya become a middle-income country by 2030 is 22 percent of GDP (Republic of Kenya, 2007). This tax ratio is perceived to be sufficient to ensure adequate provision of infrastructure, and adequate investment in education and health, which are vital to propel Kenya to a middle level income state rank by 2030 (Republic of Kenya, 2007). The trends in Kenya's tax ratio are illustrated in Figure 4.1.

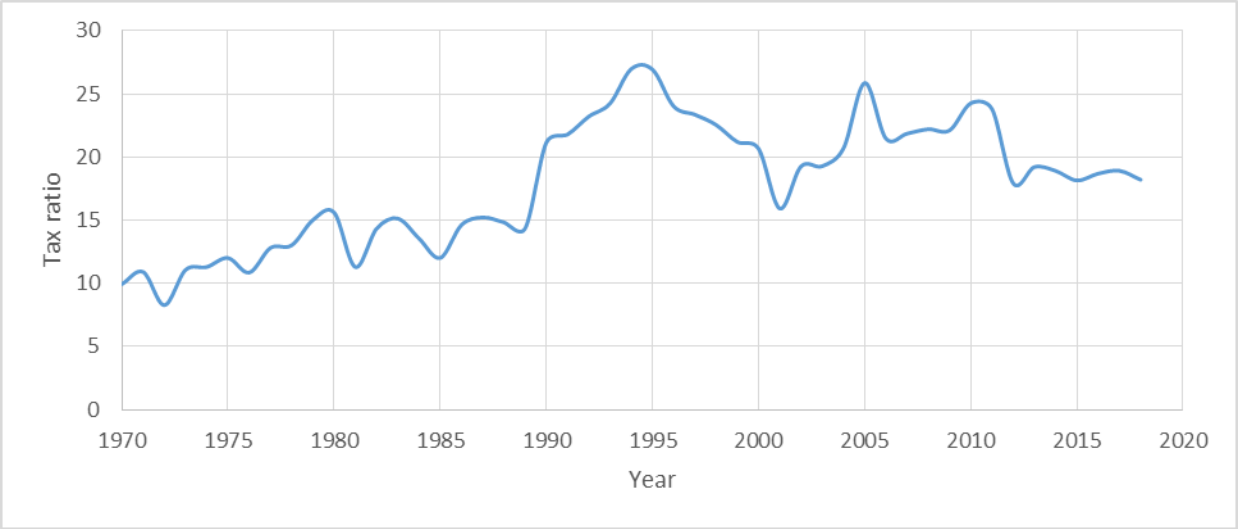

Figure 4.1: Trends in Kenya's Tax Ratio (1970-2018)

Source: Kenya National Bureau of Statistics (Various), Economic Surveys

From Figure 4.1, it is evident that Kenya's tax ratio increased from about 10 percent of GDP in 1970, realizing its peak of 27 percent of GDP in 1995. This improved performance in tax revenue can be linked to various tax reforms initiated and implemented during the period. For instance, the government introduced a sales tax in 1974 to counter dwindling tax revenue due to

the oil shock of the early 1970s. Later, sales tax was found to be narrowly based, triggering the government to introduce broad-based VAT in 1990. Later, the government realized that most taxpayers were encountering bureaucracy since they had to be cleared by various departments at the Finance ministry. This made the government incorporate KRA to centralize tax collection (Eissa and Jack, 2009). The tax ratio fell from 24 percent of the country's GDP in 1996 to 15 percent in 2001. During this period, the tax ratio was observed to be decreasing every year. The decrease in tax revenue can be linked to reduced productivity in the country, and the 1997 general elections led to tribal clashes in the Rift Valley region. This resulted in the displacement of people, thus resulting in decreased productivity. The situation was further exacerbated by the vagaries of El-Nino rains that occurred in 1997 and 1998. A prolonged drought in 2000 caused power rationing that resulted in reduced productivity (Wawire, 2006). During this period, the tax ratio was observed to be decreasing every year.

From 2003, the tax ratio started to go up again, increasing from 19 percent of Kenya's GDP in 2003 to 24 percent in 2011. This rise in tax during this period can be attributed to improved tax morale among Kenyans as they believed there was value for their tax. It is during this time that Kenyan experienced a spike in the implementation of many infrastructural projects. Among these projects was the construction of the Thika Superhighway. In addition, the government launched free primary education in 2003 (Republic of Kenya, 2004; Republic of Kenya, 2012). From 2012 to 2018, the tax ratio remained at 18 percent of the country's GDP. Failure of the tax ratio to pick an upward trajectory can be linked to increased corruption during the period. For instance, the corruption cases recorded at Ethics and Anti-Corruption Commission (EACC) increased from 4,013 in 2013/14 to 5,551 in 2014/15 In 2014/2015, the cases reduced to 2,747 but later increased to 3,856 in 2015/2016 (Republic of Kenya, 2018).

The rise in tax revenue has not been proportional to growth in government's expenditure. For instance, government expenditure increased from about KES 2 trillion in 2017 to about KES 2.3 trillion in 2018. During the same time, tax revenue increased from about KES 1.3 trillion to about KES 1.6 trillion. This resulted in a budget deficit of about KES 430 billion (Republic of Kenya, 2019).

4.3 Budget Deficit in Kenya

Kenya's economic development plan, the Kenya Vision 2030, appreciates the part played by fiscal policy in making Kenya attain a middle-income country rank by 2030. To achieve this, Kenya's budget deficit must be maintained at 5 percent of national income. This is the budget deficit level that is known to be international best practice concerning public debt sustainability (Republic of Kenya, 2008). Figure 4.2 shows the trend in budget deficit share in GDP in Kenya from 1970 to 2018.

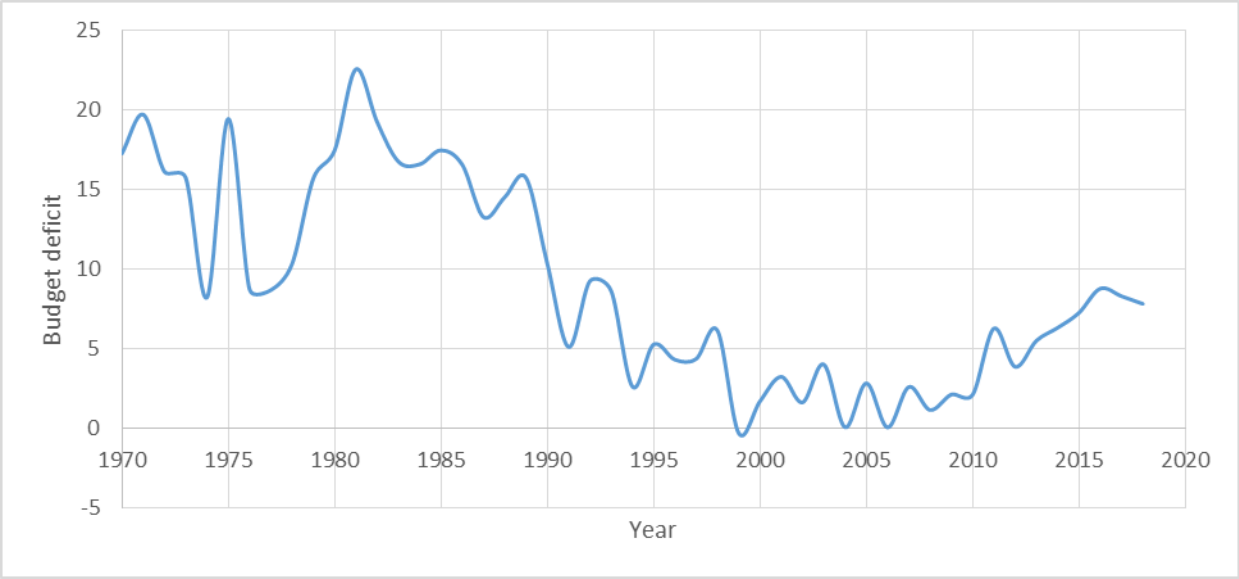

Figure 4.2: Trends in Kenya's Budget Deficit (1970-2018)

Source: Kenya National Bureau of Statistics (Various), Economic Surveys

Figure 4.2 shows that Kenya has experienced an unstable budget deficit. The average share of budget deficit in GDP was 9.2 percent between 1970 and 2018. This average budget deficit illustrates that Kenya's fiscal policy was unstable during the period under study. The instability of the country's fiscal policy can be linked to several shocks faced by the Kenyan economy, which required the government to intervene through fiscal policy. Some of the shocks that needed government intervention to comprise the fuel price shocks of 1973/74 and 1979/80, the coffee boom of 1978 and drought of 1984, the Gulf War of 1991, which caused an increase in oil prices, post-election violence of 2007/2008, the global financial meltdown of 2008 (Makau, Ocharo and Njuru, 2018). These shocks affected the economy adversely in terms of government

revenues and expenditures. The fiscal deficit contributed to a weak economic performance by amassing high public debt (Republic of Kenya, 2003). Tax revenue has been the primary fiscal instrument used by the Kenyan government, but some of the individuals that are engaged in taxable income-generating activities have not supported it fully and use various tactics to evade tax. This could be due to the feeling that they are overtaxed. Therefore, this implies that the revenue shortfalls may also be due to either over-taxation or under taxation.

4.4 Economic Growth and Taxation in Kenya

The Kenyan tax system has undergone tax reforms over time. These reforms were undertaken to repeal ones that are obsolete and simplify the main ones. Under the current Kenyan law, tax revenue is collected at 2 tiers of government, namely the National and County Governments. Each of these tiers has its sphere, as clearly enshrined in the 2010 Kenyan constitution. The constitution mandates the National Government to collect income tax, VAT, customs levies and other levies on import and export goods and excise tax. The County Governments are mandated to levy entertainment taxes, property taxes and any other taxes that county governments are permitted to levy by the Act of Parliament (Constitution of Kenya, 2010).

Kenya’s economic growth has been experiencing fluctuations since the 1970s. Kenya's economic growth rate reduced from an average of 8.15 percent per annum a decade after independence to 4.33 percent per annum between the early 1970s and early 1980s. The annual growth rate decreased further to 2.51 percent between 1993 and 2002. This annual growth rate later rose to 5.28 between 2003 and 2012. The annual economic growth rate performed even better by averaging 5.45 percent between 2013 and 2018 (Newman et al., 2016; Republic of Kenya, 2019). The decline in economic performance in the 1970 and early 1980s was due to the shrinking of agricultural output, the oil shock of 1973, and reduction of aid and grants from bilateral and multinational donors. The inflation occasioned by the coffee boom of 1978 and the attempted coup of 1982 also dealt a big blow to the Kenyan economy. The shrinking of the economy between 1990 and 2002 can be attributed to the Gulf wars, political clashes, poor climatic conditions such as the Elnino rainfall of 1997, and the aid freeze (Kinyanjui, 2013; Wawire, 2006).

The country experienced a revitalized economic performance between 2003 and 2007 due to the initiation and carrying out of various economic reforms under the ERS. This impressive growth can also be linked to reduced interest rate that encouraged domestic investment. During this time, the average real interest rate was 4 percent, down from 15 percent for the period between 1990 and 2002. Jordaan (2003) asserted that interest rate decline triggers increased consumption and level of investment, which are vital components of a nation's output.

According to the Republic of Kenya (2009), the growth rate of GDP sharply decreased from 7 percent in 2007 to 1.6 percent in 2008 as a result of post-election violence. The Kenyan economy recovered from the poor performance by registering an economic growth of 5.2 percent between 2009 and 2019 (Republic of Kenya, 2014; Republic of Kenya, 2020). This impressive performance can be attributed to providing a conducive environment for local and foreign investment and promulgating the 2010 constitution that led to checks and balances in government offices and 47 counties (Murunga, 2014). However, due to the locust invasion in December 2019, economic growth was expected to decrease in 2020. The dwindling economic performance was probably buttressed by the outbreak of COVID-19 pandemic in March 2020. This has resulted in the cancellation of international flights, implementation of dusk to dawn curfew in the country, adoption of stay-at-home measures by people, containment of movement in Nairobi, Mombasa, Kilifi and Kwale counties. These containment measures have crippled business activities and led to loss of jobs. The economy is expected to grow at a paltry 1.5 percent due to the COVID-19 pandemic (World Bank, 2020). The economy can bounce back if various stimulus policies are implemented to address the current COVID-19 pandemic.

4.5 Distribution of Indirect and Direct Tax Burden in Kenya

The distribution of Kenya’s tax burden in terms of who bears the excess burden is discussed in sections 4.5.1 and 4.5.2.

4.5.1 Indirect tax

Kenya's indirect tax is categorized into two, namely VAT and Excise tax (Mutua, 2012). An excise tax is a levy imposed on a specific amount of volume or unit of an item purchased, while VAT is an *ad valorem* and is proportional to the price of the good or service.

(a) VAT

The VAT regime in Kenya classifies goods and services into three categories. These include goods and services that attract a standard rate of 16 percent. Some are zero-rated and exempted from VAT. Most of the commodities that are exempted from VAT are mainly found in the agricultural sector. The exemption also applies to inputs used in the agricultural sector, such as tractors, seeds and fertilizers (World Bank, 2017). The VAT in Kenya is progressive, but almost neutral, irrespective of whether the goods are zero-rated or exempted. The distribution of VAT burden is almost proportional to market income. The distribution of the burden of VAT among various income categories in Kenya is illustrated in Figure 4.3.

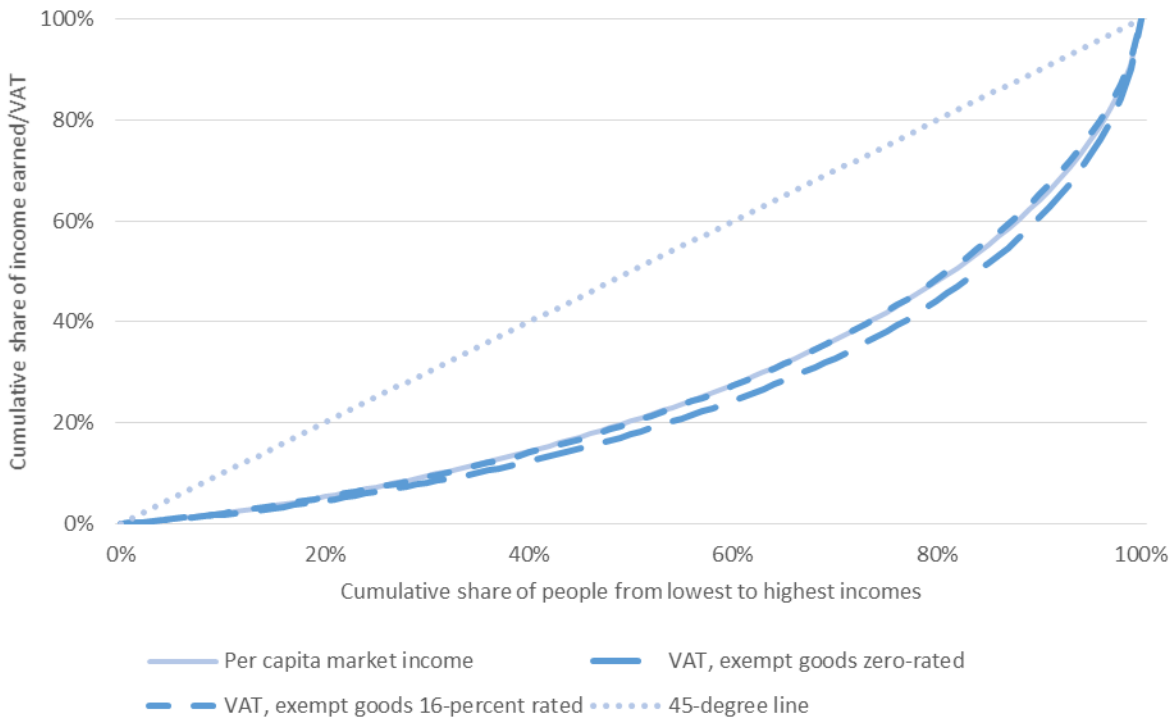

Figure 4.3: Lorenz and Concentration Curves for Market Income and VAT

Source: World Bank (2018)

Figure 4.3 shows that the bottom 40% accounts for between 12 and 14 percent of the VAT burden, based on whether the commodities are tax-exempt, zero-rated or subjected to 16 percent tax. It is also revealed that 14.3 percent of the market income goes to the same group of people.

(b) Excise Tax

The goods that are considered under the analysis of excise tax include beer, wines and spirits, soft drinks and juices, soft drinks and juices, mineral water, cigarettes and airtime. Cigarettes and beverages are taxed concerning their quantities, while airtime consumption is subjected to ten percent tax. These products accounted for 87 and 82 percent of the excise tax revenue in 2015 and 2016.

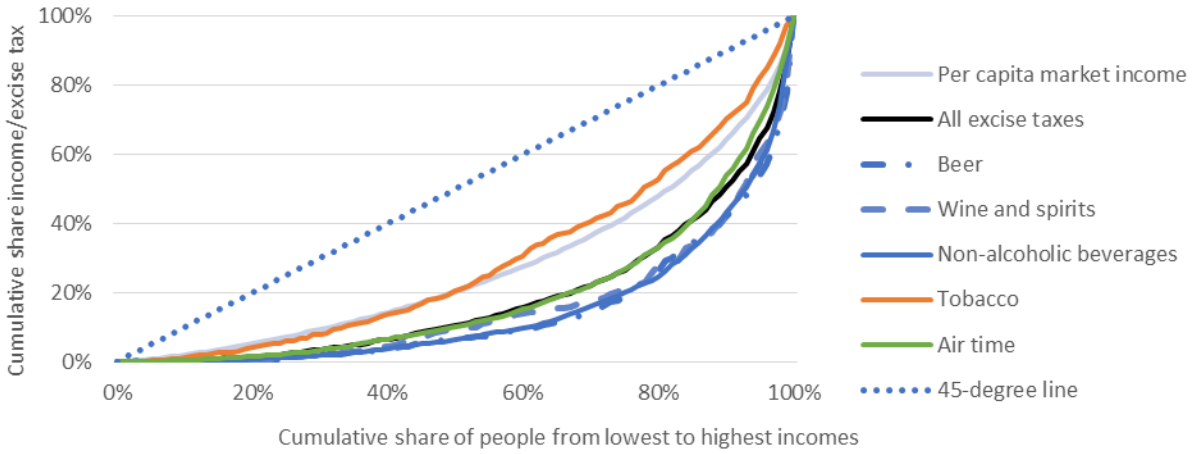

Figure 4.4: Lorenz and Concentration Curves for Market Income and Excise Tax

Source: World Bank. (2018)

Figure 4.4 shows that excise taxes in Kenya are progressive apart from tobacco products. The bottom 40 percent of the population, accounting for about 14% of total market earning, account for approximately 7% of overal excise taxes, making them highly progressive. Mainly due to an excise tax on beer (about 4 percent), non-alcoholic beverages (about 4 percent), wines and spirits (about 4 percent), non-alcoholic beverages (about 4 percent), and airtime (about 7 percent). The excise tax on tobacco (cigarette) is mildly progressive at the beginning but then becomes regressive around the median. About 10% of the lower wealth quintile account for closely 2% the countries per capita market income, yet about 1.5% of overall Kenya's tobacco is excise tax. Eventually, it is observed that concentration curve representing the Kenyan tobacco excise taxes intersects and crosses the Lorenz curve. The implication of this is that approximately 60% of te poorest 60 population could be accounting for about 31% of tobacco excise tax, a more significant share than their about 28% in market earning. This suggests relatively lower spending among the poor and a relatively higher expenditure among the middle quintiles.

4.5.2 Direct Taxes

Kenya' direct taxes are progressive. They apply to employees in the formal sector. The distribution of direct tax burden is illustrated in Figure 4.3.

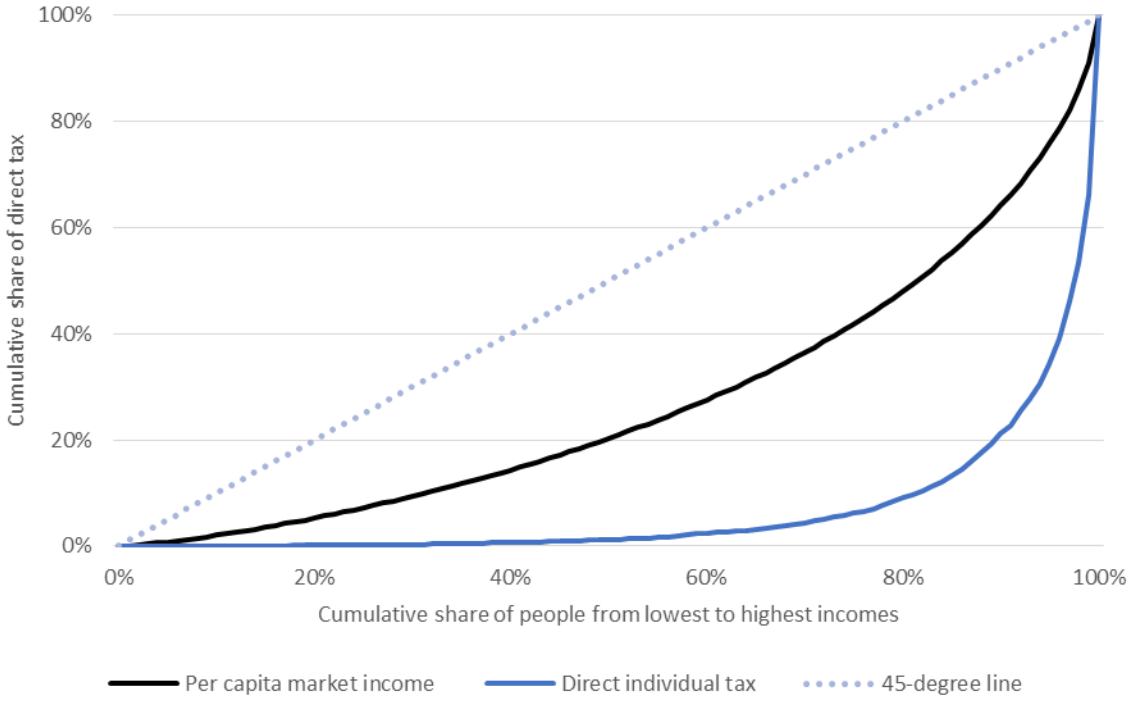

Figure 4.5: Lorenz and Concentration Curves for Market Income and Direct Tax

Source: World Bank. (2018)

Figure 4.5 shows that the poorest 40 percent of population account for about 14 percent of market income and about 1 percent of direct taxes. In contrast, 80 percent of direct tax incidence is borne by the richest, who account for 10 percent of the population. However, their share rises to about 5 percent in the fourth quintile and greater than 8 percent in the topmost quintile. This distribution of the direct tax burden can be linked to both limited access to formal sector job opportunities among poor people and the progressive nature of the tax system in the country.

4.6 Statement of the Problem

The most broadly accepted and essential determinant of the informal sector is the high tax burden. Many empirical studies find the coefficient of the tax burden in size of informal sector-tax burden relationship statistically significant. This suggests that the tax burden is an essential

determinant of the informal sector. Some of these empirical studies include Nchor and Adamec (2015) for the Kenyan, Namibian, Ghanaian and Nigerian informal sectors, Buehn (2012) for the German regions' shadow economy and Schneider (2010) for 21 OECD countries. The tax burden is of great interest to economists, since taxes inform labour-leisure choices and encourage labour supply in the informal sector. Suppose the difference between the total costs of labour and net income is high in the formal sector. In that case, individuals may see it as an incentive to operate informally to evade taxes (Hassan and Schneider, 2016).

On the flip side, if the government under-taxes its populace, it may be sacrificing extra revenue. This implies that public goods, for instance, infrastructure, healthcare, education and security maybe underprovided, thus translating into reduced economic growth (Heerden and Schoeman, 2009). This means there is an optimal level of tax rate where adequate revenue is raised to ensure sufficient provision of public goods that translate into increased economic growth and the same time, do not incentivize economic agents in the formal sector to shift to informal sector. At such a level of tax ratio, the government raises the required tax revenue and, at the same time, minimizes deadweight loss (Hendriks and Myles, 2013).

In Kenya, there has been attempts to analyze the economy's tax productivity, and policies aimed at strengthening tax revenue have been suggested. Among these studies are Wawire (2017), Omondi et al. (2014), Wawire (2006), and Muriithi and Moyi (2003). However, no study has exhaustively established the optimal level of tax revenue as a percentage of GDP. Implementing tax reforms without identifying the level of optimal tax ratio may make the country operate on the upward or downward side of the Laffer curve, thus giving up more tax revenue (Laffer, 2004). This study, therefore, set out to estimate the optimal tax ratio in Kenya using the VAR model on data running from 1970 to 2018.

4.7 Objectives of the Study

The overall objective of this study was to estimate the tax ratio that could lead to maximum tax revenue to trigger economic growth in Kenya. The specific objectives were to:

(i) Estimate the optimal tax ratio in Kenya.

(ii) Establish the nature of the relationship between real government expenditure and real disposable income, and economic growth measured by per capita GDP.

4.8 Significance of the Study

Sustainable economic performance and inclusive growth are needed for the Kenyan economy to achieve the ambitious long-term development plan, the Kenya Vision 2030. Therefore, Kenya requires an adequate tax revenue that will enable the provision of public goods, thus leading to improvement in economic growth. A study that suggests a permanent and practical solution to optimal tax ratio is essential for policy implications. The effort by the government in improving tax mobilization can be traced to initiation and implementation of various tax reforms. Tax revenue collection has not been doing well despite multiple reforms, as evidenced by the increasing budget deficit for over a decade. According to Laffer (2004), this may indicate that our tax ratio is either on left-hand side or right-hand side of the optimal tax rate of the Laffer curve. Thus, this study is an essential reference for policy makers in National and County Governments when formulating tax policies to ensure economic growth. This is actualized by providing policy makers with an optimal tax ratio, which they should focus on achieving.

Further, identifying the optimal tax ratio is essential for the Kenyan government to collect adequate tax revenue that will enable the government to provide vital services, for instance, health, energy, infrastructure, education, water and sanitation, as enshrined the Sustainable Development Goals (SDGs). This, therefore, implies that this study is essential for the achievement of SDGs. Lastly, the present study enhances the existing literature by creating an understanding of the optimal tax ratio in Kenya. This is also the first comprehensive study to carry out such estimation in Kenya.

4.9 Scope of the Study

The study focused on estimation of the optimal tax ratio in Kenya. This study's period spans from 1970 to 2018. The choice of this period was because Kenya started to experience economic challenges occasioned by the oil crises of the early 1970s and other economic downturns of the 1980s, 1990s and 2000s. Secondly, this period is characterized by the desire by the Kenyan government to meet the increasing needs of the growing population. Identifying an optimal tax ratio is vital in helping the government raise adequate taxes to meet the increasing demands.

4.10 Literature Review

4.10.1 Theoretical Literature Review

This section considers various theories of optimal taxation. These are theories that explain what the government should do in raising adequate tax while at the same time minimizing deadweight loss. These theories can be discussed in terms of optimal commodity taxes, income taxes, and Ricardian equivalence.

(a) Optimal Commodity Taxation

Optimal commodity taxation seeks to answer the question of how government can minimize the cost imposed on society when a certain amount of tax is to be raised. The assumption made under this theory is that taxes are solely imposed on commodities. The following theories can explain the solutions to this problem:

(i) The Ramsey 1927 rule

This rule is named following the works of Ramsey (1927). The assumption under this rule is that there are two goods from which the government intends to raise the required tax while minimizing the excess tax burden. Ramsey (1927) rule assumes a lack of cross-price effect between goods that are being taxed. According to this rule, for the government to raise tax revenue while minimizing the excess tax burden, then the relationship shown in equation 4.1 should be observed.

$$\frac{\text{Change in Quantity of commodity X}}{\text{Quantity X}} = \frac{\text{Change in Quantity of commodity Y}}{\text{Quantity Y}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.1$$

Equation 4.1 illustrates the Ramsey rule. The rule states that to minimize the total excess burden, the tax rate ought to be set so that percentage reduction in amount demanded of each commodity is similar. This implies that goods that are unresponsive to prices should bear higher tax rates. This rule conflicts with equity conditions since goods that are less responsive to changes in price are essential goods used mainly by low-income individuals (Hendriks and Myles, 2013).

(ii) The Inverse Elasticity Rule

This rule is the best recognized version of the Ramsey pricing rule. This rule, just like Ramsey 1927 rule, assumes a lack of cross-price effect between goods that are taxed. This means that if tax is imposed on one good, consumers cannot shift to the consumption of substitute goods. In addition, to derive the inverse elasticity of demand, it is assumed the government intends to raise the tax from only two commodities (X and Y). The inverse elasticity rule is illustrated in equation 4.2

$$\frac{\text{Tax rate of commodity X}}{\text{Tax rate of commodity Y}} = \frac{\text{Price Elasticity of demand for CommodityY}}{\text{rice Elasticity of demand for CommodityX}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.2$$

Equation 4.2, which depicts the inverse elasticity rule, shows that products should be taxed indirectly to the price elasticity of demand. This means that products that do not respond much to price changes (inelastic demand) should be highly taxed. Though the government will get the required tax, the rule goes against the equity principle, since products that are less responsive to price changes are essential products. This means low-income individuals are likely to be impoverished if this rule is put into an application (Baumol and Bradford, 1970).

(iii) The Corlett-Hague Rule

Corlett and Hague (1953) showed the implication of the Ramsey rule. According to these authors, if there are two commodities, then efficient taxation means imposing high rate of tax on a commodity that complements leisure. To understand this, recall that if it is possible to impose a tax on leisure, then the "first-best" result would be obtained where tax revenue could be collected with no excess burden. Though tax agencies cannot impose a tax on leisure, they can impose a tax on commodities that tend to be consumed together with leisure. This indirectly lowers the demand for leisure. If, for instance, a high tax rate is imposed on computer games, individuals buy less, and their time for leisure is reduced. In effect, this means imposing taxes on goods that complement to leisure provide an indirect way to tax leisure, thus approaching perfectly efficient outcome, which would be obtained if leisure was taxed (Minagawa and Upmann, 2018).

(b) Optimal Income Taxation

An income tax can lead to allocative inefficiency by altering the prices of work and leisure. If it decreases work effort, then the economy moves inside the production possibility frontier, implying a reduction in welfare. The question of optimal income taxation lies in designing income tax so that welfare loss is minimized. Laffer curve is used to explain how optimal income tax is determined. The curve shown in Figure 4.6 applies to personal income tax.

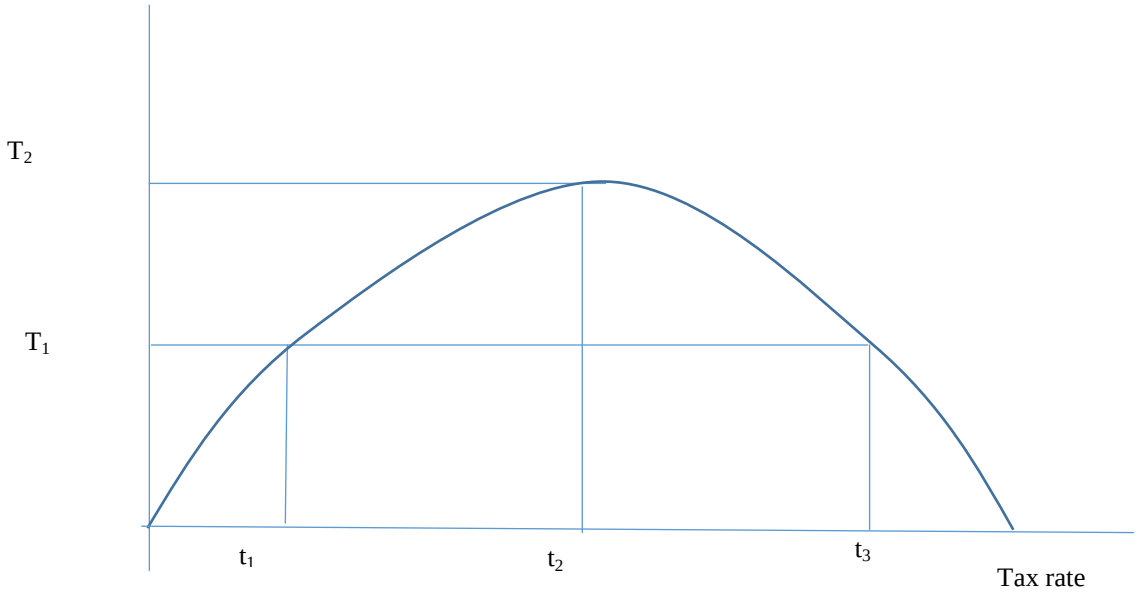

Figure 4.6: The Laffer Curve

Source: Laffer (2004)

Figure 4.6 illustrates that at tax rate t_1, the government can raise T_1 personal income tax. At t_2, the personal income tax of T_2 is raised. At tax rate t_3, personal income raised is T_1 which is less than T_2. This means that there exists an optimal tax rate at which government can increase the highest tax revenue. It is seen that beyond this optimal tax rate, tax revenue starts to decrease because people begin to practice tax evasion or may even stop working.

(c) Lump-sum Taxation

Commodity taxes may make some products disappear in the market. For instance, imposing a tax on a commodity may sometimes make direct revenue zero, making producers produce little of

the product or stop production entirely. This implies that commodity taxes may not be efficient since they may lead to increased welfare loss, especially to people who were using the product. The tax that is seen to be efficient or one that does not lead to excess burden is lump-sum tax. This tax is also known as a poll tax. It is efficient since it does not alter the relative prices of commodities, including labour. Putting it in other words, a lump-sum tax does not do away with the pre-tax marginal equality between marginal rate of substitution denoted as (MRS) and marginal rate of technical transformation denoted as (MRT). An income tax destroys marginal equality because of its selective nature imposed on income. However, since income tax is associated with income, it is much acceptable on equity terms than a lumpsum tax (Hyman, 2010).

A poll toll is regressive because the lower one's income is, the more significant the fraction of the income it takes. Equity rules usually put more weight in progressive taxation in which the part taken by tax increases as income rises or proportional taxation where part of income that goes to taxation remains same at all levels of income, but where wealthy individuals pay more tax than low-income individuals in absolute terms. Therefore, while it is said to be efficient, a lumpsum tax is generally deemed so inequitable that it is not accepted politically as a primary form of taxation. However, it may be taken as a small fraction of a more extensive tax system (Hendriks and Myles, 2013).

(d) Ricardian Equivalence

The Ricardian equivalence principle postulates that the present generation may be under-taxed if the government resorts to debt as a form of deficit financing, instead of only imposing taxes to finance government expenditure. Increasing public debt will lead to higher future taxes. This, therefore, means that public debt as a means of deficit financing is only postponing the tax burden to future generations. Should taxes be adopted as a means of financing expenditures instead, then the current generation would rather bear the tax burden. The Ricardian equivalence proposition, therefore, implies that it is indifferent to impose tax or use debt in deficit financing, since the present generation would save more by decreasing private consumption, realizing that the current debt would have to be paid off in future from the tax revenue (Romer, 2012).

(e) Endogenous Growth Model

Endogenous economic growth literature is concerned with models in which private and social returns to investment vary to allow individual choices lead to sub-optimal saving and economic growth (Romer, 1986). In this set up, private returns to scale may be fading, but social returns that show spillover of know-how or other positive externalities can be constant or increasing. Another strand of enquiry encompasses models without positive externalities, where choices of saving and economic growth determined privately are Pareto optimal (Rebelo, 1991). The models depend on constant returns (CR) to private capital, largely defined to incorporate human and non-human capital. This current investigation is anchored on both features of this literature by including public sector in a simple CR model of economic growth. Because of familiar externalities related to government expenditures and tax revenue, privately influenced values of savings and economic growth might be sub-optimal. Thus, there are exciting choices regarding government policies and empirical evidence about relations among level of taxes or size of government, saving rate and rate of economic growth.

(f) Optimal Taxation Models

Except from a zero transaction cost view, it is believed that a certain size of the government is needed for economic progress. Though the government's action to provide public goods through taxation may lead to inefficiency, the services provided for infrastructure, national defence, education, public health and protection of property contribute to a country’s economic growth. Efforts to determine growth-maximizing size of government include:

(g) The Barro Model

Barro (1990) studied the size of government and economic growth nexus. In the model, government expenditure and taxation are revealed opposite effects on economic growth. While a rise in both government consumption and investment expenditure increases marginal productivity of the capital translating to a rise in growth rate, a rise in tax rate was revealed to lower economic growth rate. In this model, productivity is attributed to government's ratio of goods and services to physical capital. Thus, output per worker denoted as y, in a Cobb-Douglas (CD) framework, is given as

$$y = kAg^{\beta} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.3$$

where k and g represent the physical capital and public goods or government consumption spending per worker. Dividing both sides of the function by k gives:

$$\frac{y}{k} = A\left(\frac{g}{k}\right)^{\beta} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.4$$

With this technology, size of government or with Ricardian Equivalence tax rate which maximizes growth rate is given by condition:

$$\beta = \frac{g}{y} = \tau \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.5$$

where τ is the tax rate. Thus, estimation of $\frac{y}{k}$ function will give the parameter estimate β, which is optimal tax rate in Barro model. One can construct the variables for the Barro model for Kenya with time series data. These variables are: $\frac{y}{k}$, GDP per capital stock and $\frac{g}{k}$, government consumption and investment spending per capital stock.

(i) The Scully Model

Scully (2000) is an alternative model to the Barro model of the optimal tax rate. In the Scully (2000) model, total taxes share in GDP is related to economic growth rate. According to Barro (1990), it is assumed that at low levels of government expenditure share in GDP, increasing the tax rate, τ, increases the economic growth rate since the public goods being provided are productive. At high levels of government expenditure, the spending is likely to be more towards the non-productive expenditure, for instance, transfers and subsidies, and the increases in tax rate lower economic growth rate. The basic model is as follows:

$$1 + g_y = a\tau^{b}(1-\tau)^{1-b} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.6$$

Where g_y is the economic growth, a and b are constants. Thus, the model attributed economic growth to part of government expenditure (taxation) and part of private production. There is a fraction of government expenditure relative to private economic activity that maximizes economic progress. Differentiating g_y concerning τ gives:

$$\frac{\partial g_y}{\partial \tau} = a\tau^{b-1}(1-\tau)^{1-b}(b-\tau) \ldots \ldots \ldots 4.6$$

Obviously, the optimal tax rate, $\tau*$, is equal to b.

A balanced budget constraint shown in equation 4.7 is imposed while deriving the Scully model like the Barro model.

$$\frac{G}{Y} = a\tau \ldots \ldots \ldots 4.7$$

Since the Government of Kenya has been in deficit for many years over this study's period, the issue is whether to use the actual tax rate, share of total tax revenue in GDP (T/Y) or anticipated tax rate, the percentage of total government expenditure in GDP (G/Y). The study chose the latter: government consumption and investment expenditure plus government transfer payments divided by GDP. This was designated as τ. The advantage of choosing this is because it sums the same measures that have been used in the estimation of the parameters of Barro's model. The disadvantage of this choice is that it invokes the Ricardian Equivalence. Empirically, there is a slight difference in the estimates when using G/Y or T/Y. However, the conclusions regarding the optimal size of the government are not materially affected by the choice of the tax rate.

4.10.2 Empirical Literature Review

The concept of optimal taxation has attracted many scholars in many countries, including developing and developed. In Africa, which is composed of developing countries, studies have been carried out in Nigeria, South Africa and Coted' Ivoire. The optimal tax ratio for South Africa had not been investigated, thus motivating Heerden and Schoeman (2009) to estimate it. This study adopted Scully (2000) balanced budget model in estimation of the optimal tax ratio in South Africa using VECM on data for 1960-2006 period. The study found that the optimal tax for South Africa was 21.94 percent of GDP. This finding, therefore, showed that the current tax ratio of 28 percent of GDP was above the optimal tax ratio. This study's results might be valid because an appropriate number of observations was considered. In addition, the study performed required pre-estimation and post-estimation tests. In another study, Saibu (2015), noting the need for countries to be self-reliant in raising resources to meet their budget requirements following the global meltdown estimated South Africa's and Nigeria's optimal tax ratio using Scully (2000)

balanced budget approach. The study adopted the Ordinary Least Square (OLS) estimation technique on time series data from 1970 to 2012. The study found an optimal tax ratio of 15 percent and 30 percent of GDP for South Africa and Nigeria, respectively. The results showed that these countries could raise more tax revenue by reducing their tax rate. This is because the exiting tax ratio was 26.2 and 33.8 percent of GDP for South Africa and Nigeria, respectively. Though this study used appropriate observations, which could allow time series methods, the study did not perform the unit root tests to rule out the possibility of spurious regression.

Other studies carried out in Africa include Keho (2010) and El Husseiny (2018). Keho (2010) was motivated to study the optimal tax ratio for Côte d'Ivoire following extensive tax reforms implemented on the Côte d'Ivoire tax system from 1994 to 2005 without identifying the level that will yield increased economic growth. Adopting Scully (2000) approach, this study adopted the OLS technique between 1960 and 2006. The study estimated an optimal tax ratio of 22.3 percent of GDP. This finding showed that Côte d'Ivoire could raise more tax revenue, given that the existing tax ratio was 16 percent of GDP. Though the study incorporated several dummy variables in their specified model to control for the macroeconomic events that were experienced by the country, the unit root test was not performed. Adopting the Scully (2000) approach, El Husseiny (2018) estimated the Egyptian optimal tax ratio using VECM on data between the fiscal year 1981/1982 and 2014/2015. This author was motivated to carry out this study following increasing budget deficits and public debt ratio. In addition, no similar study had been carried out due to inconsistent data in the earlier years. The study found that the optimal tax ratio for Egypt was 30.5 percent of GDP. This implied that Egypt had the opportunity to increase public goods due to raising more tax revenue. The current tax ratio at that time was 29.7 percent of GDP. This study's findings may be valid because relevant time series tests were carried out.

Apart from the African continent, the concept of optimal tax ratio has attracted scholars among the developing countries in other continents. For instance, Abdullaev and Konya (2014) used the Scully (2000) model to estimate the optimal tax ratio for Uzbekistan using quarterly data from 1996 to 2011. The author noted that Uzbekistan had continuously implemented tax reforms to reduce the tax burden for two decades after the economy's transition from central to the market economy. The author noted that though the reforms had led to economic growth, there was need to estimate the optimal tax ratio to guide policy makers. The results showed that Uzbekistan

optimal tax ratio was at 22 percent of GDP. This implied that the country had reached the required tax ratio that could guarantee economic growth, and therefore there was no need to reduce the tax ratio further. This study tested for stationarity of variables and differenced the variables that were found to be non-stationary. The results could have been better had the study considered the ARDL model, which is suitable for variables that are stationary at a level and stationary at first difference. Differencing variables results in the loss of some information. Also, Amgain (2017) studied the optimal level of taxation for growth among 32 Asian countries. This study was informed that growth maximizing tax rate had only been investigated among the developed countries and, therefore, was needed to extend the same to developing countries. The study adopted Scully (2000) approach and used a fixed-effects panel model on data between 1991 and 2012. The findings showed that the optimal tax ratio for 32 Asian countries was 18 percent of GDP. The study found that 25 of the 32 countries in the Asian continent were on the increasing side of the Laffer curve, indicating that there was still room for them to increase tax revenue without hampering their economic growth. Using the same Scully (2000) approach, Lkhagvajav et al. (2019) examined the economic growth maximizing tax ratio in Mongolia. The authors were motivated by lack of such investigation using Mongolian data. The study used the OLS technique to estimate the Mongolian optimal tax ratio for the period between 1991 and 2018. This study's results may not be reliable due to data limitations. Time series of fewer than 30 observations may not be enough to handle the most crucial time series tests.

The optimal tax ratio has also been studied among the developed countries. For example, Chao and Grubel (1998) used the Scully approach on Canadian data and estimated that the growth maximizing or optimal tax ratio in Canada was 34 percent of GDP. The lack informed the decision to carry out this study of specific studies for Canada. The existing studies had investigated optimal tax ratio in general without focus on a particular country. However, the study used 67 observations, which are way above the required data size for a time series study. Unit root test was not implemented. This implied that the reliability of the results could not be observed due to suspected case of spurious regression. To prove the theoretical underpinning for the existence of an optimal tax ratio as illustrated by an inverted U curve, Mehrara, Rezaei and Rahat (2013) carried out an empirical study using data from 31 European countries. The study adopted the Scully (1994) approach. The study used the Kao panel cointegration test on panel data running from 1995 to 2010. The study found that the growth maximizing tax ratio for the 32

countries was at 27 percent of GDP. The study results may be valid because the study carried out a unit root test, thus choosing an appropriate model. However, there is need for a follow-up study for each of the countries under study. This is because each country has unique tax revenue needs due to unique government expenditure arrangements.

4.10.3 Overview of Literature

The topic of optimal tax ratio has been examined at both theoretical and empirical levels. Empirically, mixed results are obtained for growth maximizing tax ratio. The results show that some countries existing tax rate is on the downward side of the Laffer curve, while others are on the upward side. It is also revealed that most of the empirical studies have adopted Scully (2000) balanced budget model to estimate optimal tax ratio.

The reviewed literature revealed that the concept of optimal tax ratio had been studied in both developed and developing countries. In Africa, the optimal tax ratio of only three countries, namely Coted'Ivoire, South Africa and Nigeria, have been estimated. Empirically, the concept of optimal tax ratio has not received much attention in Kenya.

4.11 Methodology

4.11.1 Introduction

This section includes the different phases that were followed to achieve the study's objectives. It comprises a theoretical framework, empirical model, data sources and type, variable description, and measurement and general estimation tests.

4.11.2 Theoretical Framework

The study used Scully (2000) model to estimate the optimal tax ratio in Kenya. The framework is based on a simple, constant-returns endogenous non-linear Cobb-Douglas (CD) production function. The rate of real economic growth is associated with the part of the output influenced by a two-sector economy in the public and private sectors. This means that investment by government and that of private individuals influence economic growth. It is further noted that the level of disposable income affects private investment. Following this notion, it therefore means

that the share of actual government expenditure in GDP represented as $\frac{rgs_{t-1}}{y_{t-1}}$ and disposable income denoted as $(1-\text{Ƭ})y_{t-1}$ determine economic growth rate.

The model is designed to have two assumptions: First, a balanced budget where government expenditure is equal to government revenue. Secondly, all other determinants of economic growth are held constant.

The non-linear CD production function that satisfies the above assumptions is thus given as:

$$y_t = \eta(rgs_{t-1})^{\rho}[(1-\text{Ƭ})\ y_{t-1})]^{\alpha} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.8$$

But the growth rate is given by the ratio of change in growth to previous period growth. This is illustrated in equation 4.9.

$$g_t = \frac{y_t - y_{t-1}}{y_{t-1}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.9$$

Equation 4.9 can be simplified to yield equation 4.10.

$$(1+g)_t = \frac{y_t}{y_{t-1}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.10$$

Replacing equation 4.8 into equation 4.10, we get:

$$(1+g)_t = \frac{\eta(rgs_{t-1})^{\rho}[(1-\text{Ƭ})y_{t-1}]^{\alpha}}{y_{t-1}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.11$$

Simplifying 4.11 gives equation 4.12

$$(1+g)_t = \eta(rgs_{t-1})^{\rho}[(1-\text{Ƭ})y_{t-1}]^{\alpha} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.12$$

Where η is total productivity, y_t is GDP in current period, y_{t-1} is GDP in the previous period, rgs_{t-1} is real government expenditure in the last period, g is economic growth, and Ƭ is the tax ratio.

The non-linear CD production function can be linearized by converting equation 4.12 to logarithm form, as shown in equation 4.13.

$$\ln(1+g)_t = ln\eta + \rho lnrgs_{t-1} + \alpha \ln(1-\text{Ƭ}) + \alpha \ln y_{t-1} - ln\, y_{t-1} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.13$$

Differentiating equation 4.13 concerning real government expenditure, we get equation 4.14.

$$\frac{\partial ln(1+g)_t}{\partial rgs_{t-1}} = \rho(rgs_{t-1})^{-1} > 0 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.14$$

We can check the nature of relationship between economic growth and real government expenditure by checking for second derivative of equation 4.13 concerning real government expenditure. This is illustrated in equation 4.15.

$$\frac{\partial^2 ln(1+g)_t}{\partial (rgs_{t-1})^2} = -\rho(rgs_{t-1})^{-2} < 0 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.15$$

Equations 4.14 and 4.15 show that real government expenditure is positively linked to growth rate but diminishing. The equations show that holding total productivity and employment constant, the economic growth rate increases with an increase in real government expenditure up to a certain level and eventually declines.

Differentiating equation 4.13 concerning tax rate (Ƭ), we get equation 4.16.

$$\frac{\partial ln(1+g)_t}{\partial \text{Ƭ}} = -\alpha(1-\text{Ƭ})^{-1} < 0 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.16$$

We can check the nature of the relationship between economic growth and tax rate by checking for the second derivative of equation 4.13 concerning tax rate. This is illustrated in equation 4.17.

$$\frac{\partial^2 ln(1+g)_t}{\partial \text{Ƭ}^2} = -\alpha(1-\text{Ƭ})^{-2} < 0 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.17$$

Equations 4.16 and 4.17 show an inverse relationship between tax rate and economic growth rate but at an increasing rate.

Based on assumption of balanced budget, to calculate tax rate that maximizes growth, real government expenditure should be equal to tax revenue obtained by the state. This relationship is shown in equation 4.18.

$$rgs_{t-1} = \text{Ţ}y_{t-1} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.18$$

Substituting rgs_{t-1} in equation 4.8 with $\text{Ţ}y_{t-1}$, we obtain equation 4.19.

$$y_t = \eta(\text{Ţ}y_{t-1})^{\rho}[(1-\text{Ţ})\ y_{t-1})^{\alpha} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.19$$

Equation 4.19 can be simplified to yield equation 4.20.

$$y_t = \eta\text{Ţ}^{\rho}(1-\text{Ţ})^{\alpha}\ (y_{t-1})^{\alpha+\rho} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.20$$

Substituting equation 4.20 in the growth rate that is equation 4.9, we get equation 4.21.

$$(1+g)_t = \frac{y_t}{y_{t-1}} = \eta\text{Ţ}^{\rho}(1-\text{Ţ})^{\alpha}\ (y_{t-1})^{\alpha+\rho-1} \ldots\ldots\ldots\ldots\ldots\ldots 4.21$$

Since the constant returns to scale (CRS) assumption are made, then *α+ρ =1*. This means equation 4.21 becomes:

$$(1+g)_t = \frac{y_t}{y_{t-1}} = \eta\text{Ţ}^{\rho}(1-\text{Ţ})^{\alpha} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.22$$

We linearize equation 4.21 by transforming it into a logarithm, as shown in equation 4.23.

$$\ln(1+g)_t = ln\eta + \rho ln\text{Ţ} + \alpha\ln(1-\text{Ţ}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.23$$

Optimal tax rate which maximizes economic growth is obtained by differentiating equation 4.23 concerning tax rate and then equating derivative to zero, as shown in equation 4.24.

$$\frac{\partial ln(1+g)_t}{\partial\text{Ţ}} = \rho\text{Ţ}^{-1} + \alpha[(1-\text{Ţ})^{-1}](-1) = 0 \ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.24$$

Equation 4.24 can be simplified to give equation 4.25.

$$\frac{\rho}{\tau} - \frac{\alpha}{1-\tau} = 0 \ldots\ldots 4.25$$

Equation 4.25 can be simplified to yield equation 4.26.

$$\frac{1-\tau}{\tau} = \frac{\alpha}{\rho} \ldots\ldots 4.26$$

From equation 4.26, it can be shown that optimal tax ratio (τ) is given by:

$$\tau = \frac{\rho}{\alpha+\rho} \ldots\ldots 4.27$$

Equation 4.27, τ represents the optimal tax ratio while ρ and α are elasticities of real GDP growth rate for actual government expenditure and real disposable income, respectively. Taking constant-returns endogenous nonlinear CD production function into consideration, α and ρ sum to the unit. This means the optimal tax ratio becomes:

$$\tau = \rho \ldots\ldots 4.28$$

Where τ and ρ is optimal tax ratio and elasticity of real GDP growth rate with respect to real government expenditure in the Cobb-Douglas production function.

4.11.3 The Empirical Model

This study adopted Scully (2000), which was used by Lkhagvajav et al. (2019) while studying Mongolian optimal tax ratio and Saibu (2015) while studying optimal tax ratio for South Africa and Nigeria. The empirical model is obtained by linearizing the non-linear cobb-production function shown in equation 4.8 and including other variables that affect real per capita GDP as shown in Romer (2012) and Wawire (2006). The specified model is illustrated in equation 4.29.

$$lnrpgdp_t = \beta + \rho lnrgovtexp_t + \alpha lnrdispincome_t + \sigma lnrintrate_t + \lambda dum_t + \mu_t \ldots 4.29$$

Where ln represents natural logarithm, $rpgdp_t$, dependent-variable is per capita GDP(real) at time t, $rgovtexp_t$ and also, $rdispincome_t$ regressors are real government expenditure at time *t* and real disposable income at time *t*, respectively. Romer (2012) avers that investment accounts

for one-third of a country's GDP. The study incorporated the natural log of interest rate denoted as $lnrintrate$ as a control variable in the specified model to account for the importance of investment on Kenya's GDP. In addition, there are some years the country experienced unusual circumstances that had adverse effects on the country's economic performance. Taking cognizant of these unusual circumstances on country's economic performance, the study included a dummy variable for the unusual circumstances denoted as dum, as control variable in this model. Disturbance error term is captured by μ_t while β, ρ, α, $\sigma$and λ, are parameters to be estimated.

4.11 Description of Variables, their Measurements, Expected Signs and their Source

Variables description, how they are measured and expected signs are as shown in Table 4.1.

Table 4.1: Variable Descriptions, Measurement, Study's Expected-Signs and Source

Variable, and its Abbreviation	Description	Unit	Expected Signs/Source
Per capita GDP (real) at time *t* ($rpgdp_t$)	This is value of commodities produced by an individual in the country adjusted for inflation	KES million	
Real government expenditure at time *t* ($rgovtexp_t$)	This is government spending from one period to another, adjusted for inflation	KES million	+ Saibu (2015); Keho (2010)
Real disposable income at time *t* ($rdispincome_t$)	This is after-tax income that goes to individuals from one period to another, adjusted for inflation	KES million	+ Saibu (2015); Keho (2010)
Real rate of interest at time t ($rintrate_t$)	This is cost of loans imposed by commercial banks in Kenya	Percent	Jordaan (2013)

4.11.5 Data Type and the Source

Time series data spanning from 1970 to 2018 period was sourced from KNBS-Economic-surveys and abstracts. This period was preferred because the Kenyan government started to make various reforms in its fiscal policy to counter oil shocks, increasing public debt, droughts, and structural adjustment programmes.

4.11.6 Pre-estimation Test

The study performed the following pre-estimation tests to determine the appropriate model to be used by the study.

(a) Unit Root Tests

Dickey and Fuller are founders of unit root testing (Dickey and Fuller, 1979). Initially, macroeconomists were interested in the unit roots in looking for how trends could be represented in time series (Libanio, 2005). For many years, unit root tests have to be a common approach in testing for stationarity in time series (Gujarati, 2009). Unlike graphical analysis, tests for unit roots tend to be objective (Yaffee and McGee, 2000). Baltagi (2001) agrees that most of the macroeconomic series are nonstationary. The unit root in any time series is significant due to past unending shocks of various economic features (Dolado, 1992). The most commonly used unit- root-tests are PP and ADF.

ADF-test is broadly used because it is general and straightforward (Harris, 1995). Before ADF test, the authors Dickey and Fuller had proposed Dickey-Fuller (DF) test based on a data generating procedure shown in equation 4.30.

$$X_t = \rho X_{t-1} + u_t \quad \ldots\ldots 4.30$$

The DF tests the H_0 that $\rho = 1$, meaning the data series has a unit root against the H_a of absence of unit root; in other words, the data series is stationary. However, to account for possibility of serial correlation among residuals, lagged difference values of response variable are included. To achieve this, Dickey and Fuller transformed equation 4.30 to get ADF shown in equation 4.31.

$$X_t = \delta X_{t-1} + \sum_{i=1}^{m-1} \mu_i \Delta X_{t-i} + u_t \quad \ldots\ldots 4.31$$

Where u_t is the white noise error term, X_{t-i} is the lag differenced values of the dependent variable, Δ is the difference operator, $m-1$ is the optimal lag length chosen using an Akaike information criterion (AIC).

The null hypothesis under ADF test is that δ is equal to zero, meaning the presence of non-stationarity, while alternative hypothesis is that δ is not equal to zero, signifying the presence of stationarity. The ADF test is sided, implying that the greater negative the ADF value is compared to critical values, the greater the probability of rejecting H_0 is being rejected, thus signifying stationarity. If ADF statistic is less than critical values, the null hypothesis is not rejected, meaning the variable is non-stationary. If the series turns out nonstationary, then there is a need to difference. If it is differenced once and then it becomes stationarity, then series is I(1). If series turns out to be non-stationary post differencing once, then the series should be differenced again and subjected to the ADF test. If it turns out to be stationary, then the series is said to be I (2). In general, if a series is differenced *d* times for it to be stationary, then such time series is believed to be integrated of the order *d*, that is, I (d) (Wooldridge, 2016).

It is argued that ADF test and PP test may give wrong conclusions when there is a structural break. The two tests tend to favour the acceptance of the null hypothesis in case there is a structural break. To remedy this drawback, the Zivot-Andrews unit root test is highly recommended since it accounts for the presence of the structural break when testing for the existence of unit root test (Zivot and Andrews, 1992). The test considers one structural break in testing for the presence of unit root, and it determines structural breaks endogenously. It permits a structural break in both the intercept and trend of each variable while checking for nonstationarity. If a unit root is observed at level and not at first difference, it permits one to apply the techniques of long-run relationship (Uddin, Alam and Gow, 2016).

(b) Lag Length Selection Criteria

It is important to choose the correct model specification. The choice of long lag length may reduce the degrees of freedom and lead to multicollinearity problems. Choosing a short lag length may result in model misspecification. To ensure the appropriate lag length is chosen, this study used five lag selection criteria, namely FPE, LR, AIC, SBIC and HQIC. The rule of thumb in the selection of the lag length is to choose one that is suggested by at least three of the five criteria (Asteriou and Hall, 2007)

(c) Cointegration

According to Johansen (2014), the notion of cointegration was put forward initially by Granger (1983). It was later expounded later by Engle and Granger (1987). The former postulates that combining non-stationary processes may lead to stationary linear combinations. Cointegration illustrates the presence of long-run relationship. This implies that variables may be drifting from each other in short-run but consistently achieve their long-run equilibrium (Brooks, 2008). This, therefore, means that cointegrated series share a typical long-run trend (Hendry and Nielson, 2007). The cointegration process is controlled by a feedback mechanism that ensures that the series is maintained close to each other (Enders, 2015). The concept of cointegration is best explained by a case of a drunkard and her dog. The author postulates that if the two are observed in the short-run, the dog may wander on the road as the drunk individual staggers on her way home. However, looking at the two movements, it will be revealed that they both wander to home, an illustration of long-run equilibrium (Murray, 1994). Differencing nonstationary series makes them stationary when cointegration between the variables may throw away important information (Enders, 2015).

Asteriou and Hall (2007) postulates that a suitable lag length should be selected for cointegration tests. This is to avoid spurious regression and obtain robust standard errors. In addition, appropriate lag length selection helps in avoiding heteroscedasticity and serial correlation problems. To this end, this study used five lag selection criteria, namely FPE, LR, AIC, SBIC and HQIC. In selecting the lag length, the rule of thumb is to choose one suggested by at least three of the five criteria.

The Johansen test used in this study is a superior method of cointegration. The H_0 for this test implies that the error term from the linear linkage of variables is non-stationary. In this regard, H_0 states that variables are not cointegrated, while H_a says that variables are cointegrated.

Johansen (2000) suggests the maximum likelihood (ML) approach for establishing the presence of a cointegrating equation in a general Vector Autoregressive (VAR) model with *m* lags and *k* variables. Maddala (1992) posits that the basis of testing for the existence of cointegration, particularly in the VAR model, is that it assists in establishing whether estimation should take

place while the variables are in levels, first difference or have mixed order of integration accompanied by some restrictions. If it is assumed the model has *h* variables, then a VAR model having *m* lags is expressed as follows:

$$Y_t = \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \cdots + \beta_m Y_{t-m} + u_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.32$$

In testing for the cointegration using the Johansen cointegration test, the VAR model in equation 4.32 must be changed into a VECM of form:

$$\Delta Y_t = \pi Y_{t-m} + \beta_2 Y_{t-2} + \acute{\Gamma}_1 \Delta Y_{t-1} + \acute{\Gamma}_2 \Delta Y_{t-2} + \cdots + \acute{\Gamma}_m \Delta Y_{t-(m-1)} + u_t \ldots\ldots\ldots\ldots\ldots 4.33$$

Where $\pi = (\sum_{t-1}^{m} \beta_t) - I_h$ and $+ \acute{\Gamma}_1 = \sum_{j-1}^{i} \beta_j - I_h$

From the VECM in equation 4.33, the Johansen test of cointegration concentrates on analyzing the π matrix. The matrix illustrates long-run coefficient matrix because, in the long-run, equilibrium $\Delta Y_{t-i} = 0$ (Enders, 2015).

The Johansen cointegration test is premised on estimation of ranks of matrix. The estimation of the test is shown in equation 4.34.

$$\lambda_{trace}(\mathrm{r}) = -\mathrm{T} \sum_{t-r+1}^{h} \ln\left(1 - \widehat{\lambda_i}\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.34$$

Where *r* shows the number of cointegrating variables, *T* represents the sample size, and $\widehat{\lambda_i}$ shows the estimated eigenvalues. The null hypothesis of no cointegration is rejected if the computed trace test statistic is higher than the critical value. In contrast, to trace statistics, maximum eigenvalue test, seeks to establish presence of *r* cointegrating equations in the H_0 against H_a of r+1 cointegrating vectors. Nevertheless, like trace test, one rejects the H_0 if the test statistic is higher than critical value. The max eigenvalue test is expressed as shown in equation 4.35.

$$\lambda_{max}(\mathrm{r}, \mathrm{r}+1) = -\mathrm{Tln} \sum_{t-r+1}^{h} \ln\left(1 - \widehat{\lambda_{r+1}}\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.35$$

The results for cointegration test for this study are discussed in section 4.12.4.

4.11.7 Estimation Technique-Vector Autoregressive (VAR) Model

The study performed an unrestricted VAR to investigate the link among real per capita GDP, actual government expenditure and real disposable income. This is because the variables are integrated of order one but lack long-run relationship. As Cromwell et al. (1994) have indicated, the VAR model is majorly used for forecasting systems of interrelated time series. The model is also used in the analysis of dynamic impact of random disturbances on system of variables. In these models, some variables are treated as endogenous and some as exogenous or predetermined (the exogenous plus the lagged endogenous variables). In the case of this study, three variables $rpgdp_t$, $rgovtexp_t$ and $rdispincom_t$ are treated as endogenous. Taking into consideration that each of VAR's equations is comprised of *m* lag values, for *t* period, the model can be written as:

$$lnrpgdp_t = \alpha_1 + \sum_{j=1}^{m} \beta_j lnrgovtexp_{t-j} + \sum_{j=1}^{m} \rho_j lnrdispincom_{t-j} + \sum_{j=1}^{m} \acute{\eta}_j lnrintrate_{t-j} + \sum_{j=1}^{m} \chi_j rlnrpgdp_{t-j} + \mu_{1t} \quad \ldots\ldots 4.36$$

$$lnrgovtexp_t = \eta_1 + \sum_{j=1}^{m} \phi_j lnrpgdp_{t-j} + \sum_{j=1}^{m} \gamma_j lnrdispincom_{t-j} + \sum_{j=1}^{m} \omega_j lnrintrate_{t-j} + \sum_{j=1}^{m} \delta_j lnrgovtexp_{t-j} + \mu_{2t} \quad \ldots\ldots 4.37$$

$$lnrdispincom_t = \Omega_1 + \sum_{j=1}^{m} \sigma_j lnrpgdp_{t-j} + \sum_{j=1}^{m} \theta_j lnrgovtexp_{t-j} + \sum_{j=1}^{m} \upsilon_j lnrintrate_{t-j} + \sum_{j=1}^{m} \vartheta_j lnrdispincom_{t-j} + \mu_{3t} \quad \ldots\ldots 4.38$$

After implementing VAR, the study sought to establish the presence of short-run causality emanating from both real government expenditure and real disposable income to real per capita GDP using the granger causality test.

4.11.8 Post-estimation Tests

Diagnostic tests are essential in evaluating adequacy of the model (Box and Jenkins, 1976). The process of identifying model misspecification assists in discovering ways in which the model is inadequate. This, therefore, informs the choice of the appropriate formulation. A desirable model has the capacity of extracting the complete systematic information from given data in a way that residuals follow a stochastic process (Rachev et al., 2007). As a result, most diagnostic tests analyze model specification and the behaviour of residuals of an estimated model. This means that a well-specified model should reveal well-behaved residuals, for instance, those usually distributed and are not autocorrelated (Dlamini, 2008).

(a) Model Specification Test

Model specification is one of assumptions of classical regression models. If this assumption is violated, the estimates obtained are biased. In addition, inference testing may be rendered inapplicable. Model misspecification may be because of inclusion of not required variables or exclusion of relevant variables. The choice of wrong functional form also leads to model misspecification (Verbeek, 2008). This study adopted the correct model to estimate the optimal tax ratio in Kenya. To ensure the right model specification, the study used the Wald lag exclusion test, which is relevant under the VAR model. The following hypothesis is tested:

Ho: The model has excluded appropriate lags.

Ha: The model has included all relevant lags.

The decision on whether to reject H_0 or not is guided by the probability value of the Wald lag exclusion test at a 5 percent significance level. If computed, the probability is less than 0.05, testing at a 5 percent significance level, the H_0 is rejected, indicating the model is correctly specified by including all the relevant lags.

(b) Autocorrelation

The most generally used approaches to test for presence of serial correlation are Durbin-Watson (DW) and BG (Langrage Multiplier - LM) tests. These tests determine the existence of any serial correlation at lag one to lag *h* against an alternative hypothesis of non-zero serial correlation(s) in

one or more of the residual distributions. The BG test that was used in this study is superior to DW since, unlike DW, which is an autoregressive AR (1) process, it is an AR (p) process where p is at least 1 (Wooldridge, 2016).

(c) Normality

Jarque-Bera (JB) test is most usually used to test for non-normality in the residuals. This test is anchored on skewness and kurtosis of a particular distribution. This test aims to determine whether the skewness and kurtosis of standardized residuals agree with standard normal distribution behaviour. Verbeek (2008) showed that skewness and kurtosis of residual distribution are obtained as illustrated in equations 4.41 and 4.42, respectively.

$$\hat{S} = \frac{1}{N}\sum_{n=1}^{N}\frac{\hat{\epsilon}_t^3}{\hat{\sigma}^3} \quad \ldots\ldots 4.41$$

$$\hat{K} = \frac{1}{N}\sum_{n=1}^{N}\frac{\hat{\epsilon}_t^4}{\hat{\sigma}^4} - 1 \quad \ldots\ldots 4.42$$

Where N is the number of observations and $\hat{\sigma}$ is an estimator of standard deviation. If normality is present, the skewness and kurtosis must have zero mean. A rejection of the H_0 (residuals are normally distributed) implies that there is no third and fourth moment for the distribution, similar to standard normal distribution. This, therefore, means that the residuals are non-normal.

(d) Structural Analysis

The coefficients of VAR models are usually difficult to interpret. This is because some of the signs of the coefficients of the lagged variables may be changing across lags. This, coupled with interconnectivity of equations, could make it a challenge to observe the effect a particular variation in each variable would mean on future values of variables used in the system (Brooks, 2008). Thus, construction of impulse response functions can help in tracing the dynamic structure of VAR model (Ajilore and Ikhide, 2013). In other words, these econometric tools are important in determining whether movements in the explanatory variables positively or

negatively influence economic growth and the speed at which the given effects take to be experienced in an economy (Mnjama, 2011).

Enders (2015) shows that VAR can be given as vector of moving average (MA). According to Sims (1980), this can assist in tracing the path of diverse shocks on variables included in the VAR model. Therefore, IRFs help locate the persistence of shocks from changes in the explanatory variables to economic growth. According to Brooks (2008), distinct shocks on each of variables in VAR model can be introduced. The shocks on each of the remaining variables used in the model can then be outlined over time. The shocks are viewed as one-period responses to changes in residuals or as collective effects of the unit impulses (Hamilton, 1994). A suitable addition of coefficients of IRFs gives the cumulated responses. Of great importance is that the shocks must be finite, meaning they should come to zero over time since they cannot have fixed effects on stationary variables. The decomposition of shocks over time is expected to occur if the given system is stable. This means that model stability is essential in generating the correct impulse responses. The results obtained from impulse response analysis, to a large extent, rely on the way variables are ordered. Estimating these impulses is usually inexact; thus, confidence intervals about impulses are included for incorporating the inherent parameter ambiguity in process of estimation. Lütkepohl (2005) asserts that if key omitted variables are omitted in a model, this often results in significant distortions of impulse responses, thus, rendering structural interpretation of little worth. Given *h* variable system, *h2* IRFs can be obtained from the system.

4.12 Empirical Findings

The empirical results of this essay are presented in this section. The analysis was performed using data running from 1970 to 2018. An overview of data used in the analysis is first presented, followed by stationarity tests, empirical results and results for various diagnostic tests.

4.12.1 Descriptive Statistics

The summary statistics of the data used in the study are presented in Table 4.2. The summary statistics of concern are the measures of location, measures of dispersion and normality of the variables. These statistics are vital because they illustrate the presence of outliers in data. Failure to correct for outliers may result in biased results. One of the measures of central tendency

considered in summary statistics is the mean. Measures of variation considered include the range and standard deviation.

Table 4.2: Descriptive Statistics

Variable	Mean	Standard Deviation	Minimum	Maximum
log of per-capita GDP (real)	9.50	1.52	6.82	12.09
Natural log of real government expenditure	11.40	1.94	7.94	14.66
Natural log of real disposable income	9.41	1.60	6.66	11.97
Natural log of real interest rate	2.06	0.57	0.89	3.67

Source: Author's calculation using KNBS data

All the variables were expressed in natural logarithms as suggested by the model in equation 4.23. Looking at the minimum and maximum values of the results, it is revealed that there are no outliers since difference is not very big. The results show that observations of the natural logarithm of real per capita GDP are not far from each other, evidenced by the least standard deviation of 1.518. The findings further reveal that most of the observations of real government differ from their mean 11.403 by 1.942.

4.12.2 Stationarity Test Results

The study unit root among study variable using three(3) tests namely PP, ADF and ZA. Table 4.3 shows ADF, PP results, while those for Z-A are shown in Table 4.4.

Table 4.3: PP , ADF Unit Root Tests Results

ADF					**PP**		
		Test-Statistic	The Critical-value (5%)	Integration Status	Test Statistic	The Critical-value (5 %)	Integration Status
log of real per capita GDP	Level 1st Difference	-00.473 -09.098	-02.936 -02.938	One	-00.514 -09.116	-02.936 -02.938	One(1)
Natural logarithm of real government expenditure	Level 1st Difference	-0.680 -8.147	-2.936 -2.938	One	-0.693 -8.036	-2.936 -2.938	One
Natural logarithm of real disposable income	Level 1st Difference	-0.815 -5.481	-2.936 -2.938	One	-0.742 -5.543	-2.936 -2.938	One
Natural logarithm of real interest rate	Level 1st Difference	-2.142 -7.546	-2.936 -2.938	One(1)	-02.108 -07.572	-02.936 -02.938	One(1),

The results in Table-4.3 reveal that all the variables were integrated of order one, that is I (1). This was evidenced by test statistics being less negative than the critical value for ADF and PP unit root tests at a 5 percent significance level. The PP and ADF test may lead to acceptance of null hypotheis in the case of structural break. To overcome this drawback, the study used Z-A unit root test. This test is preferred because it controls for structural break. Table 4.4 shows the test results.

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P. O. Box 30197 00100
NAIROBI, KENYA
9 July 2021

Mr. James Mutunga
C/o Director,
School of Economics

Dear Mr. Mutunga,

NOTICE OF INTENT TO SUBMIT YOUR PH.D THESIS

We acknowledge receipt of your letter dated 22nd May 2021 giving intent to submit your PhD thesis for examination entitled; **"Essays on the Size of Kenya's Informal Sector, Tax Productivity and Optimal Tax Ratio."** We also wish to acknowledge receipt of the abstract of the thesis. Please submit a soft copy of your thesis to the Director, School of Economics, CHSS

In addition, you should run and submit an anti-plagiarism test on your thesis which must be endorsed by your supervisor and Dean/Director whose similarity index should be 15% or below. You are also required to fill and submit the acknowledgement of submission of thesis form, which is available on the Graduate School website: gradnateschool.uonbi.ac.ke

You will also be required to provide evidence of 2 publications or 2 letters of acceptance from peer reviewed journals from your PhD work before the oral defence. The publication should be co-authored with the supervisors.

We look forward to receiving your thesis within 3 months from the date of this letter subject to having received and approved the Board of Examiners from the Dean/Director.

Yours sincerely,

A.M. SIMIYU (MS)
FOR: DIRECTOR, GRADUATE SCHOOL

c.c. Director, School of Economics
Dr. Moses K. Mutiithi (Supervisor) – School of Economics
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21st, August 2021

Academic Registrar,
University of Nairobi,
P.O BOX 30197-00100,
NAIROBI.

Thro' Executive Dean
Faculty of Social Sciences

Thro' Chairman
Department of Economics

Dear Sir/ Madam,

REF: SUBMISSSION OF PHD THESIS

I submit my PhD thesis for examination. The title of the thesis is "Essays on the size of Kenya's informal sector, tax productivity and optimal tax ratio". This follows a notice of submission which I received from graduate school on 9th July 2021. Please find attached soft copy of the thesis, plagiarism report endorsed by the supervisors, a signed acknowledgement of thesis submission form and a copy of the notice to submit.

I look forward to a positive response from your esteemed office.

Your faithfully,

James Murunga
Ph.D in Economics Candidate
Department of Economics

Table 4.4: Zivot Andrews Unit Root Test

Trend and Intercept				
Variables	**Year of structural break**			
			t-statistics	**1 percent and (5 percent) critical value**
Natural logarithm of real per capita GDP	2002 2006	Level 1st Difference	-4.110 -10.253	-5.34 (-4.80) -5.34 (-4.80)
		Conclusion	*I*(1)	
Natural logarithm of real government expenditure	1999 1996	Level 1st Difference	-4.885 -8.505	-5.34 (-4.80) -5.34 (-4.80)
		Conclusion	*I*(1)	
Natural logarithm of real disposable income	1995 1998	Level 1st Difference	-3.719 -6.282	-5.34 (-4.80) -5.34 (-4.80)
		Conclusion	*I*(1)	
Natural logarithm of real interest rate	1999	Level 1st Difference	-4.881 -8.746	-5.34 (-4.80) -5.34 (-4.80)
		Conclusion	*I*(1)	

Source: Computations based on KNBS data

The Zivot-Andrews test results corroborate both PP and ADF results. The test statistics are lower than critical values while testing at levels. However, they turn out to be higher negative than the critical values at first difference. This suggests that the variables are integrated of order one, *I*(1) . These structural breaks in variables as revealed by Zivot-Andrews test happen at same time when certain events affected the economic variables. These events include rain shortages that led to power rationing, destructive El-Nino rains, and political shocks in 1996, 1998 and 2002, respectively. Structural breaks in 2006 can be linked to the economy maintaining the momentum initiated and implemented by the Economic Recovery Strategy (ERS) in 2003. Having identified that all variables are non-stationary, the study suspected they could both be drifting in the long-run. This characteristic of the variables called for the need to investigate possibility of a long-run

linkage among variables. Johansen Cointegration test was used to check this possibility of long run linkage among the study variables. The study investigated the optimal lag length as discussed below.

4.12.3 Lag Length Selection

Five selection criteria, namely LR, FPE, AIC, HQIC and SBIC, were used to determine the appropriate lag length and results are shown in Table A.7 of appendix. SBIC suggested one lag and this is the one that was adopted by the study. Thus, one lag was used while executing Johansen cointegration test as discussed in section 4.12.4.

4.12.4 Johansen Cointegration Test

Having established that all the variables are integrated of order one and the appropriate lag length, the study investigated cointegration. This was done using Johansen cointegration test. Results are shown in Table 4.5.

Table 4.5: Johansen Cointegration Tests

Trend considered: constant			observations = 48		
Sample Size: 1971-2018			Number of Lags = 1		
maximum rank	parms	LL	The eigenvalue	The trace statistic	Critical Value (5 percent)
0	3	150.93	.	23.84*	29.68
1	8	159.27	0.29	0.55	15.41
2	11	162.58	0.13	0.42	3.76
3	12	162.85	0.01		

Source: Calculation based on data from KNBS data

The Johansen cointegration results revealed absence of cointegration. Having established absence of cointegration, this study adopted the unrestricted VAR estimation technique. The results are discussed in section 4.12.5.

4.12.5 Unrestricted VAR Regression Results

By estimating equation 4.36, the results for the unrestricted VAR model are illustrated in Table 4.6.

Table 4.6: Regression Results

Dependent Variable: Real per capita GDP	
Independent Variables	Coefficients
Lag one of the natural logarithm of real GDP per capita	0.608***
	(0.130)
Lag one of natural log of real government expenditure	0.1587 **
	(0.071)
Lag one of natural log of real disposable income	0.1759 ***
	(0.0973)
Lag one of natural log of real interest rate	-0.0113
	(0.0231)
Constant	0.3897 ***
	(0.112)
Observations	48
R-squared	0.9978
F(P>chi^2)	0.0000
Breusch-Godfrey	0.446
Jarque-Bera test	0.0569
Eigenvalue stability condition	0.529
Wald lag exclusion test/Variable omission Test	0.000
optimal tax ratio $(\tau) = \rho$ (Coefficient of the natural log of real government expenditure)	**15.87 percent**
Granger causality Wald tests	0.000

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: Author's Computations based on data from KNBS

The results show that the model performed well in terms of coefficient of determination (R-squared) and overall significance denoted by F (P>chi^2). The R-squared showed that study's explanatory variables (lag one of natural log of real GDP per capita, natural log of government expenditure in real terms, natural log disposable income in real terms, natural log and dummy variable to control for presence of adverse effects on Kenya's economy) used in the model accounts for 99.78 percent variation in dependent variable (natural log of real per capita GDP). The slopes of these explanatory variables are jointly statistically different from zero as suggested by a significant F-test (probability of F = 0.000). This means that regressand are jointly important in influencing real per capita GDP in Kenya. The coefficient of lag one of the natural log of real per capita GDP was significant at a 1 percent significance level. This means that the previous natural log GDP per capita in real terms positively influence present natural log GDP

per capita in real terms. log of government (real) and log disposable income in real terms are individually significant at 5 and 1 percent significance levels, respectively. The coefficients of natural log of real interest rate and a dummy variable for adverse effects on Kenya's economy are insignificant. This implies that these two variables are not an essential determinant of the natural log of real GDP.

The results indicated in Table 4.6 are valid as suggested by the various diagnostic tests. For instance, the Breusch-Godfrey test statistic of 0.5251 meant that null hypothesis (H_0) of no autocorrelation was accepted. The J-B test results of 0.05688 suggested that the study accepted H_0 of variables being normal. In addition, Eigenvalue stability condition 0.5467 implied that the null hypothesis of VAR satisfies stability condition was not rejected. This means that all eigenvalues were inside unit circle, confirming model stability. Lastly, Wald lag exclusion Test results of 0.00 suggested that H_0 of variable or lag was excluded was rejected. This, therefore, ascertained that no variables or lag was omitted. Thus, the diagnostic tests revealed that the model was correctly specified.

As suggested in equation 4.28, the elasticity of the natural log of real per capita GDP with respect to natural log of real government expenditure depicts the optimal tax ratio. From the results in Table 4.6, this elasticity was found to be 0.146. The study, therefore, established that Kenya's optimal tax ratio was 15.87 percent of GDP. This was obtained by multiplying the elasticity of real per capita GDP with respect to real government expenditure by 100 and rounding it up to a whole number. Considering the current actual tax ratio of 18.2 percent of GDP, the study found that Kenya's tax ratio is beyond the optimal tax ratio, suggesting that Kenya's tax system could be operating on the downward-sloping part of the Laffer curve. This could be implying that the country could be losing some tax revenue. This is because the current tax ratio could be acting as an incentive for taxpayers to practice tax evasion. This could therefore mean the few taxpayers are paying taxes beyond their tax share. The case of EABL Senator Keg can illustrate how a high tax ratio can result in a loss of tax revenue. According to Republic of Kenya (2004), the informal alcohol market accounted for 56 percent of the total market. However, when the government allowed EABL 80 percent remission of excise tax on Senator Keg, the informal alcohol market dropped to 40 percent of the total market share. This tax policy managed to fight illegal alcohol by making about 50 percent of its consumers consume

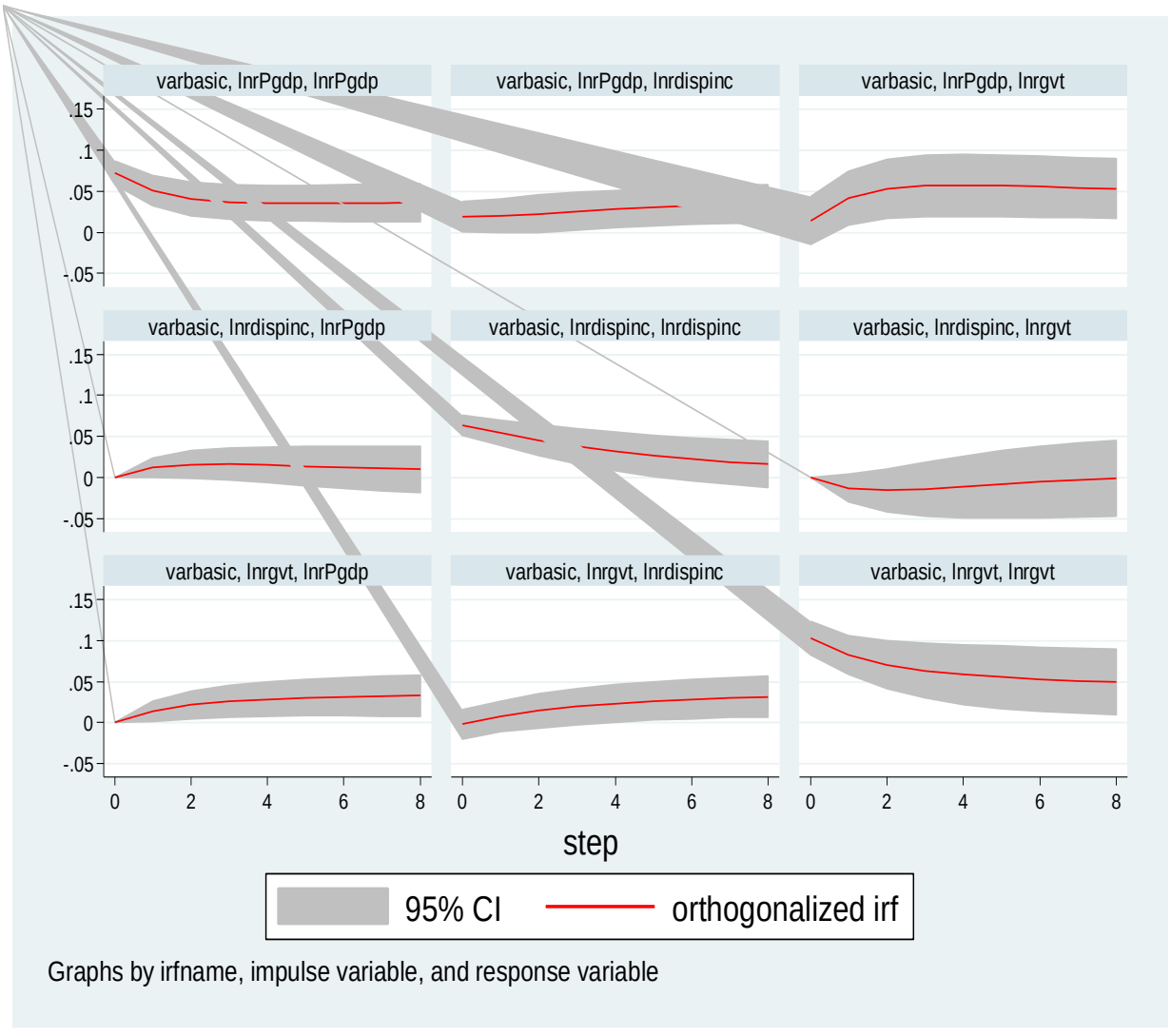
a safe and regulated product and, in turn, raising more tax revenues. This tax policy resulted in increased tax revenue and created a thriving value chain with about 12,000 sorghum farmers and approximately 12,000 retail outlets.

This study's findings conform to results by Saibu (2015), who found South Africa's optimal tax ratio to be 15 percent of GDP, much less than the actual 35 percent of GDP. Saibu (2015) also established an optimal tax ratio of 33 percent of GDP for Nigeria, which was lower than the actual tax ratio of 33.8 percent of GDP. Other studies which found optimal tax ratio less than the current actual tax ratio include Scully (2006), Keho (2010) and Davidson (2012). These results, however, contradict some studies which found optimal tax ratio higher than the current actual tax ratio. These studies include Amgain (2017) and Lkhagvajav et al. (2019). The former study found the optimal tax ratio for selected 32 Asian countries to be 18.12 percent of GDP above their actual tax ratio of less than 15 percent of GDP, on average. The latter study found that the optimal tax ratio for Mongolia was 34.8 percent of GDP, more than the current actual tax ratio of 31.3 percent of GDP.

According to Republic of Kenya (2020), Kenya's GDP was KES 9.7 trillion. This means that a tax ratio of 15.87 percent of GDP will translate into about KES 1.54 trillion. This tax revenue level is enough for government expenditure if a balanced budget is considered. According to Republic of Kenya (2020), the Government of Kenya's recurrent and development spending for 2020/2021 was KES 1.9 trillion. There is a possibility of the government expenditure to decrease, primarily due to reduction in public wage bill to match the optimal tax ratio of 15.87 percent of GDP. In addition, if leakages in development expenditure are sealed, there is a possibility of government expenditure to reduce. According to Wawire (2020), the country loses a third of its annual public budget to corruption. In addition, many government agencies indulge in binge spending at the end of the financial year. This is through unnecessary replacement of ICT equipment, and furniture which is in good shape. In addition, there is usually unnecessary staff trips meant to exhaust the remaining cash in the government agencies' bank accounts at the end of the financial year. In addition, Oguso et al. (2018) and Wawire (2020) showed that completion of some government projects is intentionally delayed to escalate costs for corrupt individuals to steal.

The study also investigated short-run causality running from study's regressors to natural log of GDP per capita in real terms using Granger causality Wald tests. The results revealed the presence of short-run causality running from explanatory variables to dependent variable. This was evidenced by the highly significant Granger causality Wald test that rejected null hypothesis of no short-run causality, thus favouring the alternative hypothesis. The alternative hypothesis tests for the presence of short-run causality.

To trace the persistence of the shocks from changes in log of government expenditure in real terms and log of disposable income in real terms to the natural log of real per capita GDP, the study extracted the impulse response functions (IRFs) as shown in Figure 4.7



Source: Author's calculations based on KNBS data

Figure 4.7: The Impulse Response Functions (IRFs)

After estimating the unrestricted VAR model, the study analyzed real per capita GDP responses to a standard shock on real government expenditure and real disposable income. Impulse Response Functions (IRFs) in columns 2 and 3 of the first row of Figure 4.7 were considered. The IRF in column 2 of the first row revealed that one standard deviation shock to real disposable income temporarily increases real per capita GDP. This response continues until second period and reaches steady state. Beyond the second period, real disposable income rises above its steady-state value and remains in the positive region beyond the second period. This implies that the natural logarithm of real disposable income will positively impact real per capita GDP both in the short-run and long-run.

The IRF graph for real per capita GDP and government expenditure shown in column 3 of the first row also lies above zero. The graph revealed that a one standard deviation to real government spending temporarily increases real per capita GDP. This response continues until second period and reaches steady state. It then remains there until 6th period. After 6th period, it reduces below its steady-state value but remains above the positive region. This means that the log of real government spending will positively impact real GDP per capita in short- and long-run.

4.13 Conclusions and Policy Implications

4.13.1 Conclusions

The size of informal sector in Kenya has remained above 20 percent of GDP, on average from 1970 to the present (see chapter two of this study; Ouma et al., 2007). Teera (2002) argued that high informal sector leads to loss of tax revenue for government due to tax evasion. Given that some of the income is untaxed and indirect taxes, namely VAT and excise taxes, are dodged, it concludes that the tax revenue is lower than if every economic agents participating in income-generation had paid their taxes. Hibbs and Peculescu (2013) postulate that high tax ratio increases the informal sector's size, since economic agents feel overtaxed. Following the increased size of the informal sector and rising budget deficit due to dwindling tax revenue, the study estimated optimal tax ratio in Kenya using Scully (2000) balanced budget approach.

The econometric findings showed that log government expenditure in real terms and natural log of disposable income in real terms are essential determinants of natural log of GDP per capita in real terms. The study's results agree (Scully, 2006; Keho, 2010; Davidson, 2012; Abdullaev and Konya, 2014; Saibu, 2015, and El Husseiny, 2018), previous studies which estimated optimal tax ratio for various countries and regions.

Using the coefficients of log of government expenditure (real) and log of disposable income(real), considering the constant returns to scale, the study computed an optimal tax ratio of 15.87 percent of GDP for Kenya. This finding, therefore, revealed that the current tax ratio of 18 percent of GDP in Kenya is high and thus could be incentivizing some economic agents who prefer informal sector. In addition, the results suggested that Kenyan tax system is operating on downward side of Laffer curve, meaning the country is sacrificing more tax revenue, translating into increased economic growth. This study's findings conform to Scully (2006), Keho (2010), Davidson (2012) and Saibu (2015), earlier studies that found optimal tax ratios less than the actual tax ratios. However, these findings do not conform to the results of Amgain (2017) and Lkhagvajav et al. (2019), previous studies which found optimal tax ratios to be higher than the actual tax ratios.

4.13.2 Policy Implications

The results have shown that Kenya’s actual tax ratio of 18 percent of GDP is higher than optimal tax ratio of 15.87 percent of GDP. This suggests that Kenya's existing average tax burden might be on the downward-sloping side of the Laffer curve. Since high tax is an incentive for the higher size of informal sector, this could imply many economic agents could be in the informal sector. This, therefore, could imply that economic agents who are paying taxes could be paying beyond their required share.

The significant policy implication of this current study is that tax policy should aim to reduce overall tax burden in Kenya to 15.87 percent of GDP. This can be achieved by revising current tax rates downwards. Though this action may lead to reduced tax revenue, the gap may be filled by more tax from informal- sector. This is because if tax-rate is reduced, more businesses in the informal sector may formalize and start paying tax.

4.13.3 Limitations and Areas for Further Research

This study adopted Scully (2000) model to carry out an empirical investigation of optimal tax ratio in Kenya. However, this model has been criticized by many economists for being inappropriate in estimating the exact optimal tax ratio by assuming a balanced budget. This is because many countries have a deficit budget. This means that the model may not be applicable for such countries. However, this model offers some knowledge in determining the optimal level of taxation to raise adequate tax, thus realizing maximum economic growth.

This study suggests some good topics for future studies. First, it would be helpful if optimal tax ratio of income tax, VAT, import and export duties and excise tax is estimated to identify the taxes that need to be enhanced and those that require reduction.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS

5.1 Introduction

This is the last chapter of this thesis. It is comprised of the summary, and conclusion of the thesis. It also makes policy implications based on the thesis results. The limitations of the study and the areas of further research are also discussed.

5.2 Summary of the Thesis

The Kenyan government inherited a colonial tax system when the country became independent in 1963. The government was doing well in terms of revenue. However, the government started to experience revenue shortfalls due to economic problems that were occasioned by the world oil crisis of the 1970s. During this time, the Kenyan government embarked on putting in place various tax reforms aimed at improving tax revenue mobilization. These reforms have been revised and new ones introduced until recently. However, the country has continued to experience an increasing budget deficit. For instance, the budget deficit increased from 2 percent of the country's GDP in 2003 to around 8 percent of the country's GDP in 2018.

The literature links increasing budget deficit to the large size of the informal sector, unresponsive tax system to country's GDP and high tax ratio that acts as an incentive for economic agents to resort to the informal sector. Although Muchiri (2014) estimated the effect of informal sector on Kenya's tax revenue, robust results may not have been obtained. This could be because the study used several people in the informal sector instead of the monetary value of the commodities produced in the sector. The use of informal sector GDP is said to yield robust results. The productivity of the tax system has again been carried out by earlier studies, for instance, Wawire (1991), Muriithi and Moyi (2003), Wawire (2006) and Menjo and Kotut (2015), but the studies failed to separate informal sector GDP from the recorded GDP. Osoro (1993) suggested that separating this sector's output for countries where the sector makes a substantial part of their economy is essential. The area of optimal ratio in Kenya is yet to be explored exhaustively. Based on these shortcomings, this thesis sought to estimate effect of size of informal sector on

tax revenue in Kenya, estimate tax productivity of the tax reforms in Kenya, and estimate Kenya's optimal tax ratio.

To estimate the effect of the informal sector on tax revenue performance, the study used the ARDL model given a mixture of both stationary and stationary at first difference variables. The results showed that the informal sector has a negative impact on tax revenue in Kenya. In estimating the tax productivity, the study used VECM, given that the variables used were all integrated of order one, and the long-run relationship was revealed. The results showed that Kenya's tax system was buoyant but inelastic. Lastly, the optimal tax ratio for Kenya was estimated using the VAR model. The choice of this model was informed by variables that were integrated into order one. On checking for a long-run relationship, it was found to be absent. The results showed that optimal tax ratio for the country was 15.87 percent of GDP. However, this optimal ratio is only possible if the country was operating a balanced budget.

5.3 Conclusions

The study had three major conclusions. One, the informal sector in Kenya is large and thus has a negative effect on tax revenue mobilization in Kenya. Two, Kenya's tax system is less sensitive to variations in the country's income. However, the tax system was found to be responsive to discretionary tax measures. Three, the current tax ratio of 18.2 percent of GDP was beyond the optimal tax ratio of 15.87 percent of GDP.

It is, therefore, inherent that continued increase in the budget deficit and failure of KRA to meet its tax target can be linked to the large size of the informal sector, and the inelastic tax system in Kenya. The study further revealed that the large size of the informal sector in Kenya may be attributed to a tax ratio that is way above the optimal tax ratio.

5.4 Policy Implications

The study established a negative link between the size of informal sector and tax revenue in Kenya. It was further revealed that the size of the informal sector is essential in influencing tax revenue in Kenya. To reduce the size of the informal sector, KRA should be supported by the government by ensuring that it is given adequate funding. This will enable it to monitor the economy to ensure businesses whose incomes fall within the tax bracket pay taxes. In addition,

adequate funding will allow KRA to match tax filed by the taxpayers to their data at National Transport and Safety Authority (NTSA) and Kenya Power and Lighting Company. Data at NTSA and Kenya KPLC will identify importers of high-end vehicles and rich landlords, which should also translate to high tax returns. If these individuals report low taxes, then such data will assist KRA to interrogate them, thus averting tax evasion. In addition, it is revealed that 79 percent of Kenyans above 15 years receive or make digital transactions. As a result, registering for mobile money service. This means the government can leverage this impressive number of Kenyans making digital transactions to roll out a cashless transaction system. This will ensure that all businesses have bank accounts and their income can easily be detected and therefore asked to pay the required tax.

Estimation of income elasticity of tax revenue, based on Kenyan data, suggested that tax revenue in Kenya does not increase proportionately with an increase in GDP. This was reflected in an elasticity that was less than unity for the total tax system. However, Kenya's entire tax system had a buoyancy coefficient of more significant than the elasticity coefficient. This implied that the discretionary tax measures that were implemented were important in raising more tax revenue. These discretionary tax measures were most needed in tax revenue mobilization. Failure of tax revenue to increase proportionately with increase in GDP may have resulted from poor tax administration and the government granting generous exemptions. Therefore, to ensure the tax system becomes elastic, tax policy should focus on achieving strong tax administration, a constant review of the tax system to eliminate some tax exemptions that may erode the effective tax base, expand tax coverage, and adjust the tax rate for inflation regularly. The government should put more effort into implementing the presumptive tax targeting self-employed individuals and professionals whose income falls above a certain threshold.

The study found an optimal tax ratio of 15.87 percent of GDP for Kenya. This implies that the current tax ratio of 18.2 percent of GDP is above the optimal tax ratio, and thus the tax burden in Kenya could be higher. To achieve this level of taxation, tax policy should aim at revising tax rates downwards to obtain the optimal tax ratio.

5.5 Limitations of the Study and Areas for Further Research

The study's main limitation is an estimation of size of informal sector using a macroeconomic approach. The choice of this approach was due to time and resource limitations. The literature suggests that a direct method such as a survey based on a biased questionnaire may give a perfect indicator of the informal sector. Nonetheless, results in this study can be used to inform policy, since variations between the estimates of the macroeconomic approach and direct approach are likely to be not significantly different from each other. This, therefore, means that there is a desire for future studies to estimate the size of informal sector using a direct approach.

In estimating the revenue productivity of tax reforms, this study focused on overall tax revenue. This is another limitation of this study, since it fails to separate individual tax components that could be affecting tax buoyancy and elasticity. This, therefore, implies that there is need for future studies to study tax buoyancy and elasticity of income tax, VAT, excise tax and trade taxes.

Lastly, another limitation of this thesis is performing an estimation of optimal tax ratio for the overall tax system without estimating the optimal tax rate for income tax (personal and corporate) and VAT. Estimation of optimal tax rate may provide information on which tax component the government can increase and which one it should reduce. This study, therefore, suggests some promising topics for future research. First, it would be valuable to examine the optimal tax rate of personal income tax, corporate tax and VAT to identify the taxes that need to be enhanced and those that require reduction.

REFERENCES

Abdullaev, B. and Konya, L. (2014). Growth maximizing tax rate for Uzbekistan. *Applied Econometrics and International Development, 14*(1), 59-72.

Actionaid International (2018). Taxation of the informal sector. Johannesburg: ActionAid International Secretariat.

Addison, T. and Levin, J. (2012). *The determinants of tax revenue in Sub-Saharan Africa*. Washinton D.C: International Monetary Fund.

African Union. (2015). *Agenda 2063: The Africa we want*. Addis Ababa: AUC.

Agosto, A. and Giudici, P. (2020). *A Poisson autoregressive model to understand COVID-19 contagion dynamics*. Available at SSRN 3551626.

Ahmed, Q. M. and Hussain, M. H. (2008). Estimating the black economy through a monetary approach: A case study of Pakistan.*Economic Issues,13*(1), 45-60.

Ajilore, T. and Ikhide, S. (2013). Monetary policy shocks, output and prices in South Africa: A test of policy irrelevance proposition. *The Journal of Developing Areas, 47*(2): 363-386.

Al-Freijat, S.Y. and Adeinat, M.K. (2020). Determinants of tax effort and tax capacity in Jordan.*International Journal of Business and Economics Research,* 9(1), 1-10.

Allaro, H. B., Kassa, B. and Hundie, B. (2011). A time series analysis of structural break time in the macroeconomic variables in Ethiopia. *African Journal of Agricultural Research 6*(2), 392-400.

Amgain, J. (2017). Estimating optimal level of taxation for growth maximization in Asia. *Applied Economics and Finance, 4*(3), 47-55.

Amoh, J.K. and Adom, P.K. (2017). The determinants of tax revenue growth of an emerging economy–the case of Ghana. *International Journal of Economics and Accounting, 8*(3-4), 337-353.

Andersen, S.P. (1973). Built-in flexibility of sensitivity of the personal income tax in Denmark. *Swedish Journal of Economics, 75*, 23-38.

Asaolu, T.O., Dopemu, S.O. and Monday, J.U. (2015). Impact of tax reforms on revenue generation in Lagos State: A time series approach. *Research Journal of Finance and Accounting, 6*(8), 85-96.

Asteriou, D. and Hall, S.G. (2007). *Applied econometrics: A modern approach* (Revised Ed.). Hampshire: Palgrave Macmillan.

Atambo, P. and Katuse, P. (2017). Challenges in the implementation of the business automation project at Kenya Revenue Authority (KRA): A case of Kenya Revenue Authority. *European Journal of Business and Strategic Management, 2*(3, 89-116.

Aydin, C. and Esen, Ã.M. (2019). Optimal tax revenues and economic growth in transition economies: A threshold regression approach. *Global Business and Economics Review, 21*(2), 246-265.

Bahl, R.W. (1971). A regression approach to tax effort and tax ratio analysis. *Staff Papers, 18*(3), 570-612.

Baltagi, B.H. (2001). *A companion to theoretical econometrics*. Massachusetts: Wiley-Blackwell Publishing Ltd.

Battaglini, M. and Coate, S. (2008). A dynamic theory of public spending, taxation, and debt. *American Economic Review, 98*(1), 201-36.

Bajada, C. and Schneider, F. (2018). *An international comparison of underground economic activity. In size, causes and consequences of the underground economy*. Abingdon: Routledge.

Barro, R.J. (1990). Government spending in a simple model of endogenous growth. *Journal of political economy*, *98*(5), 103-125.

Baumol, W.J. and Bradford, D.F. (1970). Optimal departures from marginal cost pricing. *The American Economic Review, 60*(3): 265-283.

Bayu, T. (2015). Analysis of tax buoyancy and its determinants in Ethiopia (cointegration approach). *Journal of Economics and Sustainable Development, 6*(3), 182-195.

Besley, T. and Persson, T. (2014). Why do developing countries tax so little? *Journal of Economic Perspectives*, *28*(4), 99-120.

Bigsten, A., Kimuyu, P. and Söderbom, M. (2010). *The manufacturing sector: Policies for prosperity*. Nairobi: Oxford University Press.

Blankard, O. (2017). *Macroeconomics*. Harlow: Pearson Education Limited.

Bonga, W.G., Dhoro-Gwaendepi, N.L. and Mawire-Van Strien, F. (2015). Tax elasticity, buoyancy and stability in Zimbabwe. *Journal of Economics and Finance, 6*(1), 21-29.

Box, G.E.P. and Jenkins, G.M. (1976). *Time series analysis: Forecasting and control*. Revised edition. San Francisco: Holden-Day, Inc.

Brooks, C. (2008). *Introductory econometrics for finance*. 2nd edition. New York: Cambridge University Press.

Buehn, A. (2012). The shadow economy in German regions: An empirical assessment. *German Economic Review, 13*(3): 275-290.

Cagan, P. (1958). The demand for currency relative to the total money supply. *Journal of political economy*, *66*(4), 303-328.

Castells, M. and Portes, A. (1989). *World underneath: The origins, dynamics and effects of the informal economy*. London: The John Hopkins University Press.

Castro, G.R.B. and Aranda, D.A. (2018). *The informal economy and its impact on tax revenues and economic growth, Analysis of OECD members and Latin America Countries (1995-2016)*. Lima: Pontificia Universidad Católica del Perú.

Caves, R.E. and Jones, R.W. (1973). *World trade and payments*. Boston: Little Brown.

Chelliah, R.J. (1971). Trends in taxation in developing countries. *Staff Papers, 18*(2), 254-331.

Choudhry, N.N. (1975). A study of the elasticity of the West Malaysian income tax system. *IMF Staff Paper, 22*, 494-501.

Choudhry, N.N. (1979). Measuring the elasticity of tax revenue: A divisia index approach. *IMF Staff Papers, 26*, 87-96.

Cromwell, J.B., Labys, W.C. and Terraza, M. (1994). *Univariate tests for time series models*. London: Sage.

Davoodi, H.R. and Grigorian, D.A. (2007). *Tax potential vs tax effort: A cross country analysis of Armenia's stubbornly low tax collection*. Washington DC: IMF.

Dell'Anno, R. (2007). The shadow economy in Portugal: An analysis with the MIMIC approach. *Journal of Applied Economics*, *10*(2), 253–277.

Dellas, H., Malliaropulos, D., Papageorgiou, D., & Vourvachaki, E. (2017). *Fiscal policy with an informal sector*. CEPR Discussion Paper.

De Mel, S., McKenzie, D. and Woodruff, C. (2010). Who are the microenterprise owners? Evidence from Sri Lanka on Tokman versus De Soto. In International differences in entrepreneurship. Chicago: University of Chicago Press.

De Soto, H. (1989). *The other path: The invisible revolution in the Third World*. London: I. B. Tauris and Co.

Dharmapala, D., Slemrod, J. and Wilson, J.D. (2011). Tax policy and the missing middle: Optimal tax remittance with firm-level administrative costs. *Journal of Public Economics, 95*(9-10), 1036-1047.

Dickey, D.A. and Fuller, W. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association, 74* (366), 427-431.

Dlamini, S.K. (2008). *Bank credit extension to the private sector and inflation in South Africa*. Unpublished MA project, Rhodes University, South Africa.

Dolado, J.J. (1992). A note on weak exogeneity in VAR cointegrated models. *Economic Letters, 38*(2): 139-143.

Dougherty, C. (2016). *Introduction to econometrics*. Oxford: Oxford University Press.

Dreher, A. and Schneider, F. (2010). Corruption and the shadow economy: An empirical analysis. *Public Choice, 144*(1): 215-238.

Dudine, P. and Jalles, J.T. (2018). How buoyant is the tax system? New evidence from a large heterogeneous panel. *Journal of International Development, 30*(6), 961-991.

Egwaikhide, F.O. (2019). *Nigeria's low tax collection and poor quality of government expenditure: Political and administrative impediments to improvement*. Washington D.C: Centre for Global Development policy paper 162.

Eissa, N. O. and Jack, W. (2010). *Tax reform in Kenya: Policy and administrative issues. Taxation in developing countries: Six case studies and policy implications*. New York: Initiative for Policy Dialogue Publication.

El Husseiny, I.A. (2018). On the cyclical behavior of fiscal policy in Egypt. *Contemporary Economics, 12*(1), 95-125.

Engle, R. F. and Granger, C.W.J. (1987). Cointegration and error correction: Representation, estimation and testing. *Econometrica, 55* (2), 251-276.

Enders, W. (2015). *Applied econometric time series*. New Jersey: John Wiley and Sons.

Faal, E. (2003). *Currency demand, the underground economy and tax evasion: The case of Guyana.* Washington D.C: International Monetary Fund.

Frey, B.S. and Weck, H. (1983). Estimating the shadow economy. *Oxford Economic Papers, 35*(1), 23-44.

Friedman, E., Johnson, Kaufmann, S. and Zoido-Lobaton, P. (2000). Dodging the grabbing hand: The determinants of unofficial activity in 69 countries. *Journal of Public Economics, 76*, 459-493.

Friedman, M. (1997). If only the US were as free as Hong Kong. *Wall Street Journal, 9*(6), 14.

Gasper, V., Gupta, S. and Mulas-Grandos, C. (2017). *Fiscal politics*. Washington, DC: International Monetary Fund.

Greenidge, K., Holder, C. and Mayers, S. (2009). Estimating the size of the informal economy in Barbados. *Journal of Business, Finance and Economics In Emerging Economies, 4*(1): 1-33.

Grubel, H.G. (1998). *How to use the fiscal surplus: What is the optimal size of government?*. Vancouver : The Fraser Institute.

Gituku, F.C. (2011). *Tax reforms and revenue productivity in Kenya*. Washington D.C: Centre for Global Development Policy Paper 163, University of Nairobi, Kenya.

Gordon, D.F. (1959). What was the labor theory of value. *American Economic Review Papers and Proceedings, 49*(2), 462-472.

Gujarati, D.N. (2009). *Basic econometrics*. Delhi: Tata McGraw-Hill Education.

Gunes, A.T.A., Starzec, C. and Gardes, F. (2013). *A new estimation of the size of informal economy using monetary and full expenditures in a complete demand system*. Paris: Sorbonne.

Gupta, M.R. and Barman, T.R. (2015). Environmental pollution, informal sector, public expenditure and economic growth. *Hitotsubashi Journal of Economics,56* (1), 73-91.

Gupta, S. Keen, M, Shah, A. and Verdier, G. (2017). *Digital revolutions in public finance*. Washington, DC: International Monetary Fund.

Hamilton, J.D. (1994). *Time series analysis.* Princeton: Princeton University Press.

Harris, R. (1995). *Using cointegration analysis in econometric modelling*. London: Prentice Hall.

Harris, R. and Sollis, R. (2003). *Applied time series modelling and forecasting*. New York: John Wiley.

Hassan, M. and Schneider, F. (2016). Modelling the Egyptian shadow economy: A currency demand and a MIMIC model approach. *Journal of Economics and Political Economy, 3*(2): 309-339.

Hendriks, J. and Myles, G.D. (2013). *Intermediate public economics* (2nd Ed.). Cambridge: MIT Press.

Hendry, D.F. and Juselius, K. (2001). Explaining cointegration analysis. *The Energy Journal, 22*(1): 75-120.

Hibbs, D.A. and Piculescu, V. (2013). Tax toleration and tax compliance. *Governance, 3*(2), 87-99.

Huňady, J. and Orviská, M. (2015). The effect of corruption on tax revenue in OECD and Latin America countries. *Theoretical and Practical Aspects of Public Finance, 1*(1), 1-7. Institute for Public Policy Research and Analysis.

Hyman, N.D. (2010). *Public finance: A contemporary application of theory to policy* (10th Ed.). North Carolina: State University.

ILO. (2002). Measuring the NonMeasuring the Non--Observed Economy: A HandbookObserved Economy: A Handbook. Geneva: International Labour . Geneva: International Labour Organization.

Institute of Economic Affairs (IEA)–Kenya (2006). *Taxation and modernization in Kenya: A diagnosis of performance and options for further reform*. Nairobi: IEA.

Institute of Economic Affairs (IEA)–Kenya (2012). *Informal sector and taxation in Kenya*. Nairobi: IEA.

Isaac, M.K. and Samwel, K.C. (2015). Decomposition of the tax-to-income elasticity of major taxes in Kenya. *Research Journal of Finance and Accounting, 6*(3), 81-87.

Jalil, A., Ma, Y. and Naveed, A. (2008). The finance fluctuation nexus: Further evidence from Pakistan and China. *International Research Journal of Finance and Economics 14,* 212-231.

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control, 12*, 231-254.

Johansen, S. (1991). Estimation and hypothesis testing of cointegrating vectors in Gaussian Vector Autoregressive Models. *Econometrica, 59,* 1551-1580.

Johansen, S. and Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration with applications to the demand for money. *Oxford Bulletin of Economics and Statistics, 52*(2): 169-210.

Johansen, S. and Juselius, K. (1992). Testing structural hypothesis in a multivariate cointegration analysis of the PPP and UIP for UK. *Journal of Econometrics 53*, 211-244.

Johansen, S. and Juselius, K. (1994). Identification of the long-run and the short-run structure: An application to the ISLM model. *Journal of Econometrics, 63,* 7-36.

Johansen, S. (2000). Modelling of cointegration in the vector autoregressive model. *Economic Modelling, 17*(3): 359-373.

Jordaan, J.C. (2013). Impact of interest rate changes on South African GDP and households: A combined macroeconomic and social accounting matrix modelling approach. *Southern African Business Review, 17*(3), 156-186.

Joshi, A., Prichard, W. and Heady, C. (2012). *Taxing the informal economy: Challenges, possibilities and remaining questions*. Brighton: Institute of Development Studies.

Kariba, L.W. (2011). *An analysis of tax reform policies and tax revenues in Kenya*. Unpublished MA Research Paper, University of Nairobi, Kenya.

Karingi, S.N. and Wanjala, B. (2005). *The tax reform experience of Kenya*. WIDER Research Paper. Helsinki: United Nations University.

Kendrick, M.S. (1939). The ability-to-pay theory of taxation. *The American Economic Review, 29*, 92-101.

Kennedy, P.E. (2000). On measuring the growth maximizing tax rate. *Pacific Economic Review, 5*(1): 89-91.

Kennedy, P. (2008). *A guide to econometrics* (6th Ed.). Oxford: Blackwell.

Keho, Y. (2010). Estimating the growth-maximizing tax rate for Cote d'Ivoire: Evidence and implications. *Journal of Economics and International Finance, 2*(9), 164.

Keynes, J.M. (1936). *The general theory of interest, employment and money*. London: Macmillan.

Khattry B. and Rao J.M. (2002). Fiscal faux pas? An analysis of the revenue implications of trade liberalization. *World Development, 30*, 1431-1444.

Kieleko, P.M. (2006). *The effects of tax reforms on tax productivity in Kenya*. Unpublished M. A Project. University of Nairobi, Kenya.

Kinyanjui, B.K. (2013). *Reversed fortunes in the South: A comparison of the role of FDI in industrial development in Kenya and Malaysia*. Leiden: University of Leiden, African Studies Centre.

Kharusi, S. A., & Ada, M. S. (2018). External debt and economic growth: The case of emerging economy. Journal of economic integrationJournal of economic integration, , 3333(1),(1), 1141--1157.

Kondo, E.M. (2015). *The effect of revenue enhancement strategies on financial performance of Kenya revenue authority*. Unpublished MA project, University of Nairobi, Kenya.

Koto, P.S. (2015). An empirical analysis of the informal sector in Ghana. *The Journal of Developing Areas, 49*(2), 93-108.

Kristoffersen, S. (2011). *Taxation and informal sector growth in developing countries*. Unpublished M.A. Project, University of Oslo, Norway.

Koatsa, N.J. and Nchake, M.A. (2017). *Revenue productivity of the tax system in Lesotho*. Unpublished M. A. Project, National University of Lesotho, Lesotho.

Kusi, N.K. (1998). *Tax reform and revenue productivity in Ghan*a. Research Paper No. 74, African Economic Research Consortium (AERC), Nairobi.

Laffer, A.B. (2004). The Laffer curve: Past, present, and future. *Backgrounder, 1765*, 1-16.

Libanio, G.A. (2005). Unit roots in macroeconomic time series: theory, implications, and evidence. *Nova Economia, 15*(3): 145-176.

Lkhagvajav, B., Enkhbat, R., Suvdaa, D. and Ankhbayar, C. (2019). Economic growth and optimal taxation: A case of Mongolian economy. *Business, 11*(2), 11-19.

Lütkepohl, H. (2005). *New introduction to multiple time series analysis*. Berlin: Springer-Verlag.

Maddala, G.S. and Lahiri, K. (2009). *Introduction to econometrics* (4th Ed.). Chichester: John Wiley and Son.

Mabugu, R. (2019). *How erratic tax policies are impeding revenue mobilization in Zambia*. Washington D.C: Centre for Global Development Policy Paper 161.

Makau, J., Njuru, S. and Ocharo, K.N. (2018). Fiscal policy and public debt in Kenya. *Journal of Economics and Finance, 9*(5): 12-24.

Maloney, W.F. (2004). Informality revisited. *World Development, 32* (7), 1159-1178.

Masinde, M.M. and Makau, P. (2010). *Unlocking the revenue potential in Kenya.* Parliamentary Service Commission Policy Working Paper No.2/2010.

Maurin, A., Sookram, S. and Watson, P.K. (2006). Measuring the size of the hidden economy in Trinidad and Tobago, 1973-1999. *International Economic Journal, 20*(3, 321-341.

Medina, L., Jonelis, M.A.W. and Cangul, M. (2017). *The informal economy in Sub-Saharan Africa: Size and determinants*. Washington, D.C. International Monetary Fund.

Mehrara, M., Rezaei, A. A. and Rahat, S. (2013). Government size and economic growth in EU-31. *International Journal of Research in Social Sciences, 3*(1), 373-398.

Menjo, I. K. and Kotut, S.C. (2015). Decomposition of the tax-to-income elasticity of major taxes in Kenya. *Research Journal of Finance and Accounting, 6*(3), 81-87.

Minagawa, J. and Upmann, T. (2018). Optimal taxation under a consumption target. *Social Choice and Welfare, 50*(4): 663-676.

Mnjama, G.S. (2011). *Exchange rate pass-through to domestic prices in Kenya.* Unpublished Masters degree thesis, Rhodes University, South Africa.

Moyi, E. and Ronge, E. (2006). *Taxation and tax modernization in Kenya: A diagnosis of performance and options for further reform*. Nairobi: Institute of Economic Affairs.

Mpapale, C. (2014). *Broadening the tax base in Kenya. The case of informal sector.* Nairobi: The East Africa Tax and Governance Network**.**

Muriithi M.K. and Moyi, E.D. (2003). *Tax reforms and revenue mobilization in Kenya*. Research Paper No. 131. Nairobi: African Economic Research Consortium (AERC).

Murray, M.P. (1994). A drunk and her dog: An illustration of cointegration and error correction. *The American Statistician, 48* (1): 37-39.

Murunga, J. (2014). *An empirical investigation of factors influencing tax effort in Kenya*. Unpublished Masters degree thesis, University of Nairobi, Kenya.

Murunga, J., Muriithi, M. and Kiiru, J. (2016). Tax effort and determinants of tax ratios in Kenya. *European Journal of Economics, Politics and Law, 3*(2): 24-36.

Musgrave, P.B. (1969). *United States taxation of foreign investment income: Issues and arguments*. New York: Prager Publishers.

Musgrave, R.A. and Musgrave, P.B. (1989). *Public finance in theory and practice*. New York: McGraw-Hill Book Company.

Muchiri, B.K. (2014). *An analysis of the effect of the growth of the informal sector on tax revenue performance in Kenya*. Unpublished MA project, University of Nairobi, Kenya.

Mutua, J.N. (2012). *A citizen's handbook on taxation in Kenya*. Nairobi: Institute of Economic Affairs.

Nachtscheim, C.J. and Neter, J. (2004). *Applied linear regression models* (4th Ed.). Boston: McGraw-Hill Irwin.

Nchor, D. and Adamec, V. (2015). Unofficial economy estimation by the MIMIC model: The case of Kenya, Namibia, Ghana and Nigeria. A*cta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis, 63* (6): 2043-2049.

Ndaka, A.K. (2017). Informal sector and taxation in Kenya: Causes and effects. *International Journal of Law, Humanities and Social Science, 1*(4): 77-86.

Ndiaye, A.S. (2017). *Does the implementation of tax-related reforms and institutions-related reforms offer scope for sustained tax revenue mobilization in Senegal?* A paper presented at the African Economic Conference on Governance for Structural Transformation, Addis Ababa, Ethiopia.

Newman, C., Page, J., Rand, J., Shimeles, A., Söderbom, M. and Tarp, F. (Eds.). (2016). *Manufacturing transformation: Comparative studies of industrial development in Africa and emerging Asia*. Helsinki: United Nations University.

Ngui, D.M., Muniu.J. M. and Wawire, N.H.W. (2014). *Determinants of informal sector performance in the rural areas of Kenya: Evidence from Makueni County*. International Conference on Dynamics of Rural Transformation in Emerging Economies 27-28 March, 2014.

Njoroge, L.W. (2018). *An assessment of the implementation of transfer pricing and its role on revenue leakage in Kenya*. Unpublished PhD thesis, United States International University, Kenya.

Njoroge, J.W. (1993). *Revenue productivity of tax reforms in Kenya: 1972/73-1991/92*. Unpublished M.A. Research paper: University of Nairobi.

Nwanna, I.O. and Nkiruka, U.G. (2019). Deficit financing and economic growth: The Nigerian experience. *International Journal of Economics and Financial Management, 4*(1), 28-49.

Oguso, A., Mwega, F.M, Wawire, N.H.W. and Samanta, P. (2018). Analysis of budget imbalance.

Okech, T.C. and Mburu, P.G. (2011). Analysis of responsiveness of tax revenue to changes in national income in Kenya between 1986 and 2009. *International Journal of Business and Social Science, 2*(21), 275-287.

Ole, A.M. (1975). *Income elasticity of tax structure in Kenya: 1962/63-1972/73*. Unpublished. M.A. Research Paper, University of Nairobi.

Omondi, V.O., Wawire, N.H., Manyasa, E.O. and Thuku, K.G (2014). Effects of tax reforms on buoyancy and elasticity of the tax system in Kenya. *International Journal of Economics and Finance, 6*(10), 97-111.

Ordonez, J.C.L. (2014). Tax collection, the informal sector, and productivity. *Review of Economic Dynamics, 17*(2), 262-286.

Organization for Economic Co-operation and Development (2018). *Global revenue statistics database*. Paris: OECD.

Osoro, N.E. (1993). *Revenue productivity implications of tax reform in Tanzania.* Research Paper No. 20, African Economic Research Consortium (AERC), Nairobi.

Ouma S., Njeru, J., Kamau, A., Khainga, D. and Kiriga, B. (2007). *Estimating the size of the underground economy in Kenya*. Discussion Paper No. 82. Nairobi: Kenya Institute for Public Policy Research and Analysis.

Ouma, D. (2019). Revenue effects of tax reforms, economic growth and political environment in Kenya. *African Journal of Economic Review, 7*(1): 136-153.

Pesaran, M.H; Shin, Y. and Smith, R.J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics, 16,* 289-326.

Pesaran, M. H. and Pesaran, B. (1997). *Interactive econometric analysis.* Oxford University Press.

Peters, A. (2017). *Estimating the size of the informal economy in Caribbean States*. Washington D.C: Inter-American Development Bank.

Perron, P. (1997). Further evidence on breaking trend functions in macroeconomic variables. , P. (1997). Further evidence on breaking trend functions in macroeconomic variables. Journal of Journal of econometrics, , 8080(2), 355(2), 355--385.

Prest, A.R. and Barr, N. (1985). *Public finance in theory and practice*. London: Weidenfeld and Nicolson.

PWC (2014). *Paying taxes. The global picture. A comparison of tax systems in 189 economies worldwide*. London: PWC.

Rachev, S.T., Mittnik, S., Fabozzi, F. J., Focardi, S. M. and Jašić, T. (2007). *Financial econometrics: From basics to advanced modelling techniques*. New Jersey: John Wiley and Sons Inc.

Republic of Kenya (1997). *Economic Survey*. Nairobi: Government Printer.

Republic of Kenya (2003). *Economic Recovery Strategy for Wealth and Employment Creation 2003-2007*. Nairobi: Government Printer.

Republic of Kenya (2004). *Economic Survey*. Nairobi: Government Printer.

Republic of Kenya (2008). *Kenya Vision 2030.* Nairobi: Government Printer.

Republic of Kenya (2010). *Constitution of Kenya*. Nairobi: Government Printer.

Republic of Kenya (2012). *Economic Survey*. Nairobi: Government Printer.

Republic of Kenya (2013). *Economic Survey*. Nairobi: Government Printer.

Republic of Kenya (2017). Economic Survey. Nairobi: Government Printer.

Republic of Kenya (2018). Economic Survey. Nairobi: Government Printer.

Republic of Kenya (2019). *Communication Authority of Kenya First Quarter Sector Statistics Report for the Financial Year 2018/2019*. Nairobi: Government Printer.

Republic of Kenya (2019). *Economic Survey*. Nairobi: Government Printer.

Republic of Kenya (2020). *Finance Bill 2020*. Nairobi: Government Printer.

Republic of Kenya (2020). *Public Debt Management Report 2019/2020.* Nairobi: Government Printer.

Romer, D. (2012). *Advanced Macroeconomics* (4th, Ed.). New York: McGraw-Hill.

Saibu, O.M. (2015). Optimal tax rate and economic growth. Evidence from Nigeria and South Africa. *Euroeconomica, 1*(34):41-50.

Sahota, G.S. (1961). *Indian tax structure and economic development*. Mumbai: Asia Publishing House.

Sanjit, D. and Ahal-Nowaihi (2006). *Why do people pay taxes? Prospect theory versus expected utility theory*. University of Leicester, UK. Working Paper No.05/23 August.

Schneider, F. and D.H. Enste (2002). *The shadow economy. An international survey*. Cambridge: Cambridge University Press.

Schneider, F., Buehn, A. and Montenegro, C.E. (2010). New estimates for the shadow economies all over the world. *International Economic Journal, 24*(4), 443-461.

Schoeman, N. J. and Heerden, V.Y. (2009). Finding the optimum level of taxes in South Africa: A balanced budget approach. *South African Journal of Industrial Engineering, 20*(2), 15-31.

Scully, G.W. (2000). The growth-maximizing tax rate. *Pacific Economic Review, 5*(1), 93-96.

Sebora, T.C. and Cornwall, J.R. (1995). Expected utility theory vs prospect theory: Implications for strategic decision makers. *Journal of Managerial Issues, 22*, 41-61.

Simiyu, D. (2010). *Challenges affecting collections of turnover tax in Nairobi County*. Unpublished Masters degree thesis, Kenyatta University, Kenya.

Sims, C.A. (1980). Macroeconomics and reality. *Econometrica, 18*(1), 1-48.

Singer, N.M. (1968). The use of dummy variable in establishing the income elasticity of state income tax revenue. *National Tax Journal, 21*, 200-204.

Stock, J. and Watson, M. (1988). Testing for common trends. *Journal of American Statistical Association, 83*, 1097-1107.

Studenmund, A.H. and Johnson, B.K. (2017). *A practical guide to using econometrics*. Pearson Education Limited.

Tanzi, V. (1983). The underground economy in the United States: Annual estimates, 1930-80. *Staff Papers, 30*(2): 283-305.

Teera, J.M. (2002). *Determinants of tax revenue share in Uganda*. Unpublished Research Paper, University of Bath.

Thomas, M.A.H. and Trevino, M.J.P. (2013). *Resource dependence and fiscal effort in Sub-Saharan Africa (No. 13-188)*. Washington DC: International Monetary Fund.

Transparency International (2019). *The Corruption Perception Index*. Berlin: TI.

Uddin, G.A., Alam, K. and Gow, J. (2016). Population age structure and savings rate impacts on economic growth: Evidence from Australia. *Economic Analysis and Policy, 52*, 23-33.

Ulbrich, H.H. (2013). *Public finance in theory and practice* (2nd, Ed.). London: Routledge.

UNCTAD (2019). *Mapping the impact of illicit trade on the Sustainable Development Goals report*. Geneva: UN.

UNCTAD (2019). *Current challenges to developing country debt sustainability*. Geneva: United Nations Publication.

United Nations (2015). *The Sustainable Development Goals (SDGs)*. Geneva. UN.

Verbeek, M. (2008). A guide to modern econometrics. New Jersey: John Wiley and Sons.

Vuletin, G.J. (2008). *Measuring the informal economy in Latin America and the Caribbean*. Washington D.C: International Monetary Fund.

Wawire, N.H.W. (1991). *An empirical assessment of tax performance in Kenya*. Unpublished MA project, Kenyatta University, Kenya.

Wawire, N.H.W. (2003). Trends in Kenya's tax ratios and tax effort indices and their implications for future tax refoms. *Egerton Journal of Humanities, Social Sciences and Education, 4*(3), 25-279.

Wawire, N.H.W. (2006). *The determinants of tax revenue in Kenya*. Unpublished PhD thesis, Kenyatta University, Kenya.

Wawire, N. (2017). Determinants of value added tax revenue in Kenya. *Journal of Economics Library, 4*(3): 322-344.

Wawire, N.H.W. (2020). *Constraints to enhanced revenue mobilization and spending quality in Kenya*. Washington D.C: Centre for Global Development policy paper 163.

World Bank (2017). *Value added tax - Improving tax policy for strengthening domestic revenue mobilization*. Washington, DC: World Bank.

World Bank (2018). *Incidence analysis for Kenya using the Kenya Integrated Household Budget Survey 2015/16*. Washington, DC: World Bank.

World Bank (2020). *Kenya economic update: Turbulent times for growth in Kenya. Policy options during the COVID-19 pandemic.* Geneva: World Bank.

Wooldridge, J.M. (2016). Introductory econometrics: A modern approach. Toronto: Nelson Education.

Yaffee, R.A. and McGee, M. (2000). *An introduction to time series analysis and forecasting with applications of SAS and SPSS*. Amsterdam: Elsevier.

Zangeneh, H. (2007). *An estimate of Iran's underground economy: A monetary approach.* Chester: Widener University.

Zivot, E. and Andrews, W.K. (1992). Further evidence on the great crash, the oil price shock and the unit root hypothesis. *Journal of Business and Economics Statistics 10*, 251-270.

APPENDIX

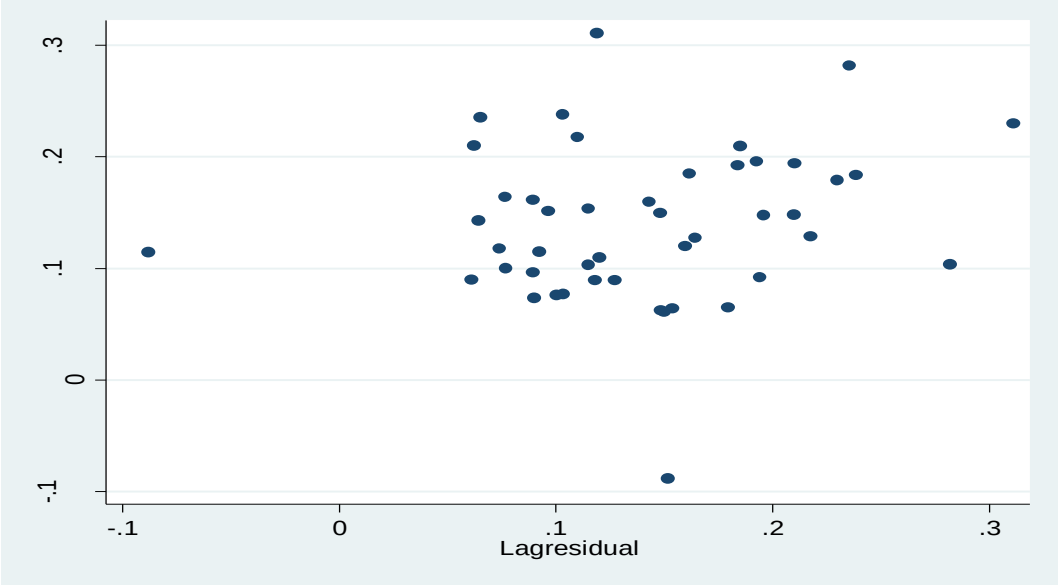


Figure A.1: Currency Demand function with Tax
Source: Author's computations based on data from KNBS

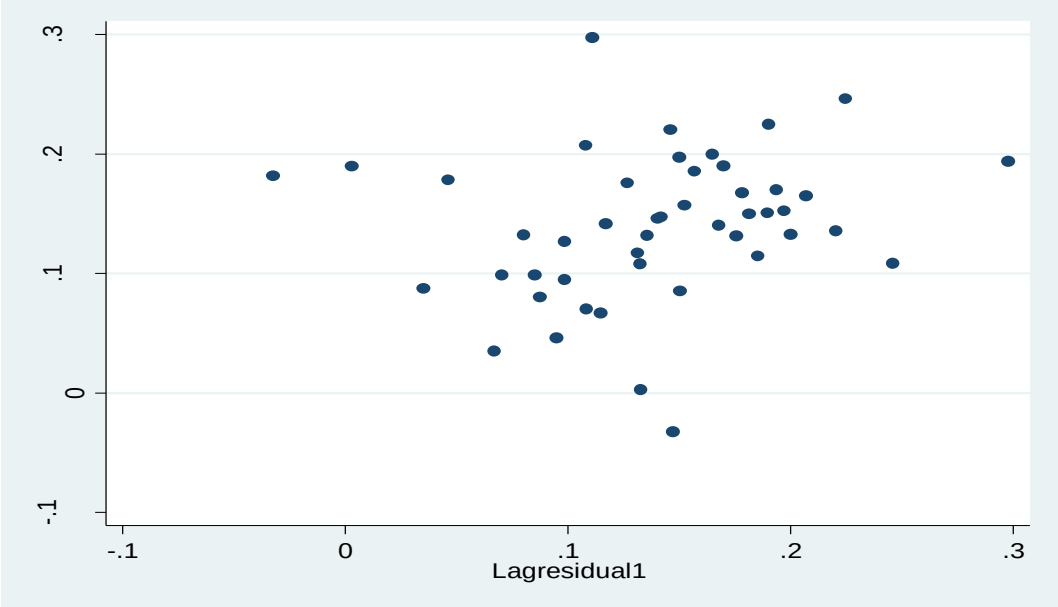


Figure A.2: Currency Demand function with least tax
Source: Author's computations based on data from KNBS

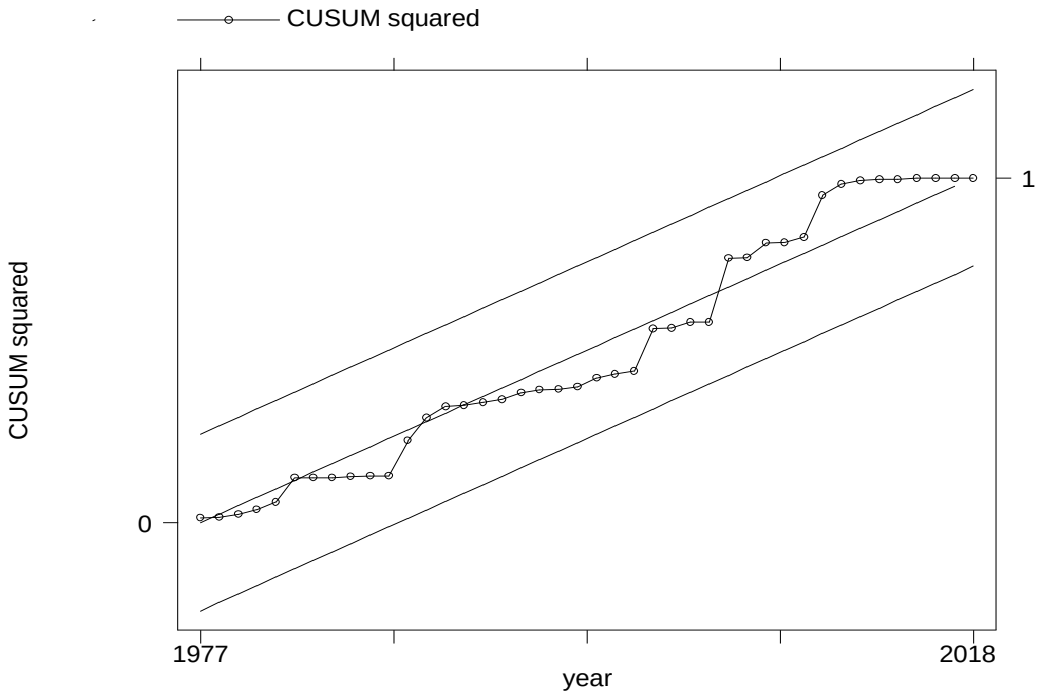


Figure A.3: CUSUM of squares parameter stability for currency model with tax

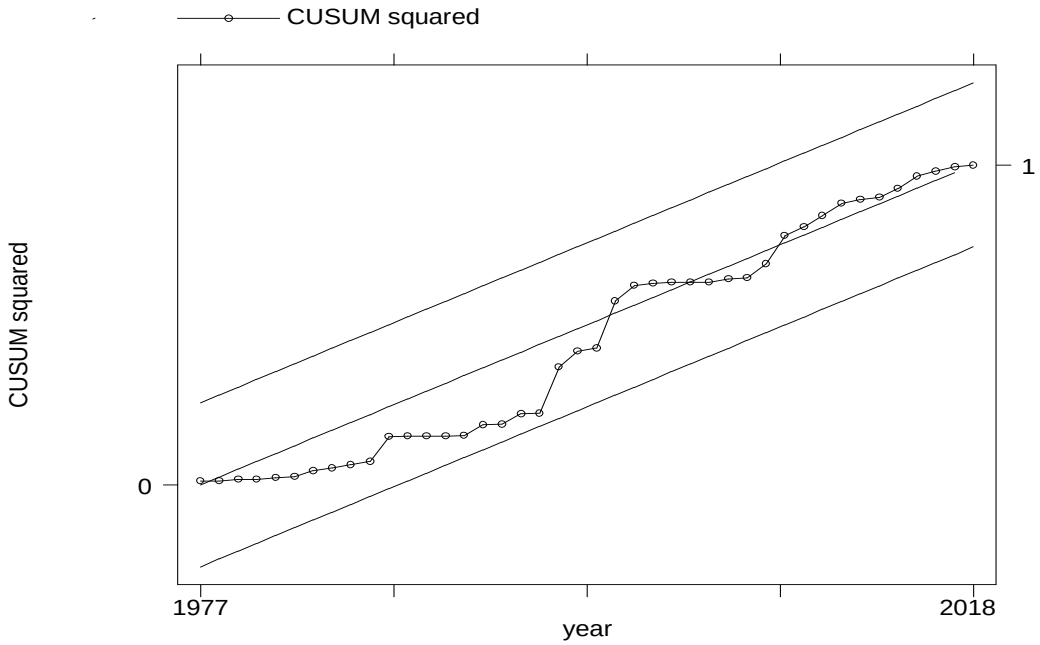


Figure A.4: CUSUM of squares parameter stability for currency model with least tax

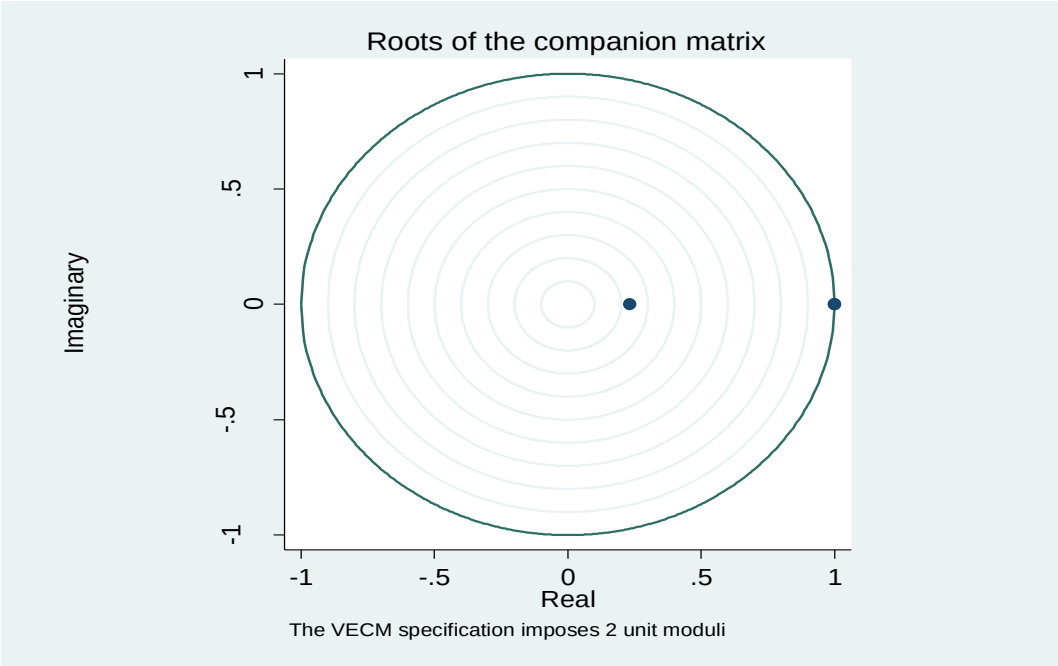


Figure A.5: Model Stability for the Buoyancy Model

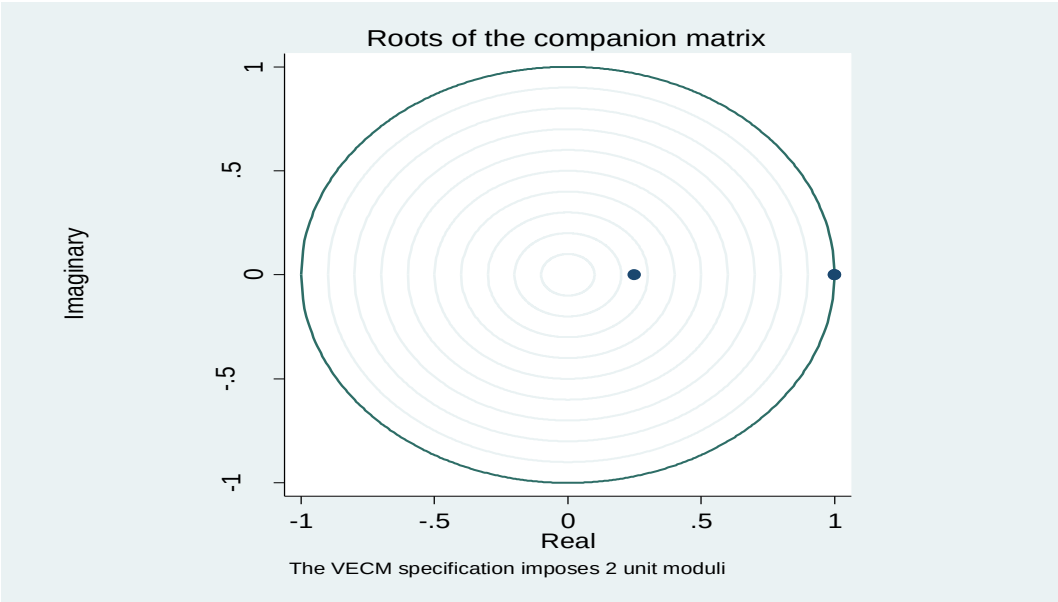


Figure A.6: Model Stability for the Elasticity Model

Table A.1: The Augmented Dickey Fuller and Phillips-Perron Unit Root Tests

Augmented Dickey Fuller					Phillips-Perron		
		Statistic	Critical value (5%)	Order of Integration	Statistic	Critical value (5%)	Order of Integration
Natural log of currency outside banks	Level 1st D	-0.988 (-6.562)	-2.936 (-2.938)	One	-0.988 (-6.562)	-2.936 (-2.938)	One
Natural log of per capita GDP	Level 1st D	-0.611 (-9.058)	-2.936 (-2.938)	One	-0.611 (-9.058)	-2.936 (-2.938)	One
Inflation rate	Level 1st D	-3.976	-2.936	Zero	-3.976	-2.936	Zero
Deposit interest rate	Level 1st D	-3.039	-2.936	Zero	-3.039	-2.936	Zero
Natural log of tax ratio	Level 1st D	-2.291 (-9.020)	-2.936 -2.938)	One	-2.291 (-9.020)	-2.936 (-2.938)	One
Financial innovation	Level 1st D	-2.168 (-7.787)	-2.936 (-2.938)	One	-2.168 (-7.787)	-2.936 (-2.938)	One

Table A.2: Zivot Andrews Unit Root Test

Trend and intercept						
Variables	Year of structural break	Level		First difference (Second difference)		Order of integration
		t-statistics	5% critical value	t-statistics	5% critical value	
Natural log of currency outside banks	2006	-3.517	-4.42	-6.548	-4.42	One
Natural log of per capita GDP	1977	-3.496	-4.42	-9.570	-4.42	One
Inflation rate	1993	-4.357	-4.42	-	-	Zero
Deposit interest rate	1994	-4.178	-4.42	-9.434	-4.42	One
Natural log of tax ratio	1995	-4.498	-4.42	-	-	Zero
Financial innovation	1997	-3.565	-4.42	-7.822	-4.42	One

Table A.3: The Augmented Dickey Fuller and Phillips-Perron Unit Root Tests

Augmented Dickey Fuller					Phillips-Perron		
		Statistic	Critical value (5%)	Order of Integration	Statistic	Critical value (5%)	Order of Integration
Natural log of tax revenue	Level 1st D	-1.056 (-10.665)	-2.936 (-2.938)	One	-0.970 (-13.05)	-2.936 (-2.938)	One
Natural log of the size of informal sector GDP	Level 1st D	-1.556 (-9.413)	-2.936 (-2.938)	One	-1.269 (-10.50)	-2.936 (-2.938)	One
Natural log of manufacturing share in GDP	Level 1st D	-2.184 (-7.213)	-2.936 (-2.938)	One	-2.421 (-7.206)	-2.938 (-2.938)	One
Agriculture share in GDP	Level	-3.329	-2.936	Zero	-3.368	-2.938	One
Natural log of foreign aid share in GDP	Level 1st D	-1.589 (-7.961)	-2.936 (-2.938)	One	-1.667 (-7.885)	-2.936 (-2.938)	One

Table A.4: Zivot Andrews Unit Root Test

Trend and intercept						
Variables	Year of structural break	Level		First difference (Second difference)		Order of integration
		t-statistics	5% critical value	t-statistics	5% critical value	
Natural log of tax revenue	1997	-6.206	-4.80	-	-	Zero
Natural log of informal sector GDP	1999	-5.406	-4.80	-	-	Zero
Natural log of share of manufacturing in GDP	1996	-3.573	-4.80	-7.698	-4.80	Zero
Agriculture share in GDP	1996	-3.902	-4.80	-7.596	-4.80	Zero
Natural log of share of foreign aid in GDP	1996	-2.882	-4.80	-8.862	-4.80	one

Table A.5: Lag Selection for Buoyancy Model

lag	LL	LR	df	P	FPE	AIC	HQIC	SBIC
0	-139.97				.007063	6.39866	6.45852	6.55925
1	1.26213	282.46	16	0.000	.000027	.832794	1.13213*	1.63576*
2	21.591	40.658	16	0.001	.000023	.640402	1.17921	2.08573
3	38.9911	34.8*	16	0.004	.000022*	.578173*	1.35645	2.66587
4	43.2768	8.5714	16	0.930	.000041	1.09881	2.11655	3.82888

Table A.6: Lag Selection for Elasticity Model

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-174.108				.032207	7.91589	7.97576	8.07649
1	-31.9984	284.22	16	0.000	.000119	2.31104	2.61038*	3.114*
2	-15.1344	33.728	16	0.006	.000117	2.27264	2.81145	3.71797
3	2.52245	35.314*	16	0.004	.000113*	2.199*	2.97728	4.2867
4	9.06112	13.077	16	0.667	.000189	2.61951	3.63725	5.34957

Table A.7: Selection-order criteria

Sample: 1974 – 2018				Number of observation = 45				
Lag	LL	LR	df	P	FPE	AIC	HQIC	SBIC
0	50.13				0.0079	-2.006	-1.93	-1.81
1	58.56	16.85*	1	0.000	0.0057*	-2.33*	-2.25*	-2.09*
2	58.84	0.57	1	0.45	0.0059	-2.30	-2.19	-2.02
3	58.90	0.11	1	0.74	0.0061	-2.26	-2.14	-1.94
4	59.01	0.24	1	0.62	0.0064	-2.22	-2.09	-1.86

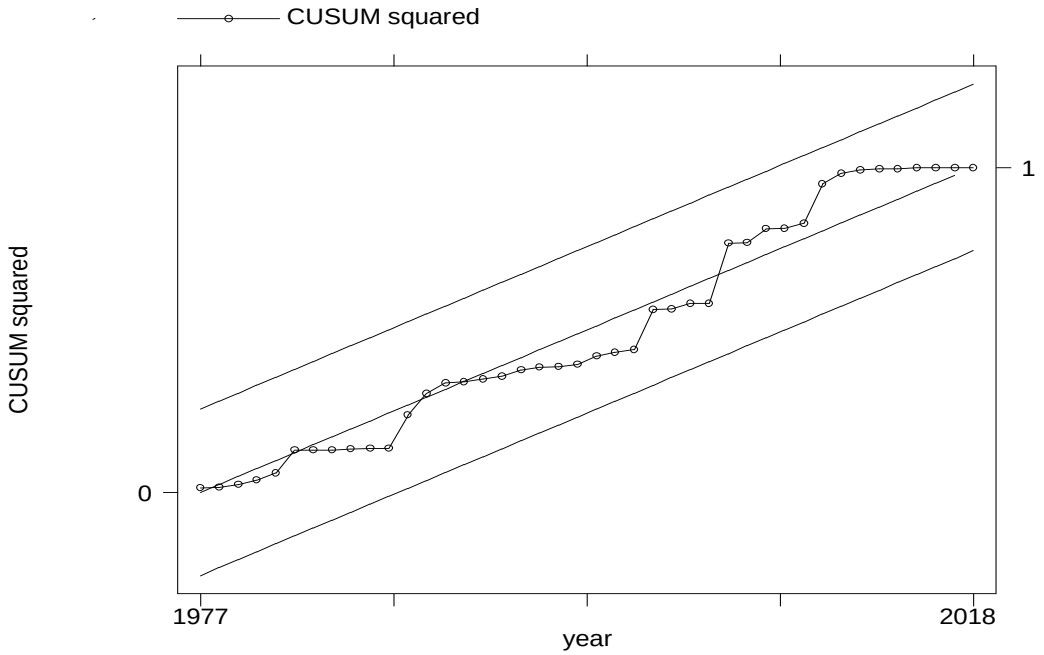


Figure A.6: Model Stability for the Currency Model With Tax
Source: Author's computations based on data from KNBS

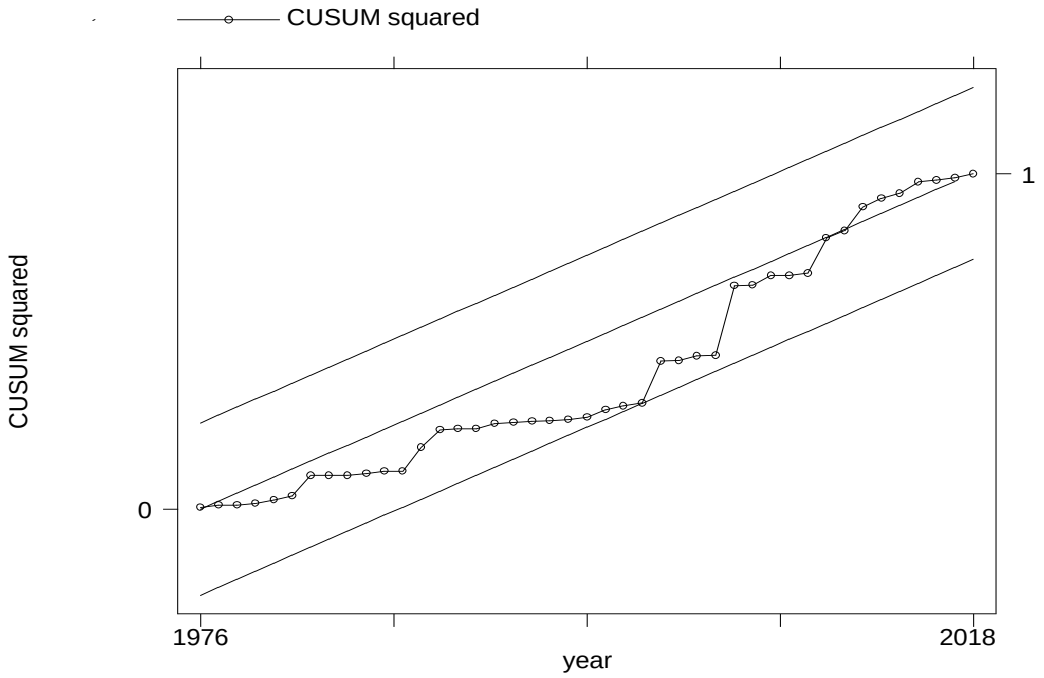


Figure A.7: Model Stability for the Currency Model Without Tax
Source: Author's computations based on data from KNBS