

**PUBLIC DEBT, TAX REVENUE AND GOVERNMENT EXPENDITURE IN
KENYA: 1960-2012**

KIMINYEI FELIX KIMTAI

**A RESEARCH PROJECT SUBMITTED TO THE SCHOOL OF ECONOMICS IN
PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF
MASTER OF ARTS (ECONOMICS) DEGREE OF THE UNIVERSITY OF
NAIROBI.**

OCTOBER 2014

DECLARATION

This research project is my original work and has not been presented for a degree award in any other University or Institution

Signature.....

Date.....

Name : Kiminyei Felix Kimtai

Reg No : X50/63752/2011

This research project has been submitted for examination with our approval as University supervisors

Signature.....

Date.....

Name : Prof. Nelson Wawire

Signature.....

Date.....

Name : Dr. John Gathiaka

DEDICATION

My parents and the entire family of Mr. Charles Kiminyei for their unending dedication and commitment in fighting the ravages associated with illiteracy.

ACKNOWLEDGEMENTS

Thanks to The Almighty God for the gift of Life and Good Health. The author would like to recognize sincere appreciation stemming from several players that in any manner made this research project possible, even with underlying challenges in mentioning all in person. Specifically, sincere appreciation goes to; supervisors, Prof. Nelson Wawire and Dr. John Gathiaka, to whom a lot is still owed for their time devoted going through a number of drafts while at the same time providing significant guidelines that equally played a huge role in shaping the understanding of main tenets guiding the writing of a research project ; entire staff at Kenya Bankers Association for being hospitable- specifically Mr. Jared Osoro, The Director Research and Policy at the Kenya Bankers Association (KBA) Centre for Research on Financial Markets and Policy (CRFMP) for extending and offering an internship opportunity upon which continued learning was inevitable ; colleagues, a good lot whom have been out of contact since completion of coursework yet their insight in developing interest into this topic would not be neglected as such ; institutions including the Kenya national bureau of statistics (KNBS) library, the national treasury library and the University of Nairobi (UON) school of economics graduate library for their resourceful assistance; and all other persons that directly or indirectly made this research project successful.

TABLE OF CONTENTS

DECLARATION.....	ii
DEDICATION	iii
ACKNOWLEDGEMENTS	iv
TABLE OF CONTENTS	v
LIST OF TABLES	viii
LIST OF FIGURES.....	ix
ABBREVIATIONS AND ACRONYMS	x
OPERATIONAL DEFINITION OF TERMS.....	xi
ABSTRACT	xiii
CHAPTER ONE: INTRODUCTION	1
1.1 Background.....	1
1.1.1 Public Debt, Tax Revenue and Government Expenditure	4
1.1.2 Trends in Public Debt, Tax Revenue and Government Expenditure.....	8
1.2 Statement of the Problem.....	11
1.3 Research Questions.....	12
1.4 Objectives	13
1.5 Significance of the Study.....	13
1.6 Scope and Organization of the Study	14
CHAPTER TWO: LITERATURE REVIEW	15
2.1 Introduction.....	15
2.2 Theoretical Literature.....	15
2.2.1 Classical Theory of Public Debt	15
2.2.2 Keynesian Debt Theory	18
2.2.3 Lerner’s Theory of Functional Finance	21
2.2.4 Tax Smoothing.....	23
2.2.5 Ricardian Equivalence	25

2.3	Empirical Literature	30
2.4	Overview of the Literature.....	41
CHAPTER THREE: METHODOLOGY		43
3.1	Introduction.....	43
3.2	Theoretical Framework.....	43
3.3	Model Specification.....	46
3.4	Definition and Measurement of Variables.....	49
3.5	Data Type, Source and Refinement	49
3.6	Stationarity Analysis.....	50
3.7	Cointegration Analysis	51
3.8	Distribution and other Diagnostic Tests	54
3.9	Data Analysis.....	55
3.9.1	Correlation Analysis	55
3.9.2	Vector Error Correction Model.....	57
3.9.3	Granger Causality	58
3.9.4	Impulse Response Functions	59
3.9.5	Forecasting.....	60
CHAPTER FOUR: EMPIRICAL FINDINGS.....		61
4.1	Introduction.....	61
4.2	Descriptive Statistics.....	61
4.3	Findings for Stationarity Analysis	63
4.4	Findings for Cointegration Analysis.....	64
4.5	Distribution and other Diagnostic Test Results	65
4.6	Regression results	66
4.6.1	The relationship between public debt and government expenditure	74
4.6.2	The relationship between public debt and tax revenue.....	75

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS	77
5.1 Introduction.....	77
5.2 Summary	77
5.3 Conclusions.....	78
5.4 Contribution to Knowledge	80
5.5 Policy Implications	80
5.6 Limitations and Areas for Further Research.....	81
REFERENCES	83
APPENDICES.....	94

LIST OF TABLES

Table 4.1: Results for Vector Error Correction Model (VECM)	67
Table 4.2: Results for VECM Short run model.....	68
Table 4.3: Results for Forecast Error Variance Decomposition (FEVD)	72
Table A1: Descriptive Statistics: Public debt, tax revenue and government expenditure ...	94
Table A2: ADF and PP Unit Root Test Results: Public debt, tax revenue and government expenditure	94
Table A3: Johansen Cointegration Test Results.....	95
Table A4: Eigenvalue stability condition.....	95
Table A5: Results for Granger causality tests: Public debt, tax revenue and government expenditure	96
Table A6: Results for correlation analysis: Public debt, tax revenue and government expenditure	96
Table A7: Data for Public debt, tax revenue and government expenditure, 1960-2011....	103

LIST OF FIGURES

Figure 1.1: Budget deficit, Public debt, Tax revenue and Government expenditure (Percent of GDP)	10
Figure A1: Trends in Public debt, tax revenue and government expenditure, 1960-2011...	97
Figure A2: Residual plots for cointegration equations.....	97
Figure A3: Graph for response of public debt to innovations in tax revenue	98
Figure A4: Graph for response of tax revenue to innovations in public debt	98
Figure A5: Graph for response of public debt to innovations in government expenditure..	99
Figure A6: Graph for response of government expenditure to innovations in public debt..	99
Figure A7: Graph for response of public debt to innovations in public debt	100
Figure A8: Ex ante forecasts, public debt tax revenue and government expenditure components, 2001-2011	101
Figure A9: Out-of sample dynamic forecasts, 2011-2030	102

ABBREVIATIONS AND ACRONYMS

AD	Aggregate Demand
AIC	Akaike Information Criterion
CBK	Central Bank of Kenya
CPI	Consumer Price Index
DSR	Debt Service Ratio
GDP	Gross Domestic Product
GE	Government Expenditure
GR	Tax Revenue
HIPC	Highly Indebted Poor Countries
KES	Kenyan Shilling
KNBS	Kenya National Bureau of Statistics
MEI	Marginal Efficiency of Investment
MPC	Marginal Propensity to Consume
PD	Public Debt
PVBC	Present Value Borrowing Constraint
REPO	Repurchase Order
SSA	Sub-Saharan Africa
VAR	Vector Autoregression
VECM	Vector Error Correction Model

OPERATIONAL DEFINITION OF TERMS

Budget deficit is higher government expenditure over tax revenue.

Confidence interval is a measure of reliability of the estimate that a population parameter falls between two set values.

Consumer price index is a measure of the effect of inflation on purchasing power of a basket of goods consumed by the consumer.

Correlation is a measure of statistical degree and type of relationship between any two or more time series over a period of time.

Economy is the entire network of producers, distributors and consumers of goods and services in a national community.

Government expenditure is money that a government spends.

Government is a group that exercises sovereign authority over a nation.

Government revenue is income a government receives.

Model is an abstraction from reality based on theory and having a set of logical and quantitative relationships.

Policy is a plan of action.

Public debt is total borrowing by the government to finance its expenditure.

Seignorage is government revenue due to printing money.

Splicing is joining short series of data to obtain longer series.

Tax is compulsory transfer of money from private individuals, institutions or groups to the central government for public purposes.

Tax revenue is government income due to taxation.

ABSTRACT

In lieu of rising budget deficits in many countries across the world, driven by tax revenue insufficiency in financing government expenditure, many governments have continued to accumulate public debt due to the financing of budget deficits. In the long run, however, persistent budget deficits as well as debt accumulation are unsustainable and pose several problems to the economy including inflationary spirals, depressed growth, higher associated poverty levels and consequently fiscal crisis. To offer any policy prognosis towards controlling and consequently reducing budget deficit as well as public debt and associated problems requires an understanding of the relationship between public debt, tax revenue and government expenditure. This study utilized the present value borrowing constraint (PVBC) to study the relationship between public debt, tax revenue and government expenditure in Kenya, for 1960-2011. Annual time series data for total public debt, tax revenue and government expenditure were converted into their respective real values by dividing their respective nominal values by the Consumer Price Index (CPI). Data was collected from Kenya economic surveys from 1960-2013. Because data was available in fiscal years, it was converted to calendar years by splicing. Augmented Dickey Fuller and Philips Perron unit root tests were employed to establish the stationary properties of the series while the Johansen and Juselius co-integration techniques were used to determine presence of linear long run economic relationships in the series. Because cointegrating relationships invalidated ordinary estimation techniques, to achieve these relationships, which formed the objectives of the study, data was analysed using vector error correction model (VECM) with correlation analysis. The study found that public debt responds to both tax revenue and government expenditure particularly in the long run. There was strong positive correlation between public debt tax revenue and government expenditure and all correlation coefficients were statistically significant.

CHAPTER ONE

INTRODUCTION

1.1 Background

Budget deficits have been rising recently and have been associated with rising government expenditures relative to revenue capacity. For example, expenditures on salaries, wages, and even interest on debt have been growing rapidly and can be traced back to the first and second World Wars when the share of spending in GDP rose to over 45 and 60 percent in that order in Britain and across Nations (Hjerpe et al., 2007).

Running budget deficits, however, has received defense from a political economy perspective – that budget deficits are used to control repercussions that may result from sharp changes in the rates of taxes. In this sense, Battaglini and Coate (2008) argue that governments act much the same as individuals hence their expenditure needs change from time to time. Thus, in time of high expenditure demands governments would run budget deficits. The converse would be true in times of low government expenditure needs, paving way for budget surpluses (excess of tax revenues over government spending).

Along this line of argument, there has been increasing proponents for balanced budgets calling for modest deficits during times the economy is doing badly and surpluses when the economy is in a boom. The underlying argument is that fiscal policy ought to be brought to the channel that is largely seen to be sustainable in both the short and long run.

In its real sense, sustainability would mean deficits remain low and even though they grow with time, the rate of growth is below the rate of GDP growth. In this perspective, the economy can sustain the budget deficits.

Towards financing these government budget deficits, fiscal authorities have always resorted to and relied on borrowing from the private sector (domestic and foreign) using various instruments at their disposal. Other forms of budget deficit finance, in any case, exist, for example seignorage where government turns on the printing press. But it seems fiscal authorities have either exercised caution in dealing with this mode of deficit finance or have attempted totally to keep away from it. This particularly has to do with the complexities¹ associated with the printing of money.

In the context of these complexities, the desirability and reliability of borrowing in budget deficit finance is evident. This though does not mean public debt is extremely safe. Persistent accumulation of public debt beyond levels deemed sustainable is known to cause difficulty in adjustment of fiscal variables especially through their effects on Gross Domestic Product (GDP) via private investment (Cottarelli and Schaechter, 2010). Second, public debt can involve transfer of resources from the private sector into

¹ Berneim (1989) and also Mankiw (1989) on the theory of optimal seignorage discussed in detail how the arising inflation, an outcome of printing money would interact with a tax system consequently creating significant distortions, randomness and uncertainty in the economic environment. Moreover, inflation (a tax on money) and high payment frequencies coupled also with administration costs of this tax would increase transaction costs and exacerbate social (welfare) losses.

unproductive uses that would affect the rate of capital formation (Araujo and Martins, 1999; Carneiro, Faria, and Barry, 2005).

Along with rising budget deficits, revenues have grown slowly² (or have been falling), a pattern in stark contrast to that in expenditure. This is despite the fact that governments rely on such revenues that are raised mainly through taxation to finance government expenditure programs on defence, infrastructure and social safety net programs of education and health for example, which are seen to have more productivity and efficiency gains in directly linking objectives to outcomes. The argument behind this reliance on taxation has to do with ease of manipulating tax rates to fit desired objectives. The reality, however, is that this imposes tax burdens to society which lead to welfare losses. Nevertheless, reliance on taxation is insufficient in financing government expenditure and is the reason behind budget imbalances (deficit or surplus). Specifically, most governments run budget deficits due to higher government expenditure relative to tax revenues.

Given the roles played by both public debt and tax revenue in financing the fiscal/budget deficit and government expenditures, the relationship between public debt, tax revenue and government expenditure is the main concern of this study for the purpose of drawing policy implications on fiscal deficit and public debt control and/or reduction.

² Slow growth in revenues has been attributed to reliance on few sources of the same like income tax and trade taxes (see Wawire, 2011). In addition, it is also attributed to lack of fiscal discipline and information on the functions of tax revenue.

Understanding this relationship is important in the following ways: First, this relationship links the size of government, level of public deficits and the structure/pattern of taxation and expenditure (Hussain, 2004). In addition, this relationship is passed on to fiscal policy which is significant in the government tax and expenditure structure/patterns and plans and therefore aids in effective fiscal policy design. Second, in analysing the role played by government in the distribution of resources, this relationship *ceteris paribus*, is critical in aiding design and implementation of sound fiscal policy for rapid, sustained social — economic growth and development (Chang, 2009; Obioma and Ozighalu, 2010). Indeed, this relationship is critical in understanding the causes, outcomes and future paths/directions of government budget deficit and hence drawing the optimal strategy/policy framework for both deficit control and deficit reduction (Sadiq, 2011; Al-Zeaud, 2012). In particular, this study examined these relationships over the period 1960-2011.

1.1.1 Public Debt, Tax Revenue and Government Expenditure

Most governments have sustained their reliance on borrowing in financing excess of government expenditure over revenues. Governments perhaps do so to ensure implementation of government expenditure programs that are vital to the overall productivity of the economy. It is worth noting that fiscal deficits arising when government expenditures are in excess of revenues raise a number of issues. They can be used by relevant authorities to affect the direction of the economy. If the rise in the fiscal/budget deficit is due to rising development expenditure for example on critical

infrastructure initiatives like roads, railway, among others, this has the potential of reducing poverty through increasing productivity and reducing unemployment particularly in the long run.

However, a number of analysts particularly economists trace almost every economic illness to budget deficits. Specifically, persistent increases in the budget deficit has the potential of causing high inflation, low investment, low consumption and consequently low economic growth, in the long run. Overall, the effect is raising levels of poverty, therefore with low living standards and consequently leading to loss in societal welfare.

In effect, this is not the end of the cycle. Fiscal deficit finance involves debt contracting. Public debt is distributed both as internal and external debt. While internal debt instruments including Treasury bills and bonds are commonly used by governments in financing various operations including development aspects of the economy like supporting huge infrastructure development initiatives which increase capital stock formation, they nonetheless serve as safe and attractive investments available to the public promising some fixed and attractive rates of return.

Internal debt instruments can also be used to affect the economy in terms of increasing or reducing economic activity depending on the state of health of the economy. However, use of internal debt instruments lead to competition for fixed private savings held by individuals pushing up market rates of interest and therefore in the long run will crowd out private investments and lead to low capital formation. Low capital formation today

means depressed economic growth in future. Use of external debt is neither safer, it carries with it the harm to the current account in the balance of payments. The current account worsens (current account deficit increases) which in turn leads to appreciation in the exchange rate. Exports become expensive with appreciation while imports become cheap leading to falling net exports (Mehmood and Sadiq, 2010).

In general, public debt accumulation raises two major issues as regards fiscal deficit finance – debt overhang and loan repayments. Debt overhang is the disincentives to investments due to the threat from high debt so that a lot of resources are channelled to repaying debt. Investors will become sceptical to undertake any investments in a country which might harm future growth prospects. That is, when investment is discouraged/reduced/negatively affected, the main possible outcome is reduced growth both in the present time and in future since a lower capital stock today and in future would reduce the size of the economy from what it would be, all else equal. On the other hand, debt (the principal amount) must be repaid at some time/point as well as interest on debt. In particular, interest payments will either need increase in tax rates hence raising tax burdens, or increase inflation whenever debt monetization is resorted to.

Thus, increased efforts into repayment of debt lead to misallocation of resources, increases in poverty, as well as reduction in economic growth since a lot of emphasis is placed on debt and interest repayment rather than improving the general state of the economy.

Budget deficits also create various trade-offs between various variables. For example, for the case of growing budget deficits as well as growing public debt, the most likely solution would be to cut government expenditure, raise taxes or both ways in order to achieve sustainability. In the present period, a huge reduction in government expenditure or rise in taxes would be highly desirable to be able to spread these changes with time. All in all, public debt is not the only means to finance the deficit, other ways exist, for example seignorage. But either way used, reducing budget deficits is contractionary in the short run resulting to increasing unemployment and reducing output (Labonte, 2012). So government or relevant authorities need to examine these trade-offs carefully in devising policies aimed at reducing the deficits.

Public debt, tax revenue and government expenditure are therefore closely interrelated and not easily separable. Both public debt and tax revenue are used to finance government expenditure projects say on infrastructure, social sectors, among others broadly classified based on their recurrent or/and development aspects that are vital ingredients in stimulating demand therefore increasing output and reducing unemployment. While both public debt and taxes represent shift of resources from the private into the public sector, one distinctive feature between these components of government finances is that taxes are usually seen as necessary transfers yet public debt are transfers that are voluntary in nature.

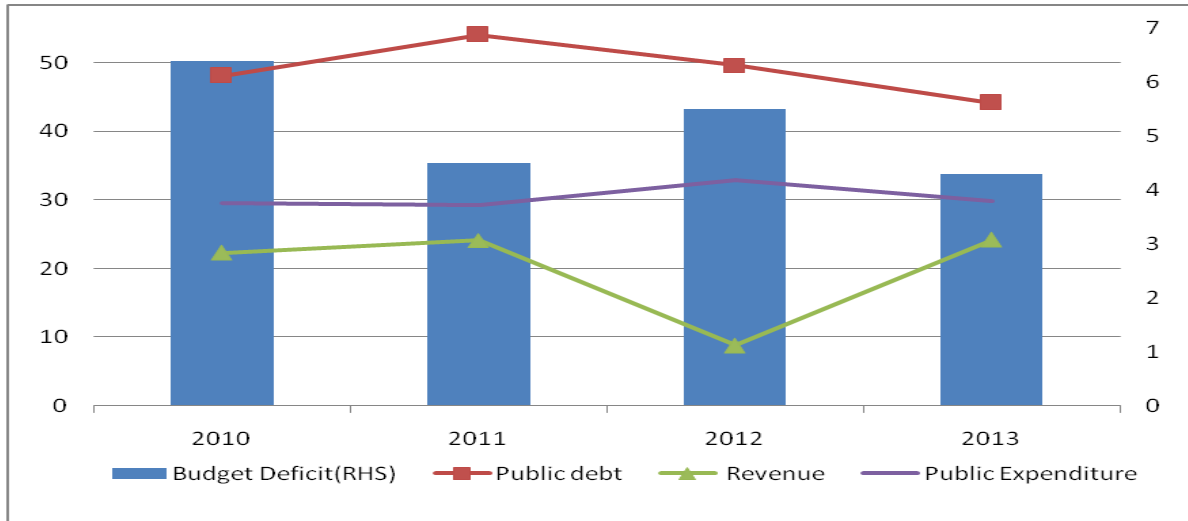
Thus, when public debt and taxes are to be chosen by the public, the public usually chooses public debt financing. The reason is that raising taxes to finance government expenditure is usually socially undesirable hence the reason to resort to public debt. Also, public goods have characteristics of non-exclusion (practically impossible to exclude a person from enjoying them, say public road or public health facility) so that people even opt for reduction in taxes as the free rider problem comes to play. The choice of debt financing has to do with low political cost associated with it. And it is this reason that even politicians run huge budget deficits prior to obtaining elected offices knowing the public has fiscal illusion — overestimating the benefits accruing in the present period and underestimating the costs associated with future tax burdens.

1.1.2 Trends in Public Debt, Tax Revenue and Government Expenditure

In nominal terms, public and publicly guaranteed debt and its components (domestic and external debt) sustained an upward trend between 2011 and 2012 to stand at Kshs. 1.6 trillion. The composition was 52.6 % domestic debt while 47.4 % was external debt. It is good noting that debt was financing a budget deficit of Kshs. 117.8 billion and Kshs. 181.5 billion in 2011 and 2012, respectively. As a percent of GDP, even though public debt declined by 20.4 % with its respective components following cue, the decline in external debt, however, is so pronounced at 10.7 % compared to that of domestic debt at 5.8% and shows government debt restructuring policy towards more long term domestic debt components. Government debt management strategy is also meant to cushion the

risks associated with use of external debt instruments and short term debt instruments. This policy is bearing fruit with Treasury bonds consisting 80.9 % of total domestic government debt securities (Kshs. 687 billion in 2012, an increase of Kshs. 91.2 billion from 2011), while treasury bills inclusive of Repurchase orders (Repos) consisted 19.1 % of total government securities in 2012. In addition the 10 year as well as 30 year Treasury bond rose by 0.8 % in this period. At the same time, interest repayment on domestic debt rose by Kshs. 14 billion while interest accumulated on external debt rose by Kshs. 0.7 billion with external debt principal repayment amounting to 34.7 billion and debt service ratio (DSR) rose from 5.1% to 5.25%.

Government revenue inclusive of grants increased to 734.4 billion in 2012 from 679 billion in 2011. As a percent of GDP, this was an increase of 1.7% and on account of growth in both tax and non-tax revenue sources by Kshs. 74.5 billion (12.7%) and Kshs. 7 billion, respectively. And even with their positive growth, both tax and non-tax revenue remained below their projected levels on account of depressed economic activity and special revenue policies meant to reduce the cost of living for example, reduced excise duty on selected fuels. However, the share of government revenues in total GDP declined from 24.6 % to 22.3 % in the same period.



Source: Republic of Kenya and Central Bank of Kenya (CBK).

Figure 1.1: Budget deficit, Public debt, Tax revenue and Government expenditure (Percent of GDP)

Finally, expenditure as well as net lending rose to Kshs. 915.9 billion in 2012 from Kshs. 817.1 billion in 2011. While recurrent expenditure rose by Kshs. 57.6 billion to settle at Kshs. 639.1 billion, development expenditure rose by Kshs. 41.2 billion to settle at Kshs. 276.8 billion, yet both components remained below their projections of Kshs. 697.5 billion and Kshs. 385.4 billion, respectively. And in recent times there has been increased investments into infrastructure development in line with vision 2030 on creating a suitable environment for business and investment that saw the a share of development expenditure in total expenditure rise by approximately 4.9 % from 28.8 % to 30.2 % with that of recurrent expenditure declining by 1.9 %. The graph shows the current trends in these variables.

1.2 Statement of the Problem

Government fiscal operations saw the budget deficit rise from 4.6 as a percent of GDP in March 2012 to 5.3 as a percent of GDP in the same month of 2013. Huge and persisting budget deficits show genuine underlying economic issues, for example loopholes in the tax system that include tax evasion due to ineffective tax administration. It further indicates that budget deficit finance, more often than not through resort to public debt – may not be channelled into those areas that hold more potential in boosting productivity. Consequently, rising budget deficits to levels that are unsustainable creates the risk of fiscal crisis where the government is unable to raise revenues to finance its expenditures, leading to high growth in debt than in Gross Domestic Product (GDP).

Therefore, to be able to offer any policy prescriptions towards controlling and consequently reducing budget deficit as well as resulting public debt and associated problems, it is necessary to understand the relationship between public debt, tax revenues and government expenditure.

The optimal strategy for debt reduction depends on the optimal policy embraced for budget deficit reduction which in principle entails either expenditure reduction or an increase in tax revenue. How then might public debt respond to the choice of an expenditure cut in reducing the budget deficit, all else equivalent? This is the question this study posed. It sounds reasonable to predict that public debt would reduce. However, in the last half of 2012 and part of 2013, expenditure cuts proved ineffective in developed

nations particularly in the Eurozone (Grauwe and Yuemei, 2013; Aheara, 2012; Grauwe and Yuemei, 2012; Kiguel, 2012) as it led to slow economic growth, low tax revenues, deflation and consequently rising public debt in countries such as Greece, Spain, and Ireland. Upon this background, it is evident that the effects of expenditure cuts (or tax increases) may not be straight forward, and the study sought to empirically contribute to the debate.

Among previous studies that attempted to address the relationship between public debt, tax revenue and government expenditure in Kenya is Ghartey (2012), who studied exclusively the relationship between tax revenue and government expenditure and Kanano (2006) who studied the determinants of growth in government expenditure and not the relationship between public debt, tax revenue and government expenditure per se. This relationship hence remains an essential matter of empirical study, a gap this study sought to fill.

1.3 Research Questions

The research questions this study sought to answer are:

- (i) What is the relationship between public debt and government expenditure?
- (ii) What is the relationship between public debt and tax revenue?
- (iii) What policy implications can be drawn from the study?

1.4 Objectives

The objectives of this study are:

- (i) To examine the relationship between public debt and government expenditure
- (ii) To examine the relationship between public debt and tax revenue
- (iii) Based on the findings, draw policy implications

1.5 Significance of the Study

First, this study brings additional knowledge to the field of government finance in Kenya specifically concerning the relationship between public debt, tax revenue and government expenditure. Given that previous studies are few, for example Gharthey (2012) and Kanano (2006) and with the recent studies devoting rather to explore economic growth and government expenditure, for instance Kipkosgei (2011) and Kibe (2009), it is evident that this study bears great significance in contributing to the literature on Kenya that has a bearing on future research. This is useful to researchers and scholars interested in pursuing further research on the relationship between public debt, tax revenue and government expenditure and/or related issues, as a source of reference. Secondly, to policymakers especially those in government and other public policy institutions if the finding of this study is anything to go by it will shape the reactions in terms of implementing both relevant and appropriate policies in the short and long run geared towards addressing budget deficit and associated debt problems.

Third, this study examined the relationship between public debt, tax revenue and government expenditure over 1960-2011. To the best of the author's knowledge, there was no single study in this perspective done in Kenya. A related study was that of Kanano (2006) and Ghartey (2012). However, Kanano studied the determinants of government expenditure growth over 1980-2004 while Ghartey examined the relationship between tax revenue and government expenditure for Kenya, Ethiopia and Nigeria, and not the relationship between public debt, tax revenue and government expenditure per se.

1.6 Scope and Organization of the Study

This study period is 1960 – 2012. This period is important because a number of events occurred that had a direct or indirect effect on public debt, tax revenue or government expenditure. The government implemented expansionary fiscal policies particularly between 1974 and 1985. These policies, however, had their own problems as budget deficits rose rapidly even a decade later. Public debt problems could thus be traced into this period. Other notable events include the oil crisis in 1972/1973, free primary education in 2003, the post election violence of 2007/2008 and the global financial crisis of 2008. Furthermore, the Kenyan vision 2030 was designed during this period.

The rest of this study is organized as follows: Chapter two reviews theoretical and empirical literature with an overview of the literature, chapter three presents the methodology, chapter four presents the empirical findings while chapter five presents the summary conclusions and policy implications.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents the theoretical and empirical review of literature on the relationship between public debt, tax revenue and government expenditure.

2.2 Theoretical Literature

2.2.1 Classical Theory of Public Debt

Classical³ (1742-1859) debt theory maintained that debt imposed a burden on future generations and very high levels of public debt would create national bankruptcy. It was Buchanan (1958) who made this view clear stating that bondholders acted voluntarily (not sacrificing) choosing from a number of investment opportunities and in future would be better off the moment they are paid the principal together with interest. Hence they did not bear the real burden of debt (burden of debt was a utility loss and not a financial loss). In addition, public debt was accompanied by a cost; interest payment on debt that affected net income negatively therefore reduced future standard of living of a borrower

³ The term Classical or Smithian economists does not refer to a particular economist but rather a school of thought made up of mainstream economists who wrote between 1742 through the early 1930s, and were much more active over 1800-1850. The school of thought diminished with the onset of the neoclassical economists in about 1900. They held some common views (beliefs) that have been entangled into a school of economic thought, upon which the classical debt theory is derived.

if it was used to finance high present consumption. Buchanan concluded that public debt was immoral since it made future generations pay the principal together with interest towards government expenditure (government spending was seen as unproductive)⁴ decisions they did not participate themselves (Templeman, 2007).

Classical economists favoured balanced budgets — all government expenditure financed by taxation. Running budget deficits and resort to borrowing would be justified only during national emergencies, say war or a natural disaster. Smith (1776, 1937), in particular stated that the choice between a tax and public borrowing mattered for capital accumulation. Since to these economists savings was equal to investment, taxation would only reduce household expenditures, new investment and consequently new capital accumulation but would leave the economy's productive capacity and hence existing capital stock unaltered. In contrast, however, public borrowing would alter productive capacity by diverting savings from private investment which was productive, into unproductive and wasteful uses (Tsoulfidis, 2007). This, simply put was that tax versus debt finance (and their effects on the economy) were and contrary to Barro's (1974) equivalence hypothesis, not equivalent.

⁴ Classical economists held that public expenditure was unproductive, that is to say, public expenditure was channelled to useful social functions like paying salaries and wages and provision of security among others, which although could not be left in the hands of the private sector, would consume part of the social wealth already produced in order to provide such functions. This act of taking away from social wealth to provide for social functions is what rendered public expenditure unproductive.

Ricardo (1951), whom a lot is credited on developing the Ricardian equivalence, rejected as to whether tax and debt finance were equivalent. Ricardo stated explicitly that these two methods were non-equivalent. In the case of public debt for example, the public did not view it as equal to a tax cut and would tend to save less compared to when a tax was really imposed-therefore reducing the rate of capital formation. In the event that capital accumulation continued to fall, it would do so together with output/income causing revenues to government generally from taxation and also income tax to respond just the same way. In response to falling revenues, government would hike the tax rates attempting to maintain her level of revenues. The outcome was however ugly, accentuating the fall in capital accumulation and consequently breeding national bankruptcy.

To Ricardo therefore, there were only two extreme circumstances under which tax and debt finance were equivalent. First, taxation and borrowing were seen to be only economically equal, that is saying, the same amount of debt would be paid for by taxes, for example in a situation when a budget deficit was financing public investment on infrastructure. Second, taxation and borrowing might be equal only in the short run where they give forth similar outcome. In the long run, however, while taxation would affect current income for which it was not clearly established whether such incomes would be consumed or invested, public borrowing would have devastating effects on the society's capacity to accumulate capital by reducing savings that could have been directed into productive investments.

It was Mill (1976) who incorporated the idea of crowding out in the classical debt theory. To Mill, if debt was being financed by the surplus that was not needed by the private sector, there was no crowding out. However, crowding out occurred only when the government and the private sector competed for the same funds eventually causing the rates of interest (price of capital) to rise. Rising interest was partly due to increasing rate of profit which happened since borrowing led to falling private capital. Such a fall in private capital would increase competition among workers and decrease their real wages, which was equivalent to an increase in the rate of profits. High rates of interest therefore would cause Investment to fall, and similar trends would be seen in employment and output, chronically. In addition, Mill did not view public debt as having adverse consequences to a nation under three cases: If it was foreign debt, when it created savings that would not have occurred and when borrowing absorbed savings that would have otherwise been invested in unproductive uses or in foreign nations.

2.2.2 Keynesian Debt Theory

Keynes (1936) position was that the economy had various forces and mechanisms within it which were pushing it into disequilibria. Hence contrary to the classical economist's say's law, market forces of supply and demand left alone were unable to deliver an equilibrium with economic and efficiency gains. In particular, the economy was cyclically unstable and therefore under the threat of fluctuations because investment was insufficient and saving was very high. This was accounted for by high uncertainty which rendered market forces insufficient in creating equilibrium with full employment. The

only solution to insufficient investment was to incorporate public investment in its place which would occur through borrowing to finance the budget deficit (Yergin and Stanislaw, 1998). As the effects of deficit spending for instance public works projects filtered through the economy, it increased employment together with the purchasing power. This was what Keynes called the multiplier effect denoted as a reciprocal of $(1-c)$, where c is the marginal propensity to consume (MPC). The concept of the multiplier was that people purchased goods and services from the money they were paid being employed in public works projects hence maintaining or increasing employment.

On the budget position, the central idea of the Keynesian debt theory was simple - there was no need to force the budget to balance. This was like the government was taking with one hand from what it was giving with the other. In fact, doing so when the economy's health was poor was disastrous. For example, contending to balance the budget in a recession would aggravate the recession, increase the pace at which output declined, increase unemployment and consequently create deflation. A recession would need a cut in taxes and an increase in expenditure to stimulate total (or aggregate) demand. Along the same line, during a recovery, government should cut spending and increase taxes to cut total demand and avoid inflation.

Keynesians held that deficits were not supposed to crowd out private investment. To support this idea, they stated that aggregate demand (AD) increased the returns of private investment which at any given rate of interest would lead to an increase in total investment. Therefore, despite the presence of high interest rates, borrowing would foster

savings and investment and in the event that consumption increased, it was a result of unemployed resources which was at the heart the theory (Berheim, 1969). However, there was only one condition under which borrowing would crowd out investments — when the economy was in full employment. This would create displacement of resources, moving resources from the private into the public sector. Considering availability and private sector demand for these funds, rising public sector (government) demand for the same would push the market rates of interest up eventually crowding out private investment and setting up a recession. Nevertheless, the total effect of interest rates on total investment, all else equal, would be highly dependent on the demand elasticity of investment with respect to rates of interest because investment depends on a number of variables for example the marginal efficiency of investment (MEI) (Malick, 2005).

On debt burden, Keynesians stated that debt did not impose any burden on future generations. As long as the GDP trajectory and speed looked up, the ratio of public debt to Gross Domestic Product (GDP) would diminish at a faster rate. That is, high aggregate demand due to high government expenditure was necessary to diminish debt. In fact, debt had its advantages and hence was not a burden. To illustrate this point, Keynesians stated that when government borrowed to finance government expenditure, it was basically utilizing surplus savings held by the public which would be channelled to productive use leading to an increase in national output.

2.2.3 Lerner's Theory of Functional Finance

Lerner (1943), stated that government should borrow only if it was in the social interest for the government to hold more money and the public to hold more government bonds, which was the entire effect of government borrowing — efficient when the public might attempt to lend out their cash leading to low interest rates therefore inducing very high investments that consequently breeds inflation. Lerner's (1943) theory is based on what is called functional finance. Functional finance is judging fiscal policies from their effects on the economy, irrespective of whether they are sound or unsound. Therefore, government borrowing as well as debt repayment was primarily used to adjust public holdings of money and government bonds. Whenever there was a budget surplus, government could use it to repay part of public debt (if it was desirable to increase money held by the public and reduce unemployment and government bonds). Similarly, a budget deficit would be financed by either borrowing or printing money depending on their desirability in maintaining full employment and preventing inflation. On seignorage, Lerner stated that it was effected only when it was desirable to implement functional finance to spend, lend or repay debt. In the author's definition, printing of money included borrowing from banks and did not affect total money spent. In addition, printing money was conditional on new credit money provision by banks based on their additional government bond holdings.

According to functional finance (Lerner, 1943) therefore, high debt was not supposed to be a threat to society because with the application of the underlying principles of the theory, the level of total demand was maintained which was necessary for total output to ensure full employment and also avoid inflation. This means there was no debt burden either on future or current generations, to which Lerner gave four reasons. First, money and debt could be allowed to grow together in a certain balance while maintaining the two laws of functional finance — checking inflation and maintaining full employment, so that debt did not grow that fast. Secondly, private investment could be made more attractive with the main objective of maintaining full employment. This would then prevent the suspicion of a depression that would make deficit finance decline and hence debt. Third, high debt meant high private wealth (bonds in the hands of the public); hence even with taxes unchanged, government had high revenue from income taxes and bequests. Since this did not result from reduction in spending by the public, it could therefore be used to repay interest on debt. Fourth, government could tax the rich to avoid growth in private wealth (government bonds); because the rich did not reduce consumption much, the effect was low debt — and similar economic effects to those of borrowing. In fact, very high debt was unlikely a result of application of functional finance since according to functional finance (Lerner, 1943), it was natural for debt to stop growing long before it was close to too high a level like 10,000 billion dollars, Lerner's stupendous level. In addition, even though there was no principle for balancing

the budget, in the long run the budget would tend to balance as functional finance took shape so that debt could not balloon to very high levels.

On interest repayment on debt, functional finance (Lerner, 1943) stated that interest could not be financed solely by taxation unless debt had to be kept at reasonable levels - which automatically eliminated other forms of interest finance (seignorage and debt). But there was no sufficient excuse to do this since functional finance kept inflation — which was the fear of printing money, on check. Taxation, however, would only be employed when it was desirable to cut spending and prevent inflation. Otherwise, interest could be repaid using additional borrowing as long as the public could (and was willing to) lend. If the public did not wish to lend, they must and would either hoard money or spend. In the case of hoarding, the government was freed from commitments on future interest payments on bonds because the public held currency. This would necessitate printing of money to repay interest and also finance other expenditure needs. When the public spent, there was no need to borrow and taxation would be effected only when high government expenditure became a threat in breeding inflation. Tax revenues were then used to repay the principal debt together with interest.

2.2.4 Tax Smoothing

The theory of tax smoothing is credited to Barro (1979) who encompassed it to fiscal policy. This theory is based on the assumption that a representative agent - a household, who works, consumes and saves in a closed economy with no capital has the same finite

lifetime together with the government. Tax smoothing implies that fiscal deficits and public debt tends to be related to cyclical paths of the business cycles and the state which the economy is at. Specifically, public debt as a ratio of GDP would increase in the presence of an emergency for example, a war or natural disaster say hurricane, famine and et cetera; decrease in horizons characterized with lasting peace; fluctuate during business cycles, that is, increase in a recession and decrease in a recovery towards a boom. In this theory, government (a benevolent social planner maximizes the utility of the representative agent) while spending in every period, faced a constraint to keep tax rates constant to avoid distorting the economy since taxes levied on labor income were distortionary as they affected the supply of labor (Alessina and Perroti, 1994). This constraint determined by the intertemporal budget equating the present value of taxes to the present value of expenditure had a number of implications. It implied that, government would run budget deficits hence resort to borrowing when spending was high while a budget surplus would arise when spending was low.

With this background, assuming the usual property of concavity of the consumer's utility function, it becomes prudent to predict that if government expenditure is high in the present period and low in future then from a balanced budget perspective, tax revenues would have to increase in the present period and decrease in future. But this was not obviously the case here. According to tax smoothing (Barro, 1979), tax rates must remain unchanged hence government would run a budget deficit today and a budget surplus in future that in their respective present values would counterbalance the budget deficit in

the present period. Moreover, from the concept of diminishing marginal utility, such a policy would imply higher welfare gains emanating from lower tax rates in future and making up for higher tax distortions today. Therefore, tax smoothing was used ideally in minimizing distortions associated with taxes by running budget imbalances where the trajectory of spending is exogenous.

2.2.5 Ricardian Equivalence

Barro (1989) presented a theory popularly known as Ricardian equivalence/invariance or also called tax discounting. This theory was first put forward by David Ricardo. The theory basically held that tax and public debt financing of government expenditure were equivalent and hence had the same result. If public debt was financing government expenditure through a reduction in taxes, future taxes would be high with the same present value just equal to the tax cut. This was because the government's budget constraint equated revenue from taxation and other sources including public debt to government expenditure (plus interest payments). Hence, there's no free lunch, total present value of revenues was fixed by the total present value of expenditures such that it was a must that government expenditure be paid for, today or in future. If the trajectory in spending together with non-tax revenues is fixed, this implies that a tax cut today must be financed by a corresponding increase in the present value of future taxes. Barro (1989) assumed household demand was dependent on expected present value of taxes, that is, every household determined its position of net wealth based on the difference between its share of present value of these taxes and expected present value of income. Fiscal policy

therefore affected aggregate consumer demand of households only if it altered the present value of taxes. Proceeding from the previous argument that the present value of taxes was unchanged so long as the present value of spending was unchanged, substituting public debt or any other component for taxes would have no effect on aggregate consumer demand. Therefore, there was no effect on national savings, investment and other real variables for a closed economy as interest rate remained unchanged. In an open economy, the cycle was similar — there would be no effect on the current account since private savings increased just enough to discourage foreign borrowing.

About the relationship between tax revenue and government expenditure that has elicited heated debate in recent times and upon which causality shall be examined, no clear position among scholars has been reached. Four types of relationships have generally been studied: taxes cause spending (revenue — spend hypothesis (Barro, 1974)); spending cause taxes (spend — revenue hypothesis); taxes and spending are concurrent (fiscal synchronization) and; independence/institutional separation.

The revenue — spend hypothesis, also referred to as the revenue dominance hypothesis is based on the assumption that governments spend what they get from taxing the public or even more. The amount of revenue raised through taxation will therefore determine the level of government spending. This is usually where budget deficits are not entertained, and the only solution to correcting them would be to reduce revenue so that it imposes changes in government expenditure. However, this argument does not settle well with

some scholars. A case in point is Friedman (1978), who argued that this was only a temporary measure but not a solution to budget deficits since a reduction in taxes would reduce revenues required to finance government operations. According to the author, a deficit is a hidden tax and to finance it government either prints money or borrows. While printing money has inflation as a hidden cost, borrowing leads to high taxes or interest in future to repay it. Given that government expenditure is the measure of the true cost of government to the public, cutting taxes would lead to a higher deficit and would discourage government expenditure. Therefore, lower deficits need lower taxes. Further, taxes should not be increased to reduce budget deficits. The relationship in such a case is positive.

Unlike the above view, there is another set of scholars who agree that causality runs from revenue to government expenditure but instead believe this relationship is negative. These include Buchanan and Wagner. To these scholars, since public debt and both direct and indirect taxes with inflation are sources of government finance, Buchanan and Wagner (1977) argued that decreasing revenues will cause government expenditure to increase. This would occur through fiscal illusion. A cut on taxes leads the public to perceive there is a reduction in the cost of government activities or programs. The public will in turn demand more of government programs which if implemented will lead to higher government expenditure even though the public may incur extra costs - including indirect inflation tax due to money printing and high interest rates due to government debt which may crowd out private investments. Therefore budget deficits increase

because of rising expenditure and falling tax revenue. To solve the problem of budget deficits, expenditure has to be reduced and taxes increased.

The spend-revenue hypothesis also called the expenditure dominance hypothesis (Barro, 1974) argued that governments should make decisions on expenditure first before adjusting tax policies and revenues to match expenditures. According to Peacock and Wiseman (1979), presence of an emergency, crisis or natural disaster say drought, would increase the demand for some services in that period therefore increasing expenditure and shifting revenue permanently. Presence of crises has the potential of changing public perceptions about the proper level of government expenditure hence displacement of revenue and expenditure when the increases in these variables is accepted resulting from a crisis. In addition if a political majority increases expenditure, then revenues will also be increased. If it is then considered that bonds are not issued, the government or fiscal authorities will not be worried about the size of the fiscal deficit because revenues would be high when government expenditure is high and vice versa (Barro, 2001). In this case the solution to budget deficits was to reduce government expenditure.

Similarly, Barro (1974, 1978) argued that government usually exploited government expenditure since presence of any debt today would be repaid by higher tax in future on what is called Ricardian equivalence hypothesis. The Ricardian equivalence hypothesis originally done by Ricardo (1951) is based on two assumptions. First, the government budget constraint is similar to that of the consumer showing that government cannot run a

budget deficit forever as expenditures should equal revenue. Any case where expenditure is above revenue in the present time resulting due to a tax cut or an increase in expenditure would be financed through a tax increase or expenditure cut so that revenues are above expenditure. Second, consumers are rational and forward looking so that they do not increase consumption in response to a tax cut financed by debt. Thus, in anticipation of future tax increases, consumers would reduce consumption whenever increasing government expenditure was financed by debt. The implication of this theory is that fiscal policies which worsen the long run position of the budget and require government to issue bonds do not have much stimulating effects on the economy.

Fiscal synchronization hypothesis states that causality may run in either direction from revenue to government expenditure or from expenditure to revenue and is based on the assumption of rationality. Government, like any other decision maker is rational and compares the marginal benefits and costs of its operations before undertaking any fiscal program (Meltzer and Richard, 1981). According to Murat and Murat (2009) the budget process is determined both by bureaucrats and politicians and most of these items are approved from the preceding year with only very little differences. In this case, governments would make a decision regarding desirable levels of revenue and expenditure at the same time (Mithani and Khoon, 1999). When debt has no effect on savings and consumption due to GDP growth exceeding the rates of interest and an almost stable budget deficit, there was flexibility in financing government budget as there were options to either raise revenue or spend first (Ram, 1988). In this situation,

solutions to the budget deficit involve either increasing revenue which would in turn affect expenditure decisions or changing expenditure that would affect revenue decisions.

The independence or institutional separation or fiscal neutrality hypothesis holds that there is no relationship between expenditure and revenues. Growth in government expenditure is never an outcome of change in revenues since decisions on these variables are taken independently. It therefore attributes these variables to economic growth in the long run (Baghestani and McNown, 1994; Al-qudair, 2005). This hypothesis holds in a federal system of government where different independent institutions hold the responsibilities of raising and spending revenue (Hoover and Shefrin, 1992; Baghestani and McNown, 1994; Payne, 2003). However in any other system, it is mainly attributed to political reasons for example, lack of loyalty that lead to lack of accountability for government operations. This case displays no causality between revenue and expenditure.

2.3 Empirical Literature

Previous empirical studies show that public debt displays a positive and significant relationship with government expenditure. These include Kanano (2006) who studied the determinants of government expenditure growth over 1980-2004 in Kenya. Using a log linear model estimated using ordinary least square (OLS), the author found out that internal debt was the only variable that was significant at 5% and 10% levels of significance. Internal debt had a negative impact on government expenditure growth. External debt, according to this author did not exhibit any statistically significant effect

on government expenditure. The author concluded that debt overhang hypothesis was significant in Kenya.

Cassimon and Campenhout (2007) studied fiscal response on debt relief in 28 highly indebted poor countries (HIPC) over 1991-2004. Using a panel VAR model they found out that debt relief increased the revenues collected by the government and encouraged growth in both recurrent and development spending with a lag of one year. This, according to the authors was evidence of debt overhang hypothesis. Based on this finding, increasing government expenditure arose majorly due to increasing revenues that resulted after debt relief. In addition, contrary to debt relief, they stated that rising government expenditure may be due to wasteful expenditure including corruption. In relation to this study, when public debt repayments (principal and interest) are done away with, revenues are channelled to financing government expenditure causing a rise in government expenditure.

Fosu (2007) studied external debt servicing in 35 Sub-Saharan African (SSA) countries including Kenya, Madagascar and Senegal over 1975 – 1994. Using a seemingly unrelated regression (SUR) based on random effects model the author found out that external debt service moved resources away from the social sectors — including education and health with a partial elasticity of 1.5. This implied reduction of the overall budget to the sector by around a third with R-square ($R^2=0.597$). In relation to this study, an increase in public debt especially external debt would increase the debt servicing

charges and affect the social safety net. This would imply high expenditure as taxation is usually relied upon as a source of revenue.

Nyamongo and schoeman (2007) in a study of a panel of 28 African countries over 1995-2004 using a Cobb Douglas utility function and testing for panel poolability found this to be true only in health and economic services with 10% and 1% levels of significance respectively meaning debt is channelled to these sectors. Also, Bilbiie, Meier & Mueller (2008) employed a log linear model nested in vector autoregression (VAR) and a dynamic stochastic general equilibrium model (DSGE) using two U.S. samples (1957-1979 and 1983-2004). They found that the degree of deficit finance increased from 0.17 in sample 1 (1957-1979) to 0.64 in sample 2 with standard errors of 0.999 and 0.235, respectively which showed greater reliance on debt to finance government spending. However to the first sample (1957-1979), the opposite was reported to which the authors attributed to wider private access to asset markets, active monetary policy and greater degree of deficit finance.

On a study of 111 developing countries in Africa, South America, Asia and Europe over 1984-2004, Shonchoy (2010) used country specific fixed effect model and random effects model. After correcting for panel heteroscedasticity, serial correlation and correlation of errors using the Feasible Generalized Least Square (FGLS) and Prais — Winsten transformation to obtain efficient and consistent regressor estimates, the author found that in both balanced and unbalanced datasets the coefficient of debt service was statistically

insignificant at 1%, 5% and 10% levels of significance. The author concluded that public debt burden may not have a direct impact on government expenditure so that it would be appropriate for developing Nations to use taxation to finance public debt burden which is fast compared to cutting pre-planned expenditure.

Greiner, Koller and Semmler (2011) analyzed the sustainability of fiscal policy for selected European countries including France, Germany and Portugal. The primary surplus was regressed on a vector of z (containing net interest payments on public debt relative to GDP and a variable reflecting the business environment) and public debt. They found that fiscal policies in the countries under consideration were sustainable. They suggested that governments should take corrective actions due to rising debt ratios by increasing the primary surplus ratio. They stated that compliance with the intertemporal budget constraint implies that either public spending must decrease with rising public debt ratio or the tax revenue must increase. They argue that for real world economies it is not a rise in the tax revenue but a decline in public spending that generates primary surpluses. This is because public investment (expenditure) can be reduced most easily. Finally they argue that in the long-run high debt ratios may have negative repercussion for the growth rates of economies.

Christie and Rioja (2012) explored how variations in the composition and financing of government expenditures affected economic growth in the long-run. Specifically, they analyzed how public investment spending funded by taxes or borrowing affected long-

term output growth. They developed a dynamic macroeconomic model to analyze the objectives of the study. The model was then calibrated to reflect economic conditions for the seven largest Latin American economies during 1990-2008. They found that, where tax rates were not already high, funding public investment by raising taxes increased long-run growth. If existing tax rates were high, then public investment (expenditure) was only growth-enhancing if funded by restructuring the composition of public spending. They conclude that using debt to finance new public investment compromises growth, regardless of the initial fiscal condition. They also showed that in funding productive expenditure, the better strategy was always to raise taxes rather than increase debt independent of whether the economy had high or low existing debt stock. Issuing debt particularly when debt was high was harmful to long run growth. The simulations showed that in the steady-state, new debt issue financing of government expenditure led to less public investment in the long run and a lower level of public capital stock because a larger share of public spending was redirected to future debt servicing. On the other hand, productive government expenditures financed by raising taxes increased the long-run growth rate so long as the optimal tax level had not been exceeded.

Banerjee (2013) used a dynamic general equilibrium closed economy model to compute the dynamic Laffer curves for Portugal, Ireland, Greece and Spain for different categories of taxes. The author showed that under reasonable parameterization, tax rates for consumption and labor could be changed. All the economies were located to the left of the Laffer peaks for the income tax and potentially would be able to absorb marginal

increase in tax rates. Thus this provided an avenue for generating much needed resources to tackle the primary deficit in the short run which along with structural changes led expenditure cuts would give the right strategy mix that could bring down debt to sustainable levels.

Stegarescu (2013) studied the long-term nexus between expenditure composition and sub-national government debt levels. Panel data for 10 West-German states over 1974-2010 was used. Pooled OLS regressions were used in the estimation. The debt-to-GDP ratio was regressed on the composition of state and local government expenditure, while controlling for a separate level effect of total expenditure and, alternatively, socio-economic and political factors, as well as for fixed time and state effects. The author found out that larger shares of government consumption expenditure were associated with lower debt. The level of total expenditure was found to have a debt increasing effect. The author recommended a reform of the tax sharing and equalization system, including larger tax autonomy of the federal states.

Kaur et al. (2014) studied debt sustainability at the state level in India. Data was collected from the Handbook of Statistics of the Indian Economy from the reserve bank of India. Data covered the period 1980-81 to 2012-13 for 20 Indian states. Variables considered were the stock of government debt, government expenditure and revenues. Panel data was used. Data was converted to real forms by logarithm transformation. Testing for unit roots, they found tax revenue and government expenditure to be each I (1). Pedroni and

Kao panel cointegration tests revealed cointegration in the series. Generalised least square technique with cross section Seemingly Unrelated regression (SUR) with a correction for first order autoregressive error term was used for estimation. The models were then adjusted for the heteroskedasticity using white cross-section standard errors and covariance method. They found that the estimated fiscal policy response function indicated that the primary fiscal balance in Indian states responded in a stabilising manner to the increase in debt. This together with evidence of cointegration, to the authors meant prevailing debt levels was sustainable in the long run. Disaggregated level analysis, however, showed that some states still showed signs of fiscal stress and increasing level of debt burden. The authors advised that in line of falling revenue due to slowdown in economic growth, checks in expenditure to avoid increased reliance on borrowing was necessary.

Given that there is no generally agreed relationship between revenue and expenditure, most empirical studies focused to test causality based on existing hypothesis using Granger tests, among others. The revenue — spend hypothesis gained support from findings of: Eita and Mbazima (2008) who used a cointegrated VAR over 1977-2007 in Namibia; Ghartey (2008); Raju (2008) for India; and Westerlund (2010) who used an error correction (ECM) framework.

Al-Khulaifi (2012) studied the link between taxes and expenditure for Qatar on annual data over 1980-2011. The author conducted unit root tests using Philips perron as well as Augmented Dickey Fuller unit root tests. Further, the author carried out the two-step

Engle Granger cointegration technique to test the order of integration in the series. The author found that these variables were stationary in their first differences and concluded that they were cointegrated. Examining the direction of cause and effect using Granger causality analysis, the author found evidence suggesting that tax caused expenditure. Garcia (2012) who used unit root panel tests and Cointegration tests for heterogeneous panels including Pedroni, Kao and Johansen-Fisher in Spain Masenyetse and Motelle (2012) also found evidence in support of this view. The revenue-spend hypothesis thus suggests that in financing government expenditure, government raises revenue first before spending which is indeed common in many economies. However, in practice this view may not apply directly since unforeseen events like drought, earthquake or war must be financed through the government budget. Thus, in case of budget deficit problems, increase in revenue (tax) will cause reduction in the budget deficit. In other words, policies aimed at stimulating revenue (or revenue generation capacity) are paramount to reducing the fiscal deficit.

The spend-revenue hypothesis was supported by studies done by Carneiro, Faria and Barry (2005) who investigated the link between revenues and expenditures in Guinea Bissau over 1981-2002. They tested for unit roots using Philips Perron and ADF test. Further, to differentiate between pure stationary and near unit root processes, they used the Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test. The authors concluded integration of order one ($I(1)$) among the variables thus presence of a stable long run relationship (cointegration). The authors found evidence lending support to spend-revenue hypothesis

using both traditional Granger test as well as in the Error correction framework. The policy advice suggested that government should cut/limit spending to restore fiscal discipline as well as reduce the budget deficit. This meant that the government would have to spend first before raising revenues. Though it may sound unrealistic, to governments it does occur because unlike the private sector it is characterized by multiple revenue sources to choose from. Raju (2008) using India data found evidence in support of this hypothesis as well as Wahid (2008) and Zapf and Payne (2009) who used Engle Granger cointegration test for US data.

On fiscal synchronization, after conducting unit root tests and Engle Granger cointegration tests, Al-Qudair (2005) used Granger causality tests with error correction model (ECM) on time series data for 1964-2001 in Saudi Arabia. Ndahiriwe (2007) used both annual and quarterly data and found that the former displayed this trend. Nyamongo, Sichei and Schoeman (2007) found evidence lending support to this hypothesis in South Africa though only in the long run unlike in the short run where there was no evidence of causality (supporting fiscal separation/independence). The study used seasonal roots and vector error correction on monthly data. Thornton (2007) used 1895-2007 data for South Africa.

Murat and Murat (2009) investigated the intertemporal relationship between taxes and spending in Turkey over 1950-2007 and in particular; to find out if fiscal synchronization was relevant for Turkey. The authors considered the 2001 financial crisis as an

endogenous structural break and divided their sample into two: 1950-2007; and 1950-2000 then transformed both series into logarithms in order to obtain stationary variance. The authors used the three-step Engle Granger residual based and the Gregory - Hansen cointegration techniques to establish the order of integration while Augmented Dickey Fuller and the Philips Perron integration tests were used to establish whether unit roots were present. And because of structural breaks, they used the Zivot and Andrews (ZA) unit root test involving three regressions to take in account the intercept, slope and both of them since the conventional unit root tests would produce unreliable results. Finally, they tested for causality using error correction framework. They found that structural breaks were not too strong to change results of both conventional unit root and cointegration tests. The authors also established that data supported bidirectional (feedback effect or fiscal synchronization) relationship between taxes and government expenditure. Moreover, the findings were quite robust and did not depend on the number of lags. In contrast though, the outcome was quite different in comparison to previous empirical studies in Turkey. The findings on fiscal synchronization hence offer support to the view that government expenditure and revenue decisions should be made at the same time. That is, higher government expenditure will lead to higher tax revenues and vice versa. In this case, persistent budget deficit problems will be solved either through affecting expenditure or revenue.

Jalil and Muhammad (2010) who used an autoregressive distributive lag concluded a valid long run equilibrium relationship while Aladejare and Ani (2012) studied federal

government revenue and expenditure in Nigeria over 1961-2010. They used cointegrated VAR. They advise that joint determination of revenues and expenditures is appealing as long as it effectively restrains the budget deficit. Further they recommend that, efforts at enhancing sources of revenue should be accompanied by reductions in government spending for Nigeria. Aregbeyen and Insah (2013) studied this relationship in Ghana and Nigeria over 1980-2010. They used ADF, Philips Perron and KPSS unit root tests with and without trends. Further, dynamic ordinary least squares estimation that would allow for better approximation closer to normal distribution, and also error correction framework were used to determine short and long run properties. The authors found that data supported fiscal synchronization in both Nations even though the effect of expenditure on revenue was positive in Ghana while it was negative in Nigeria. And to account for the difference in results where earlier studies had supported revenue-spend hypothesis, these authors stated that it depended on the specification of the ECM equations.

Independence/institutional separation hypothesis gained support from Chang et al. (2002), Ghartey (2008) who used Jamaican data and Chowdhury (2011) who studied the States of the United States and found that 40% of the States supported this hypothesis. These empirical studies largely support the view that institutions raising revenue and those charged with expenditure decisions should be different or rather independent. This may be an argument to discourage political manipulation of these institutions so that government expenditure is not just an outcome of the political process which imposes a

tax burden without corresponding benefits to society. Ndoricimpa (2013) studied this relationship using Asymmetric Error correction Model over 1997-2013 for Burundi. The findings support this relation in the short run. To reduce budget deficits, the author recommends increasing tax collections system.

2.4 Overview of the Literature

Theories reviewed reveal that the classical economists had developed important concepts of public debt including the issue of crowding out elaborated clearly by Buchanan, the burden of debt, and the building blocks for the Ricardian equivalence that had earlier been laid down by Ricardo, work that later became revived by Barro. In fact, most of these concepts have been incorporated into modern day economic theories of public debt.

Empirical literature shows that the relationship between public debt, tax revenue and government expenditure has gained immense concern especially in the present period where most countries across the globe are facing mounting pressure due to ballooning fiscal deficits and debt. In addition, while the relationship between public debt and government expenditure still has very scant literature, the relationship between tax revenue and government expenditure which causality has always been examined, has a high volume of literature across the world and very scant literature for Kenya yet there is still no consensus among scholars. In this respect, these studies have concentrated on establishing causality between tax revenue and government expenditure either using vector autoregressions (VAR) or the famous Granger causality test with several factors

accounting for divergent results: statistical techniques, method approaches, reporting periods, and the level of aggregation (Garcia, 2012). Results for studies at national government levels are thus different from those at sub-national levels and other levels of government.

With the exception of Kanano (2006), most studies on government expenditure in Kenya have not focused on the relationship between public debt, tax revenue and government expenditure. For instance, while Njeru (2003) examined foreign aid and its implications on government expenditure, Kibe (2009) and Kipkosgei (2011) concentrated on government expenditure in relation to economic growth. The study therefore contributed to the literature by bringing recent evidence about the relationship between public debt, tax revenue and government expenditure in Kenya.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This section presents the methodology that shall be used to study the relationship between public debt, tax revenue and government expenditure. In addition, estimating techniques are also presented.

3.2 Theoretical Framework

This study adopts the present value borrowing constraint (PVBC) developed earlier by Hamilton and Flavin (1986) combining insights from Kremers (1989), Wilcox (1989), Bohn (1998), Ghatak (2001), Bohn (2005), Sampaio (2005), Sampaio and Lima (2005), Valesco (2005), Jayawickrama (2006) and Oshikoya and Tarawalie (2009), among other studies.

The basic idea underlying the present value borrowing constraint (PVBC) like in the Ricardian Equivalence Hypothesis (Ricardo, 1951) is that a government cannot run budget deficits forever. Such a policy that entails running a permanent deficit (excluding interest payments) is infeasible under the PVBC as it would imply making promises to creditors that a surplus would arise in future to make up for today's deficits. As observed by Hamilton and Flavin (1986), such a strategy would not stimulate aggregate demand because in the event that debt should be repaid, the tax hikes imposed to make this possible would involve huge distortionary effects on the private economy in terms of

dead weight losses. Further, Sampaio and Lima (2005) observed that the interpretation of this constraint is weak in terms of fiscal policy restrictions. Therefore, a more standard approach would mean that government would run budget deficits in some periods which would be compensated for by running budget surpluses at a later date.

The present value borrowing constraint (PVBC) usually begins with the government budget constraint of the form:

$$s_t + r_t b_{t-1} = b_t - b_{t-1} \dots \dots \dots 3.1$$

In the specification, s_t is the budget surplus (excess tax revenue over government expenditures). The definition of government expenditure above excludes interest payments on debt. Further, r_t is the return on government debt (interest rate) in period t and b_t is government debt in period t . Equation 3.1 asserts that whenever a government runs a budget surplus equal to zero, then the rate of growth in government debt would equal the rate of return on debt, meaning that debt would grow more slowly than the return on debt. In the event that the government runs a budget deficit, however, the rate of growth in debt would exceed the return on debt.

Rearranging equation 3.1 by collecting like terms (b_{t-1}) and making b_t the subject, the government debt accumulation equation is:

$$b_t = (1 + r_{t-1})b_{t-1} - s_t \dots \dots \dots 3.2$$

Where, r_{t-1} refers to the ex-post real interest rate. For purposes of converting the variables into their present values, a discount factor is necessary. Denoting q_t as the real discount factor from the present time (t) back to time zero, then its expression becomes

$$q_t = \prod_{j=0}^{t-1} (1+r_j), t = 1, 2, \dots$$

Thus in time zero (t=0), $q_0 = 1$. In addition, q_t is strictly a function of

interest rates ($r_i, i = 0, 1, \dots, t-1$) that are known in period t (present time). Each variable discounted to time zero can thus be obtained using q_t .

Equation 3.2 becomes $q_t b_t = q_{t-1} b_{t-1} - q_t s_t$. Furthermore, letting $B_t = q_t b_t$ and $S_t = q_t s_t$ be the discounted present values of government debt and the budget surplus in their respective orders that occur from period t back to period zero, it is possible to write $B_t = B_{t-1} - S_t$. The above equation is solved by recursive forward substitution as in (but not limited to) Jayawickrama (2006), Abeysinghe and Jayawickrama (2006) and Sampaio and Lima (2005) to obtain:

$$B_t = B_{t+N} + \sum_{j=1}^N S_{t+j} \dots \dots \dots 3.3$$

As noted also by Hamilton and Flavin (1986) and Sampaio (2005), expression 3.3 should not be a source of controversy as it is an outcome of a few accounting manipulations. In principle, the main emphasis and of economic interest in terms of empirical analysis is what agents or creditors expect to occur to the first term on the right hand side when N gets large (when it tends to infinity).

Conventionally, as N tends to infinity, then it follows that the discounted value of government debt (its present value) would in turn equal to the discounted sum of future budget surplus (excluding interest payments). This argument is specified as:

$$\begin{aligned}
 B_t &= \lim_{N \rightarrow \infty} B_{t+N} + \sum_{j=1}^{\infty} E_t S_{t+j} \\
 \lim_{N \rightarrow \infty} E_t B_{t+N} &= 0 \\
 B_t &= \sum_{j=1}^{\infty} E_t S_{t+j} \dots\dots\dots 3.4
 \end{aligned}$$

Equation 3.4 is the present value borrowing constraint (PVBC). Thus a government that runs budget deficits in some periods would be expected to run sufficiently large budget surpluses at a later date in order to offset the accumulated debt.

3.3 Model Specification

The model adopted in this study borrowed heavily from the presentation of Abeysinghe and Jayawickrama (2006) and also Jayawickrama (2006). Budget surpluses (S_t) in equation 3.4 refer to those surpluses used to offset the accumulated debt stock. Such series of surpluses are unobserved. Adopting rational expectations (Sargent, 1978; Campbell and Shiller, 1987; Hansen and Sargent, 1980), and assuming all information available at a given time (t) to policy makers, they would be able to form expectations about the discounted sum of future budget surpluses. This is presented as follows:

$$S_t = \sum_{k=0}^{\infty} \rho^k E_{t+k} S_{t+k} = \sum_{k=0}^{\infty} \rho^k E_t (Z_{t+k} + w_{t+k}) \dots \dots \dots 3.5$$

$\rho = 1/(1+r)$, $Z = a'X_t$, where, a refers to an $(n \times 1)$ vector of constants and X is a vector of relevant informational variables that is known to both the government and the public. Further, w_t is an unsystematic information variable available only to the government with the property $Ew_{t+k} = 0$. The present formulation allows for both stationary as well as non-stationary series of variables. In this context, Z_t is assumed to be stationary even though it may well be a near unit root process that S_t may display.

Assuming Z_t has an infinite order moving average representation denoted $Z_t = \psi(L)e_t$, the Wiener-Kolmogorov prediction formula (Hansen and Sargent, 1981) can be employed as in Abeyesinghe and Jayawickrama (2006) and Jayawickrama (2006) to obtain

$$EZ_{t+k} = \sum \psi_j L^{j-k} e_t, (j = k, k+1, \dots, \infty)$$

Using an autoregressive representation of the form $\phi(L)Z_t = e_t$, proposed by Hansen and Sargent (1980), equation 3.5 is specified as:

$$\sum_{k=0}^{\infty} \rho^k E_t Z_{t+k} = \phi(\rho)^{-1} \left[1 + \sum_{j=1}^{p-1} \left(\sum_{k=j+1}^p \rho^{k-j} \phi_k \right) L^j \right] Z_t \dots \dots \dots 3.6$$

Given that there is no interest in the nonlinear parameter, 3.6 is re-specified as:

$$\sum_{k=0}^{\infty} \rho^k E_t Z_{t+k} = \left[\lambda_0 + \sum_{j=1}^{p-1} \lambda_j L^j \right] Z_t \dots \dots \dots 3.7$$

Recall condition 3.4 in the definition of the PVBC which states that $(\lim_{N \rightarrow \infty} E_t B_{t+N} = 0)$. Thus,

replacing $Z_t = a'X_t$ and redefining the respective parameters, it is possible to write;

$$D_t = \sum_{i=1}^{p-1} \beta_i' X_{t-i+1} + \varepsilon_t \dots \dots \dots 3.8$$

Note that although equation 3.8 and 3.4 which is the present value borrowing constraint (PVBC) might not be different, the present formulation disaggregates the components of the budget surplus to allow a larger information set in explaining the debt equation. However, with the standard definition of the budget surplus, this formulation can easily be adopted to explain the relationship between public debt, tax revenue and government expenditure. Further in equation 3.8, ε_t is assumed to be a well behaved stochastic disturbance term.

For purposes of understanding the relationship between public debt, tax revenue and government expenditure, a VECM framework was more appropriate. The VECM was specified as:

$$\Delta W_t = V + \alpha \beta' W_{t-j} + \sum_{i=1}^{p-1} \Gamma_i \Delta W_{t-i} + \varepsilon_t \dots \dots \dots 3.9$$

The first component is the error correction components in levels while the second component on the RHS of equation 3.9 is the VAR component in first differences. W_t is a vector of variables. Γ matrix captures the short-term adjustments among the variables at the i th lag. β' is the matrix of cointegrating vectors and α is the speed of adjustment parameters. The elements of the α matrix relate also to the weak exogeneity. j is the lag structure. V is a vector of constants and ε_t is a vector of white noise error terms.

3.4 Definition and Measurement of Variables

Public debt is total outstanding borrowing by the government less currency. Public debt was measured in Kenyan shillings.

Tax revenue is total government income due to taxation. Tax revenue was measured in Kenyan shillings.

Government expenditure is total money spend by the government less interest payments. Government expenditure was measured in Kenyan shillings.

3.5 Data Type, Source and Refinement

This study utilized annual time series data over 1960 – 2011, for Kenya. Data was obtained from economic surveys from 1960-2013. Because the data was available in fiscal years, it was converted to calendar years by splicing. Splicing involves constructing a long time series of economic variables through piecing/linking together short heterogeneous series (Fuente, 2013). To obtain data in calendar years, those observations that were in fiscal years were averaged.

All variables were converted into their real values through dividing their respective nominal values by the consumer price index (CPI). Use of the CPI was justified because the variables estimated fell on the expenditure side of the economy.

3.6 Stationarity Analysis

This study employed time series data, for 1960-2011 in Kenya. With such kind of data, it was necessary to determine the properties of the series to ensure they are stationary and therefore integrated order zero $I(0)$, to avoid estimation bias (Yule, 1926; Granger and Newbold, 1974; Banerjee et al., 1993).

The first step was therefore to determine the nature of stationarity and integration in the series to be tested. This is because most time series are non-stationary (have unit roots). It becomes essential to test for unit roots since their presence would lead to spurious and inconsistent estimates so that the mean and variance are time dependent hence would explode with time (Russel and Mackinnon, 1993; Bohn, 2005; Freedman, 2007).

Spurious model is when an unrelated series gives model estimates that are statistically significant with high R-squared. This affects inference as parameter estimates are meaningless. On the other hand, inconsistent estimation is when the regressed and regressors have different orders of integration. In this scenario, inference would not be valid since the variance was time dependent. To avoid these problems, it was necessary to establish presence or absence of unit roots.

This study used the Augmented Dickey Fuller (ADF) (1979) and the Philips and Perron (1988) unit root tests. The inclusion of the Philips Perron (PP) test stemmed from the argument that in the presence of unusual circumstances, the conventional ADF unit root test would be invalid (Pierre, 1989; Sjo, 2008), for example if a series has an explosive unit root (Suresh et al., 1999). In addition, the PP unit root test is particularly robust on any heteroscedasticity in the error term and the user also does not need to specify a lag length (Rothe and Sibbertsen, 2005).

3.7 Cointegration Analysis

The next step was to test the order of integration to determine equilibrium relationships for the series which individually may not be in equilibrium. This involves testing for both short and long run equilibrium. Presence of co-integration also leads to spurious results and wrong interpretation; and is necessary to test (Nelson and Plosser, 1982; Dolado, Gonzalo and Marmol, 1999). Since the Engle and Granger (1987) co-integration technique would be invalid because more than two variables were being analysed, the Johansen and Juselius (1990) test was used. Engle and Granger showed that if variables have unit roots (they are not stationary and integrated of order one ($I(1)$) before the first difference, and become stationary after the first difference, there exists a long run relationship between the variables at level (before first difference). This also indicates that unidirectional or bidirectional causality must be present in at least the integrated order zero ($I(0)$) series/variables.

In the first step of the Engle and Granger co-integration technique, unit root tests was done to show order of integration for the variables of interest.

$$y_t = a_0 + a_1x_t + \varepsilon_{1t} \dots\dots\dots 3.10$$

$$x_t = a_0 + a_1y_t + \varepsilon_{2t} \dots\dots\dots 3.11$$

In step two, the residuals are tested to find if they are stationary using unit root tests such as Dickey Fuller. One shortcoming of this two-step test is that an error in the first step affects the second step results badly (Shah and Ali, 2012). This problem is overcome by the Johansen and Juselius (1990).

Johansen and Julius co-integration technique involves maximum likelihood estimation (MLE) of the reduced rank model. It is done by estimating an unrestricted Vector autoregression (VAR) model stretching to p lags to find the underlying lag structure of the data, as shown:

In the first step, an autoregressive process of order p (AR (p)), is specified as:

$$\Delta y_t = \mu + \Gamma_1 \Delta y_{t-1} + \dots + \Gamma_{p-1} \Delta y_{t-p+1} + \Pi y_{t-p} + e_t \dots\dots\dots 3.12$$

Δ shows variables that have been differenced and are therefore integrated order zero ($I(0)$), μ is a constant, y_t and e_t are $(n \times 1)$ vector of variables and vector of innovations, respectively. In effect, this is a reduced form equation and each variable in

y_t has the potential of being regressed on its previous values as well as those of other variables (Hinaunye and Mbazima, 2008).

Assuming there exists co-integration of order p , this equation can be rewritten by

replacing $\Pi = \alpha\beta'$, where $\Pi = \sum_{i=1}^p A_i - I = -(I - A_1, \dots, -A_p)$, is a vector that shows

long run coefficients of a matrix and are really useful in this test. $A_i, i = 1, \dots, p$, while I is an identity matrix. Replacing Π , 3.12 is then written as:

$$\Delta y_t = \mu + \Gamma_1 \Delta y_{t-1} + \dots + \Gamma_{p-1} \Delta y_{t-p+1} + \alpha \beta' y_{t-p} + e_t \dots \dots \dots 3.13$$

As mentioned, $\Pi = \alpha\beta'$ is important in capturing the long adjustments to changes in y_t and defined with asymptotically efficient estimates of α and β that this test is assumed to give, both which are of dimension $(n \times p)$. The term α shows the pace/speed that adjustment from disequilibrium occurs while β represents co-integrating vectors and are charged with facilitating y_t attains its long run equilibrium/steady state. Equation 3.12 can be simplified as:

$$\Delta y_t = \mu + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + \alpha \beta' y_{t-p} + e_t \dots \dots \dots 3.14$$

So that $\Gamma_i = - \sum_{j=i+1}^p A_j = -(I - A_1, \dots, -A_i), i = 1, \dots, p-1$, where Γ_i captures the short run adjustments to the changes in y_t , and e_t is a vector of error terms/residuals and

represents those factors the variables considered here do not capture or rather these are impacts from exogenous shocks.

Therefore, when the rank of matrix Π equals r , co-integration exists. The rank can either be a full rank, reduced rank or zero. A full rank is equivalent to rank, $r = n$ where there exists n co-integrating equations and all variables integrated order zero ($I(0)$). A reduced rank means there are $n - 1$ co-integrating variables and the most appropriate method is to utilize error correction mechanism (ECM). Rank equal zero, shows that all elements in Π are zero and there is no co-integration so that estimation is done at the first difference without any long run elements. The co-integrating rank is tested using the trace test and the maximum eigenvalue test.

3.8 Distribution and other Diagnostic Tests

A number of tests were carried out on the regression residuals to ascertain whether the VECM was well specified. Eigenvalue stability test to check whether the number of cointegrating equations was well specified, LM test for serial correlation in the residuals and Jargue-Bera test for normally distributed errors were carried out. The stationarity of the cointegrating equations was checked by plotting the predicted cointegrating equations over time and studying their behaviour. This is because the inference on the parameters of the adjustment parameters depends on the stationarity of the cointegrating equations.

3.9 Data Analysis

This section deals with how the data was processed and used to achieve the objectives of the study. Before the processing of the data, the data was summarized into descriptive statistics where measures of central tendency and dispersion such as the mean, maximum and minimum were presented. The data analysis was mainly based on quantitative econometric techniques presented in the subsections below.

3.9.1 Correlation Analysis

In examining the relationship between public debt, tax revenue and government expenditure this study employed correlation analysis. Correlation was measured by the correlation coefficient denoted as r for a sample and it shows the kind/type and strength of association exhibited by variables. Although various methods and formulae that compute correlation exist, all of them yield the same result and therefore the outcome is independent of the method.

This study used the Pearson product moment correlation coefficient (PPMCC) in examining the relationship between public debt, tax revenue and government expenditure. The Pearson product moment correlation coefficient (PPMCC) is named after Karl Pearson (1900) and is based on a number of assumptions. First, the relationship between variables studied is linear. This is because interest remains explicitly on linear correlation so that in the event of a curvilinear relationship, the Pearson product moment correlation coefficient (PPMCC) underestimates the whole relation. Second, the scale in which the variables are measured is either interval or ratio scale and needs paired

observations. Otherwise if the scale is for instance ordinal or any other, this test fails. Third, use of Pearson product moment correlation coefficient (PPMCC) requires a normal distribution with constant variance (homoscedastic), as you move along the line of best fit. Fourth, in the effect that there is presence of outliers then they should be removed or be kept at their minimum levels so that they do not affect outcome. Outliers are observations completely different from the overall data either too small or too large or just too distinct that they may have huge effects on best fit and correlation and lead to very different conclusions.

Upon satisfaction of the above assumptions, the Pearson product moment correlation coefficient (PPMCC) was computed as follows:

$$r = \frac{n \sum xy - (\sum x)(\sum y)}{\sqrt{[n(\sum x^2) - (\sum x)^2]} \sqrt{[n(\sum y^2) - (\sum y)^2]}} \dots\dots\dots 3.15$$

Where n is the sample size or the number of ordered pairs, while x and y are variables based on which correlation is computed.

Before computing the correlation coefficient it is always good practice to generate/plot a scatter diagram in the first step. A scatter diagram/plot shows how the data points fits to the line of best fit and gives a general idea of how data resembles a line. However this is not to be relied on since the eye sometimes and many times is not a good judge and may mislead. So the next step is basically to compute the Pearson product moment correlation

coefficient (PPMCC). Hypothesis tested was the null hypothesis that there was no correlation, $H_0 : r = 0$ against the alternative hypothesis indicating presence of correlation, $H_1 : r \neq 0$

After computing the Pearson product moment correlation coefficient (PPMCC), the direction of a relationship is shown by the sign accompanying the correlation coefficient. A positive sign ($r > 0$) showed that variables move together. For example, when one increases, the other variable too also increases. On the other hand, a negative sign ($r < 0$) showed that the two variables move in different directions, an increase in one variable causes the other variable to decrease, and the converse is true. The strength of the correlation was shown by the absolute value of the correlation coefficient (r). Where, $0.1 \leq |r| \leq 0.3$ showed a small/weak relation, $0.3 \leq |r| \leq 0.5$ displayed medium/moderate relation while $0.5 \leq |r| \leq 1.0$ showed a large/strong relationship between variables.

3.9.2 Vector Error Correction Model

The presence of cointegration meant that the variables were related by a Vector Error Correction Model (VECM). While the VECM measures the short run dynamics, cointegration shows long run relationships. The parameters of interest in the VECM were the coefficients on the speed of adjustment parameters and the beta coefficients.

3.9.3 Granger Causality

Series that have an error correction representation point to the existence of causal relationships among variables. This study performed causality analysis in the spirit of Granger to examine the relationship between tax revenue and government expenditure. Granger causality analysis is based on the criteria that past and present information determines the future better (Granger, 1969). That is, variable y causes variable x if past values of y and x predict x better rather than previous values of x alone (Granger, 1969). Similarly, x causes y if past values of x and y predict x better rather than previous values of y alone.

Based on the objectives of the study, granger causality was examined between public debt and tax revenue and public debt and government expenditure. Formulation of Granger causality tests for two variables x and y are written as:

$$x_t = \sum_{i=1}^{n1} a_i x_{t-i} + \sum_{i=1}^{n2} b_i y_{t-i} + \varepsilon_t \dots\dots\dots 3.16$$

$$y_t = \sum_{i=1}^{n3} c_i y_{t-i} + \sum_{i=1}^{n4} d_i x_{t-i} + \mu_t \dots\dots\dots 3.17$$

x and y are the series to be tested, $n_i; i = 1,2,3$, are maximum lag lengths determined using Akaike Information Criteria (AIC) (1969) and Schwartz information criteria (1978)

where the lag length that is minimum in either case is taken. Error terms (ε_t and μ_t) are assumed uncorrelated, that is, the expectation of their means is zero ($E(\varepsilon_t, \mu_t) = 0$).

Hypotheses to be tested in equation 3.16 are H_0 : y does not granger cause x against H_1 : x granger causes y, while in equation 3.17, hypotheses to be tested are H_0 : x does not granger cause y against H_1 : y granger causes x.

In effect that the series is integrated of order one, I (1) and hence co-integrated, traditional granger test which is based on the F test does not have a standard distribution and causality is examined within Error correction mechanism (ECM), as shown below;

$$\Delta x_{t-1} = \sum_{i=1}^{n1} a_i x_{t-i} + \sum_{i=1}^{n2} b_i y_{t-i} + \Phi_1 \varepsilon_{1t-1} + v_t \dots \dots \dots 3.18$$

$$\Delta y_{t-1} = \sum_{i=1}^{n3} c_i x_{t-i} + \sum_{i=1}^{n4} d_i y_{t-i} + \Phi_2 \varepsilon_{2t-1} + \mu_t \dots \dots \dots 3.19$$

Where ε_{1t-1} and ε_{2t-1} represent lagged error terms from equation 3.16 and 3.17 while ϕ_1 and ϕ_2 show adjustment of y and x to long run equilibrium.

3.9.4 Impulse Response Functions

Impulse response functions aid in examination of whether exogenous shocks have a positive or negative effect on the other variable in the system, or how long it will take for the effect of that variable to work through the system (Brooks, 2002; Mpfu, 2009). This

study employed Cholesky's Forecast Error Variance Decomposition (FEVD) procedure. Based on the objectives of the study the response of public debt to exogenous shocks from the tax revenue and government expenditure side was examined. The results for FEVD were examined and interpreted with the aid of graphs and tables.

3.9.5 Forecasting

VECMs that display cointegration produce forecasts with variables both at levels and at first difference. In this study, two types of forecasts were computed. These were the dynamic forecasts and the out of sample forecast. Dynamic forecasts were used to compare the predicted values to those observed in the study period. In comparison, the out-of-sample forecast was used to compare the growth of the width of the confidence interval to the forecast period.

CHAPTER FOUR

EMPIRICAL FINDINGS

4.1 Introduction

This chapter deals with the empirical findings of the study. Findings of time series properties, post diagnostic tests and the regression results including those of correlation are presented and discussed.

4.2 Descriptive Statistics

The sample consisted 52 observations over 1960-2011. Table A1 in the appendix presents the descriptive statistics. The level of public debt in magnitude remained higher than for the respective variables of tax revenue and government expenditure. This was particularly evident from the year 1994 towards the end of the study period. This was supported by both the mean and the dispersion (standard deviation). The converse was true for the tax revenue variable which had a mean and standard deviation of KES 103824.7 million and KES 160399.1 million, respectively. A graphical representation showing the trend in the series over the study period is found in figure 1A in the appendix.

Drastic movements were evident in the data. Most movements were associated with either years which had had general elections or those years around the elections. For public debt particularly, drastic movements were evident between 1977 and 1978, where

public debt rose in the range of 5%. Between 1991 and 1992, there was a sharp decline in public debt with the level going flat into 1993. Perhaps this could be once again attributed to election cycles or either aid freezes or structural adjustment programs (SAPs). Thereafter, although public debt assumed an upward trajectory, there was evidence of moderate fluctuation type growth between: 1995-1996; 2000-2001; and 2005-2006.

Prior to 1980, even though the curve for government expenditure widened at a faster rate than that for tax revenue, both curves remained smooth without those movements that captured attention. There was a sharp increase in both tax revenue and government expenditure in 1994. The growth in tax revenue moderated into 1996 but that in government expenditure persisted two years on. No much activity can be reported for the tax revenue curve for the remainder of the study period except an upward trajectory. For government expenditure, however, a decline of about 58% - also the highest in the study period was recorded over 1998-1999. Nonetheless, growth in the variable picked up a year later but a little lower than the decline. At the end of the study period, the levels of all variables were higher compared to those over the whole study period.

An interesting trend in the study period was that the rate of growth in public debt was lowest in comparison to the other two variables (tax revenue and government expenditure) and about two times lower than that in government expenditure. This would imply that although the growth in public debt is being seen as alarming, it reflects fast growth in government expenditure outpacing the growth in tax revenue. It might well

reflect the narrow tax base in the economy or inefficiencies in tax administration characterised by tax evasion. On this basis therefore, the budget deficit has to be financed by further accumulation of public debt.

4.3 Findings for Stationarity Analysis

To determine the underlying orders of integration for public debt, tax revenue and government expenditure series, the Augmented Dickey Fuller (ADF) and Philips Perron (PP) unit root tests were conducted. The results for the ADF and the PP unit root tests are reported in table A2 in the appendix. For the ADF unit root test, four lags were selected based on the Akaike Information Criteria's minimum value. 1 per cent level of significance was used. The ADF unit root test indicated that with an intercept only, public debt was the only variable that was non stationary at level. At first difference, the series for public debt remained non stationary that could question the lag selection procedure

Contrary to the case for intercept, all the series under study were non stationary at levels when considered with trend. At first difference (with the exception of the tax revenue series) most series became stationary. This meant that with the trend, public debt and government expenditure were integrated order one or, were each $I(1)$.

The results for the ADF unit root tests needed deeper insight. This could point to a problem in the lag selection procedure. And because of this, it was justified to proceed and test these series for their orders of integration using the PP unit root test. This was especially so in light of the argument put forward by Pierre (1989) and Sjo (2008) that in

the presence of unusual circumstances the conventional ADF unit root test would be invalid, for example in the presence of an explosive unit root (Suresh et al., 1999). Also, the PP unit root test is reported to be particularly robust to any heteroscedasticity in the error term. Moreover, the user does not need to specify the number of lags (Rothe and Sibbertsen, 2005) for this test. The Newey – West selected three lags For the PP unit root test with default lags. With this justification, it was fit to present the results for the PP unit root test reported in table A2 in the appendix. For all cases, none of the variables were stationary at levels. They, were however stationary or I (0) at first difference. This meant they all had one unit root each.

4.4 Findings for Cointegration Analysis

As all variables were integrated of order one (I(1)), ordinary estimation techniques were going to be invalid due to the existence of one or more equilibrium relationships among them. Given the fact that also more than two variables were being analysed, the Engle and Granger test of cointegration was in practice invalid. To estimate what and how many equilibrium relationships existed, this study adopted the Johansen and Juselius (1988, 1995) cointegration technique. Results for the Johansen cointegration test are presented in table A3 in the appendix. Three lags were selected for the test. The AIC lag selection criterion was used as it yielded minimum value (68.77). 1 percent level of significance was used. Both the trace and the maximum eigenvalue test statistics indicated two cointegrating equations.

4.5 Distribution and other Diagnostic Test Results

Before accepting the results for the specification, it was necessary to test the significance of the model. The tests conducted included the VECM stability test, the LM test for serial correlation and the Jargue Bera test for whether the residuals came from a sample that followed normal distribution. The results for the VECM stability test are presented in table A4 in the appendix. The eigenvalue stability condition in the VECM showed that the eigenvalues of the companion matrix were inside the unit circle, and the real roots were far from one (1). This was in support of the view that the number cointegrating equations in VECM was well specified.

The langrange multiplier (LM) test was used to test presence of serial correlation. The langrange multiplier (LM) test for autocorrelation on the residuals of order five indicated that at 1 percent level of significance, the null hypothesis of serial correlation could not be rejected. All p-values were lower than the 0.01 rejection level. Following Achen (2000) and Keele and Kelly (2006), who noted that serial correlation could be eliminated by inclusion of additional lags, more lags were added in an effort to eliminate serial correlation. However this was insignificant as it was only at lag six that serial correlation hypothesis could be rejected when the order of the LM test was increased to six. These results were not presented as they were insignificant.

The study proceeded to test the residuals for normal distribution. The Jargue-Bera test (Jargue Bera, 1981) was used. The null hypothesis that the residuals followed normal distribution was tested against the alternative that the residuals were not normally distributed. The results indicated that the null hypothesis of normally distributed residuals was rejected at 1 percent level of significance. This could be attributed to high fluctuations in the data in the calendar years of 1992, 1999, 2002, 2006, 2008 and 2009. These results are not reported.

The errors from the cointegrating relationships were plotted to establish how they behaved. The plots are presented in figure A2 in the appendix. The plots revealed that the errors fluctuated around zero prior to 2000. The errors from the first cointegrating equation assumed a negative trend from 2001 and never returned to zero. For the second cointegrating equation, the errors decline from 2001 to between 2002 and 2003 where they assume an upward trend. The trend however reverts, with the errors declining further before showing a slight increase into the end of the study period.

4.6 Regression results

Having conducted these diagnostic tests in the study, the estimation results on the relationship between public debt, tax revenue and government expenditure are presented. Results for VECM are reported in table 4.1.

Table 4.1: Results for Vector Error Correction Model (VECM)

Coefficients	Dependent variables		
	Public Debt	Tax Revenue	Government Expenditure
Adjustment Parameters, α_s			
α_1	-0.3576* (0.01)	-0.0749* (0.01)	-0.3615* (0.01)
α_2	4.5635** (0.02)	-0.2322 (0.58)	4.0368* (0.00)

P-values are in parentheses. An asterisk denotes a coefficient is statistically significant at 1 percent level of significance. Double indicates a coefficient is statistically significant at 5% level of significance. All values reported were rounded to four decimal places. Five lags (similar to what was used in the Johansen cointegration test) were selected based on the AIC (Akaike, 1974) value of 66.97.

All coefficients on the first speed of adjustment parameter (α_1) were negative (as expected) and less than one. Moreover, the coefficients were all statistically significant at either 1 or 5 percent levels of significance. This implies that deviations from the long run equilibrium are corrected in the next year by the size of the coefficient. For the public debt equation, about 36% of these deviations are corrected in the next period. The first speed of adjustment coefficient for the tax revenue equation was however low implying slow adjustment to the long run equilibrium. The β coefficients in the first cointegrating equation indicated equilibrium relationships between public debt and government expenditure. The β coefficients in the second cointegrating equation pointed to equilibrium relations between tax revenue and government expenditure which could possibly be the budget deficit relation.

The short run variations in the VECM model were examined. Results for the short run VECM model are presented in table 4.2.

Table 4.2: Results for VECM Short run model

	Public Debt	Tax Revenue	Government Expenditure
First lag of public debt	0.67* (0.00)	0.14 (0.00)	0.16 (0.11)
Second lag of public debt	-0.42 (0.06)	-0.01 (0.82)	0.21** (0.05)
Third lag of public debt	0.28 (0.19)	-0.08 (0.08)	0.06 (0.60)
Fourth lag of public debt	0.01 (0.96)	-0.14* (0.02)	0.28** (0.03)
First lag of tax revenue	-5.14* (0.00)	-0.78** (0.02)	-2.44* (0.00)
Second lag of tax revenue	-3.09** (0.02)	-0.45 (0.11)	-2.13* (0.00)
Third lag of tax revenue	-1.67 (0.12)	0.45** (0.04)	-0.13 (0.80)
Fourth lag of tax revenue	-2.99* (0.01)	-0.58* (0.02)	-2.57** (0.00)
First lag of government expenditure	2.48** (0.03)	-0.22 (0.36)	0.99 (0.08)
Second lag of government expenditure	2.30* (0.01)	0.02 (0.94)	0.76 (0.10)
Third lag of government expenditure	1.50** (0.02)	0.13 (0.35)	0.35 (0.25)
Fourth lag of government expenditure	0.80** (0.03)	0.08 (0.30)	-0.12 (0.51)
F-statistic	4.72* (0.00)	2.19 (0.09)	6.22* (0.00)
R-squared	0.74	0.94	0.88
D-Watson	1.54	1.63	1.98

P-values are in parentheses. An asterisk indicates a coefficient is statistically significant at 1 percent level of significance. Double asterisk indicates a coefficient is statistically significant at 5% level of significance.

Results of table 4.2 indicate that the model explains 74% of the variations in public debt.

Variation in public debt is influenced by its own first lag as well as most lags of tax revenue and government expenditure. In the public debt equation the coefficients on most lag terms of public debt, tax revenue or government expenditure is statistically significant at either 1% or 5% level of significance.

Series that have error correction representation point to the existence of causal relationships. This justified examination of granger causality tests among the variables. Granger causality was examined between: public debt and tax revenue; public debt and government expenditure, and; tax revenue and government expenditure. Granger causality between tax revenue and government expenditure was justified on account that it would be useful in devising an optimal strategy for budget deficit reduction. Moreover, the strategy for public debt reduction depends on the strategy for budget deficit reduction. Recall that unit root tests indicated each of the series was $I(1)$, pointing to possible long run equilibrium relationships among these series. The Johansen test for cointegration assuming four lags based on the AIC and 1 percent level of significance indicated 1 cointegrating equation in each of the three hypotheses tested - supporting existence of long run association. Given this outcome, in testing causality the traditional granger causality test based on the F test does not have a standard distribution and causality was examined on an error correction model (ECM). Three lags were used in estimating all ECM equations (except in testing causality between tax revenue and government expenditure where four lags were used). Results for granger causality are presented in table A5 in the appendix.

Results for table A5 indicated bidirectional flow between: public debt and tax revenue and; public debt and government expenditure in the long run. Between tax revenue and government expenditure, however, there was evidence of unidirectional flow running from government expenditure to tax revenue at 1% level of significance. The results

indicated that government expenditure granger causes tax revenue both in the short and long run. This finding is in line with the findings of Carneiro, Faria and Barry (2005), Raju (2008), Wahd (2008) and Zapf and Payne (2009). They are however in contrast to the findings by Ghartey (2008) and Ghartey (2012) in favor of the revenue-spend hypothesis. However, and as noted also by Garcia (2012), several factors account for divergent results — statistical techniques, method approaches, reporting periods, and the level of aggregation. The optimal strategy for deficit reduction hence is a cut on government expenditure to restore fiscal discipline.

Next was to conduct impulse response functions (IRF) analysis. Impulse response functions indicate how a system would respond to exogenous shocks. For the IRF, however, there's controversy as to whether the series in a VAR need to be stationary. Those against differencing argue in favor of loss of significant information related to co-movements in data. The study adopted the Cholesky forecast error variance decomposition (FEVD) procedure. 11 steps (years) were used. The graphical representation of the results for FEVD is presented in figures A3 through A7 in the appendix. The graphs were important in establishing the whether the response to shocks was positive or negative. Generally, exogenous shocks to tax revenue and government expenditure have a permanent effect on public debt.

From the graphs for the IRFs, public debt responded positively to the innovations in both tax revenue and government expenditure. In the short run, however, the response is very

minimal but is evident in the long run. A detailed interpretation is discussed under table 4.3. Similarly, response of public debt to government expenditure shocks is neutral at first (in year three to four). Thereafter public debt responds positively to exogenous shocks in government expenditure. Finally, public debt responds positively to its own shocks up to about year one (short run). Thereafter the effect of a shock is negative into the long run.

The tabular representation of the results for the FEVD is reported in table 4.3. The results of the FEVD analysis based on the VECM provide much useful information on the evolution of the public debt, tax revenue and government expenditure-relationship in Kenya over time.

Generally, public debt seems to have had a highly dominant position in the Kenyan public finance system. Over the whole sample period the forecast error variance of the public debt is almost completely attributable to exogenous shocks from the public debt side, both in the short and the long-run.

Table 4.3: Results for Forecast Error Variance Decomposition (FEVD)

Step	impulse = gr response = pd	imp = ge res = pd	imp = pd res = gr	imp = pd res = ge	impulse = pd response = pd
0	0	0	0	0	0
1	0	0	0.288	0.001	1
2	0.004	2.4e-06	0.262	0.002	0.996
3	0.006	0.002	0.152	0.015	0.992
4	0.017	0.012	0.109	0.014	0.972
5	0.033	0.017	0.317	0.180	0.949
6	0.035	0.029	0.301	0.291	0.936
7	0.104	0.027	0.302	0.309	0.870
8	0.158	0.035	0.437	0.423	0.807
9	0.347	0.035	0.356	0.316	0.618
10	0.426	0.045	0.381	0.387	0.529
11	0.441	0.047	0.431	0.460	0.512

Key: pd-public debt gr-tax revenue ge-government expenditure

Innovations in both tax revenue and government expenditure do not explain the forecast error variance in public debt up to year two. From the third year however; public debt responds positively by 1 % to exogenous shocks on tax revenue. In the long run, about 35% to 44% of the increase in forecast error variance in public debt is explained by the exogenous shocks to tax revenue. For government expenditure, its innovations are at first neutral to the variance in public debt. In the long term, the eleventh year, 5 % of the variance in public debt, is explained by the shocks to government expenditure.

Tax revenue responds positively to exogenous shocks to public debt in the short run and the long run. Innovations in public debt explain 29% and 26% of the forecast error variance in tax revenue in the first and the second years respectively. In years three and four, innovations in public debt explain about 15% and 11% of the variance in tax revenue respectively. In the long run, innovations in public debt explain about 44% of the variance in tax revenue-in the eighth year. Similarly, innovations in public debt explain the forecast error variance of government expenditure in the long run. An exogenous shock on public debt explains 39% and 46% of the forecast error variance in government expenditure in years ten and eleven, respectively. Innovations in public debt explain 100% of its own forecast error variance in the short term. In the long term it explains about 51% of its own variance. Results for FEVD support the results for granger causality analysis.

After interpreting results for FEVD, dynamic forecasts were done. The results for the dynamic forecasts are presented in figure A8 found in the appendix. The levels for tax revenue and government expenditure predicted by the model were slightly lower than that observed throughout the sample period, 2001-2011. There was however an exception in the year 2006 when the forecasted figure was above that observed. In the case of public debt, the predicted figure was equal to the observed figure over 2004-2006, otherwise the predicted values were above those observed in most years.

The out of sample forecast was then computed. The out-of-sample forecast for 2011 through 2030 is presented in figure A9 in the appendix. The width for the confidence interval increased with the forecast period, as was expected. The forecasts pointed to continued growth in these variables.

4.6.1 The relationship between public debt and government expenditure

Results for correlation analysis showed strong positive association between public debt and government expenditure. The correlation coefficient was statistically significant at 1 percent level of significance. This meant that a decrease (increase) in government expenditure would lead to a decrease (increase) in public debt which supported the findings of Bilbiie, Meier and Mueller (2008). This would particularly represent decreased (increased) reliance on borrowing (public debt) in budget deficit finance.

Granger causality analysis supported feedback effect between public debt and government expenditure in the long run. The coefficient on the ECT was statistically significant at 1 percent level of significance.

Public debt responds positively to exogenous shocks in government expenditure in the long run. This finding coincides with findings of Kanano (2006), Cassimon and Campenhout (2007), Nyamongo and Schoeman (2007) and Bilbiie, Meier and Mueller (2008). However, it contrasts with results of Shonchoy (2010) and Stegarescu (2013). In particular, Stegarescu (2013) found out that larger shares of government expenditure were associated with lower debt. This point to the usefulness of including socioeconomic

as well as political factors as they play a huge role in the overall levels of these variables. Nonetheless, this study agrees that the level of total expenditure has a debt increasing effect, which is in line with the finding of this study.

4.6.2 The relationship between public debt and tax revenue

Results for correlation analysis showed strong positive association between public debt and tax revenue. The correlation coefficient was statistically significant at 1 percent level of significance. The results of correlation between public debt and tax revenue were desirable. If public debt increased, tax revenue would also increase. This emphasised the economic argument of no direct link between public debt and government revenue but through the deficit channel. Public debt only represents a means to budget deficit finance. For public debt to increase there must be evidence of widening in the budget deficit (fast growth in government expenditure outpacing the response in revenue). In this case, fiscal authorities would increase the tax rate to finance deficits. In turn, tax revenues would increase.

Granger causality analysis supported feedback effect between public debt and tax revenue in the long run. The ECT coefficient was statistically significant at 1 percent level of significance.

Public debt responds positively to exogenous shocks in tax revenue over the long run. This supports studies by Shonchoy (2010) and Greiner, Koller and Semmler (2011). Particularly, for real world economies the degree of public debt service necessitates a

means to finance it. For developing nations like Kenya, public debt burden may not have a direct impact on government expenditure. Resort to taxation as a means to finance the public debt burden is fast and more appropriate compared to cutting pre-planned government expenditure.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS

5.1 Introduction

This chapter presents the summary, conclusions and the policy insights stemming from the study. The limitations that the study encountered are also presented. Finally, recommendations about further study are presented towards the end of the chapter.

5.2 Summary

The study sought to understand the relationship between public debt, tax revenue and government expenditure in Kenya over the sample period 1960-2011. The specific objectives in the study were the relationship between public debt and tax revenue and the relationship between public debt and government expenditure. This was inspired by the growing levels of budget deficits and public debt. The theoretical framework of the present value borrowing constraint was adopted in the study. Time series data was used over the sample period. Data for public debt less currency, tax revenue and government expenditure excluding interest payments were all measured in million Kenyan shillings. Data was obtained from the KNBS publication of the Economic Survey over 1960-2013. All variables were divided by the CPI to convert them from their nominal values into their real values. ADF unit root and the PP unit root tests were employed to determine the orders of integration in the series. After ascertaining that all the series in the study were integrated of order one or $I(1)$ pointing to the possibility of long run equilibrium

relationships, the Johansen and Juselius cointegration technique based on both the trace statistic and the maximum eigenvalue statistic was used to test for the long run equilibrium relationships. The results for cointegration based on both statistics indicated two cointegrating relationships.

The study then proceeded to use the VECM since ordinary estimation techniques were invalid due to cointegration. The tests conducted to test the significance of the model included the VECM stability test, the LM test for serial correlation, and the Jargue Bera test for normality in the residuals. As required in the VECM literature, the components of the VECM including results for impulse response functions (IRF) employing the Cholesky forecast-error variance decomposition (FEVD) and the dynamic forecasts were also evaluated. Correlation between the variables was finally investigated.

5.3 Conclusions

This study sought to understand the relationship between public debt, tax revenue and government expenditure over 1960-2011. Given the empirical findings, the study concludes that public debt responds to both tax revenue and government expenditure.

The first objective was to understand the relationship between public debt and government expenditure. The study concludes that public debt responds positively to shocks from the government expenditure side particularly over the long run. In addition, bi-directional causality exists between public debt and government expenditure.

Furthermore, results for correlation indicated strong positive association between public debt and government expenditure.

The second objective was to understand the relationship between public debt and tax revenue. The study concludes that public debt responds to tax revenue. In the short run model, public debt responds negatively to a change in tax revenue and the coefficient is statistically significant. Public debt responds positively to shocks on tax revenue particularly over the long run. Evidence of response in the long run could mean there are gaps in the implementation of government fiscal policies in the economy since such policies take time to filter through the economy. In addition, bi-directional causality exists between public debt and tax revenue. Furthermore, results for correlation also indicated strong positive association between public debt and tax revenue. This meant that government policy can affect the tax base to influence the level of public debt because a change in tax revenue would cause a more than proportionate change in public debt.

The government follows the spend-revenue hypothesis in its budget deficit decisions. This means government spends first before raising revenue sources. This could be so given multiple sources of revenue at the disposal of the government. Given the levels of the budget deficit and public debt, a cut in government expenditure is necessary to restore fiscal discipline as well as solve the budget deficit and public debt problems.

5.4 Contribution to Knowledge

First, this study explored the relationship between public debt, tax revenue and government expenditure between 1960 and 2011. This study has shown that understanding the relationship between public debt, tax revenue and government expenditure is important if any policy decisions on solving the budget deficit and public debt have to be reached. Also, the study has established that public debt, tax revenue and government expenditure move closely together such that any policy decision should be designed in such a manner that it affects the variables together.

This study has established that spend-revenue hypothesis between tax revenue and government expenditure is supported in Kenya. This contrasts the study done by Gharthey (2008) which supported the revenue-spend hypothesis.

5.5 Policy Implications

To reduce public debt, fiscal authorities should enhance measures that increase tax revenues. These include sealing tax loopholes for example tax evasion. This is because negative and statistically significant coefficients were found on most lagged terms of tax revenue in the short run VECM model. This means a KES 1 million increase in tax revenue leads to a decline in public debt in the range of KES 3 million and KES 5 million in the short run.

Fiscal discipline and fiscal consolidation is necessary in the wake of the levels of budget deficits and public debt. This can be achieved by prioritising expenditure on key sectors that have the potential of boosting the overall productivity of the economy in the long run. This study found that the coefficients of government expenditure that explained public debt in the short run VECM model were positive and statistically significant. A cut of KES 1 million in government expenditure leads to a decline in public debt of between KES 1 million and KES 2.5 million. In addition, in the long run public debt responds positively to positive shocks from the government expenditure side. Moreover, the results for correlation showed that a 1% cut on government expenditure translates to a 52% decline in public debt.

5.6 Limitations and Areas for Further Research

This study encountered a number of limitations. First, to the best of the author's knowledge no study in the past had attempted to explore the relationship between public debt, tax revenue and government expenditure. As a new study therefore, getting previous literature on the subject was a big problem. The study however relied on those studies that were as close as possible to the subject.

The study utilised time series data. Data available at the Kenya national bureau of statistics (KNBS) publication of the economic survey was in fiscal years. Splicing which involved piecing/linking together short heterogeneous series was relied upon.

Since any study is inconclusive, a number of observations about further research are therefore in line. First, the residuals in the VECM estimates depicted high serial correlation as well as non normality. To be able to justify the significance of this model, this study recommends that future research deal with this issue.

Second, this study used the theoretical framework of the present value borrowing constraint (PVBC) credited to Hamilton and Flavin (1986). However, it did not test this hypothesis, to establish whether government follows the present PVBC. Future studies should thus seek to establish whether this constraint holds in Kenya, given that to the best of the author's knowledge, no single study has taken this direction.

Third, most econometric techniques give different results. Future studies should attempt to explore the relationship between public debt, tax revenue and government expenditure using other techniques such as Generalised Least Squares (GLS) or Generalised Method of Moments (GMM).

Fourth, devolution is so far under implementation. Government expenditure may continue to stay above government revenue which shall continue to pose a threat on fiscal deficits and public debt. Future research to establish whether the findings of this study hold in the face of devolution is recommended.

REFERENCES

- Achen, C. H. (2000). *Why lagged dependent variables can suppress the explanatory power of other independent variables*. Paper Presented at the Annual Meeting of Political Methodology, Los-Angeles.
- Akaike, H. (1973). *Information theory and the extension of the maximum likelihood principle*. Proceedings for the Second International Symposium on Information Theory, Budapest, 267-281.
- Aladejare, A.S., & Ani, E. (2012). *Revisiting the government revenue-expenditure Nexus: evidence from Nigeria based on the VAR granger causality approach*. Federal University-Wukari.
- Alessina, A., & Perroti, R. (1994). *The political economy of budget deficits*. NBER Working Paper No. 4637, Massachusetts.
- Al-Khulaifi, A.S. (2012). The relationship between government revenue and expenditure in Qatar: A cointegration and causality investigation. *International Journal of Economics and Finance*, 4(9), 142-148.
- Al-Qudair, A.H. (2005). The relationship between government expenditure and revenues in the kingdom of Saudi Arabia: Testing for cointegration and causality. *Economics and Administration*, 19(1), 31-43.
- Al-Zeaud, A.H., (2012). Government revenues and expenditures: Causality tests for Jordan. *Interdisciplinary Journal of Contemporary Research in Business*, 4(7), 193-204.
- Aregbeyen, O., & Insah, B., (2013). A dynamic analysis of the link between public expenditure and public revenue in Nigeria and Ghana. *Journal of Economics and Sustainable Development*, 4(4), 18-29.

Bae, S. (2006). *Public economics, institutions, and financial management of debt financing in local governments*. The Florida State University College of Social Science, Askew School of Public Administration and Policy. Published Ph.D Thesis.

Baghestani, H., & McNown, R. (1994). Do revenues or expenditures respond to budgetary disequilibria? *Southern Economic Journal*, 311-322.

Banerjee, R. (2013). *An evaluation of the revenue side as a source of fiscal consolidation in high debt economies*. Aarhus University Economics Working Paper Series, 2013-23.

Banerjee, A., Dolado, J.J., Galbraith, J.W., & Hendry, D.F. (1993). *Cointegration, error correction and the econometric analysis of nonstationary data*. Oxford University Press, Oxford.

Barro, R. J. (1974). Are government bonds net wealth? *Journal of Political Economy*, 82, 1095-117.

Barro, R.J. (1979). On the determination of the public debt. *Journal of Political Economy*, 87(5), 940-947.

Barro, R.J. (1984). *The behaviour of U.S. deficits*. NBER Working Paper No. 1309, Massachusetts.

Barro, R.J. (2001). *Macroeconomics*. Cambridge MA: The MIT press.

Bernheim, B.D. (1989). A neoclassical perspective on budget deficits. *Journal of Economic Perspectives*, 3(2), 55 – 72.

Bilbiie, F.O., Meier, A., & Mueller, G.J. (2008). What accounts for the changes in U.S. fiscal policy transmission? *Journal of Money Credit and Banking*, 40(7), 1439-1469.

Brooks, C. (2002). *Introductory Econometrics for Finance*. Cambridge University Press, UK.

- Campbell, J. Y. (1987). Does saving anticipate declining labour income? An alternative test of the permanent income hypothesis. *Econometrica*, 55, 1249 – 1273.
- Cassimon, D., & Campenhout, B. (2007). Aid effectiveness, debt relief and public finance response: Evidence from a panel of HIPC countries. *Review of World Economics*, 143(4), 742-763.
- Carneiro, F.G., Faria, J.R., & Barry, B.S. (2005). Government revenues and expenditures in Guinea-Bissau: causality and cointegration. *Journal of Economic Development*, 30(1), 107 – 117.
- Chang, T. (2009). Revisiting the government revenue expenditure nexus: evidence from 15 OECD Countries based on the Panel Data Approach. *Czech Journal of Economics and Finance*, 59(2), 165 - 172.
- Christie, A.L., & Rioja, F.K. (2012). *Financing productive government expenditures: The importance of initial fiscal conditions*. University of the West Indies and Georgia State University.
- Cottarelli, C., & Schaechter, A. (2010). *Long term trends in public finances in the G-7 economies*. IMF, Fiscal Affairs Department.
- Dickey, D., and Fuller, W. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association*, 74, 427-431.
- Dolado, J.J., Gonzalo, J., & Marmol, F. (1999). *Cointegration*. Department of Economics, Statistics and Econometrics, Universidad Carlos III de Madrid.
- Eita, J., & Mbazima, D. (2008). *The causal relationship between government revenue and expenditure in Namibia*. Munich Personal Repec Archive, MPRA Paper No. 9154.
- Engle, R., & Granger, C.W.J. (1987). Cointegration and error correction: Representative estimation and testing. *Econometrica*, 55, 251-276.

Fosu, A.K. (2009). *The external debt servicing constraint and public expenditure composition in sub Saharan Africa*. A Paper Presented at the African economic conference (AEC) “fostering development in an era of financial and economic crises” Addis Ababa: Ethiopia.

Freedman, A.D. (2007). How can the test be inconsistent? *The American Statistician*, 61, 291-295.

Friedman, M. (1978). The limitations of tax limitation. *Policy Review*, 5, 363-374.

Fuente, A. (2013). *A mixed splicing procedure for economic time series*. BBVA Research Working Papers No. 13/02.

Galí, J., Salido, D., & Vallés, J. (2007). Understanding the effects of government spending on consumption. *Journal of the European Economic Association*, 5(1), 227-270.

Garcia, J.M. (2012). The revenues-expenditure nexus: A panel data analysis of Spains regions. *International Journal of Academic Research in Economics and Management Sciences*, 1(1), 24-38.

Ghartey, E.E. (2012). Cointegration and causal relationship between taxes and spending for Kenya, Nigeria and South Africa. *International Economic Journal*, 24(2), 267-282.

Ghartey, E.E. (2008). The budgetary process and economic growth: Empirical evidence of the Jamaican economy. *Economic Modelling*, 25(1), 1126-1136.

Ghatak, A. (2001). Structural breaks: Tests of the present–value government borrowing constraint and stability of debt–GDP ratio in the UK: 1970–2000. *European Research Studies*, 4 (3–4), 37–53.

Grauwe, P., & Yuemei, J. (2013). *Panic driven austerity in the Eurozone and its implications*. VOX Research-Based Policy Analysis and Commentary from leading Economists.

Grauwe, P., & Yuemei, J. (2012). *Self fulfilling crisis in the Eurozone: An empirical test*. Centre for European Policy Studies (CEPS) Working Document: Thinking ahead for Europe No. 366.

Greiner, A., Koller, U., & Semmler, w. (2011). *Debt sustainability in the European Monetary Union: Theory and empirical evidence for selected countries*. University of Bielefeld Department of Economics Centre for Empirical Macroeconomics, Working Paper no. 71.

Hall, D. (2010). *Why we need public spending*. PSIRU, Business School: University of Greenwich.

Hamilton, J.D., & Flavin, M.A. (1986). On the limitations of government borrowing: A framework for empirical testing. *American Economic Review*, 76 (4), 808–819.

Hansen, L.P., & Sargent, T.G. (1980). Formulating and estimating dynamic linear rational expectations models. *Journal of Economics Dynamics and Control*, 2, 7 – 46.

Hansen, L.P., & Sargent, T.G. (1980). *A note on Wiener-Kolmogorov prediction formulas for rational expectations models*. Federal Reserve Bank of Minneapolis Research Department Staff report 69.

Hjerpe, R., Pellervo, H., Kiander, J., & Viren, M. (2007). Do government expenditures increase private sector productivity? : Cross – country evidence. *International Journal of Social Economics*, 34(2), 345-360.

Huang, C.H., & Lin, K.S. (1993). Deficits, government expenditures, and tax smoothing in the United States: 1929-1988. *Journal of Monetary Economics*, 31, 317-339.

Hussain, M. H. (2004). On the causal relationship between government expenditure and tax revenue in Pakistan. *Lahore Journal of Economics*, 9(2), 105-117.

Jalil, A., & Muhammad, A. (2010). Revenue and expenditure nexus: A case study of Romania. *Romanian Journal of Fiscal Policy*, 1(1), 22-28.

Jargue, C.M., & Bera, A.K. (1981). Efficient tests for normality, homoscedasticity and serial independence of regression residuals: Monte Carlo evidence. *Economics Letters*, 7(4), 313-318.

Jayawickrama, A.M. (2006). *Essays on Fiscal sustainability and tax smoothing, and fiscal policy simulation experiments for Sri Lanka*. Department of Economics National University of Singapore published Ph.D Thesis.

Jayawickrama, A.M., & Abeysinghe, T. (2006). *Sustainability of fiscal deficits: The U.S. experience 1929-2004*. Singapore Centre for Applied and Policy Economics (SCAPE) Working Paper Series No. 2007/01.

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

Kaur, B., Mukherjee, A., Kumar, N., & Ekka, A.P. (2014). *Debt sustainability at the state level in India*. Reserve bank of India Working Paper Series WPS 07/2014.

Keele, L., & Kelly, N.J. (2006). Dynamic models for dynamic theories: The ins and outs of lagged dependent variables. *Political Analysis*, 14 (2), 186–205.

Kiguel, M. (2013). *Addressing the Eurozone crisis: Lessons from Latin America*. Think Tank 20: New Challenges for the Global Economy, New Uncertainties for the G-20.

Krogstrup, S. (2002). *Public debt asymmetries: The effect on taxes and spending in the European Union*. European Central Bank: Working Paper No. 162.

Krugman, P. (1988). Financing versus forgiving a debt overhang. *Journal of Development Economics*, 29, 253–68.

- Kremers, J.J. (1989). U.S. federal indebtedness and the conduct of fiscal policy. *Journal of Monetary Economics*, 23, 219 – 238.
- Labonte, M. (2012). *Reducing the budget deficit: Policy issues*. Congressional Research Service (CRS) Report for Progress.
- Lerner, A.P. (1943). *Functional finance and the federal debt*, in the selected economics writings of Abba P. Lerner.
- Lusinyan, L., & Thornton, J. (2007). The revenue-expenditure nexus: Historical evidence for South Africa. *South African Journal of Economics*, 75(3), 496-507.
- Malick, H. (2005). *An economic analysis of domestic debt of the central government in India*. University of Mysore, Institute of Social and Economic Change Published Ph.D Thesis.
- Masenyetse, R.F., & Motella, I.S. (2012). Government revenue-expenditure nexus in Lesotho: the decline in SACU revenue. *American Journal of Economics*, 2(1), 8-14.
- Mehmood, R., & Sadiq, S. (2010). The relationship between government expenditure and poverty: A cointegration analysis, *Romanian Journal of Fiscal Policy*, 1(1), 29-37.
- Mithani, D.M., & Khoon, G.S. (1999). Causality between government expenditure and revenue in Malaysia: A seasonal cointegration test. *ASEAN Economic Bulletin*, 16(1), 68-79.
- Mpofu, B. (2009). *The relationship between stock market returns and inflation: New evidence from Sub-Saharan Africa*. St. Andrews University, PhD Thesis.
- Murat, A., & Murat, T. (2009). Is fiscal synchronization hypothesis relevant for Turkey? Evidence from cointegration and causality tests with endogenous structural breaks. *Journal of Money, Investment and Banking*, 12, 14 – 25.

Musgrave, A.R., & Musgrave P.B. (1976). *Public finance in theory and practice*. Second edition: Mcgraw Hill co.

Mustafa, H., & Tayeb, A. (2011). The determinants of public expenditure in Jordan. *International Journal of Business and Social Science*, 2(8), 45-49.

Ndahiriwe, K. (2007). *Temporal causality between taxes and public expenditures: The case of South Africa*. University of Pretoria, Department of Economics Working Paper Series 2007-09.

Ndoricimpa, A. (2013). *Analysis of asymmetries in the tax-spending nexus in Burundi: evidence from threshold modeling, TAR and M-TAR Models*. Work-In-Progress Submitted to the African Economic Research Consortium (AERC).

Nelson, C.R., & Plosser, C.I. (1982). Trends and random walks in macroeconomic time series: Some evidence and implications. *Journal of Monetary Economics*, 10, 139-162.

Nyamongo, M., Sichei, M., & Schoeman, N. (2007). Government revenue and expenditure nexus in South Africa. *SAJEMS*, 10(2), 50-61.

Obioma, E.C., & Ozughalu, U.M. (2010). An examination of the relationship between government revenue and government expenditure in Nigeria: Cointegration and causality approach. *Central Bank of Nigeria Economic and Financial Review*, 48(2), 35-57.

Payne, J. (2003). A survey of the international empirical evidence on the tax-spend debate. *Public Finance Review*, 31, 302-323.

Peacock, A., & Wiseman, J. (1961). *Growth of public expenditure in the United Kingdom*. NBER and Princeton Press.

Philips, P. C. B., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, 75, 335-346.

Pierre, P. (1989). The great crash, the oil price shock, and the unit root hypothesis. *Econometrica*, 57, 1361-1401.

Raju, S. (2008). *The revenue-expenditure nexus: evidence for India*. Contemporary issues and ideas in Social Sciences: University of Mumbai.

Ricardo, A.D. (1951). Principles of political economy and taxation. *Works and Correspondence*, 1, Cambridge: Cambridge University Press reprint.

Russell, D., & Mackinnon, J. G. (1993). *Estimation and Inference in Econometrics*. Oxford University Press.

Sadeghi, S., & Karimi, P.S. (2012). Relationship between government spending and revenue: Evidence from oil exporting countries. *International Journal of Economics and Management Engineering (IJEME)*, 2(2), 95-97.

Sampaio, R.M., & Lima, R.L. (2006). *The asymmetric behaviour of the U.S. public debt*. Graduate School of Economics, Getulio Vargas Foundation.

Sargent, T.J. (1978). Rational expectations, econometric exogeneity, and consumption. *Journal of Political Economy*, 86(4), 673 – 700.

Stanislaw, J., & Yergin, D. (1998). *Excerpt from John Maynard Keynes profile in the commanding heights*. Reprinted by permission of Simon & Schuster, Inc., N.Y.

Shonchoy, A.S. (2010). *Determinants of government consumption expenditure in developing countries: A panel data analysis*. IDE Discussion Paper No. 266.

Shonchoy, A.S. (2010). *What is happening with the government expenditure of developing countries-a panel data study*. IDE: Chiba, Japan and University of New South Wales.

Stegarescu, D. (2013). *Does expenditure composition influence the debt level? Evidence from German federal states.* Deutsche Bundesbank Discussion Paper No 52/2013.

Subhani, M. I., Hasan, S. A., Osman, A., & Rafiq, T. (2012). An investigation of granger causality between tax revenues and government expenditures. *European Journal of Scientific Research*, 68(3), 340-344.

Suresh, C., Manjunath, S.M., & Vaman, H.J. (1999). Least squares estimation for linear explosive models and its ramifications. *Statistical Methods*, 1, 54-64.

Templeman, J.H. (2007). James M. Buchanan on public-debt finance. *The Independent Review*, 10(3), 435 – 449.

Wagner, A. (1883). *Three extracts on public finance*, translated and reprinted in R.A. Musgrave and A.T. Peacock (eds), *Classics in the Theory of Public Finance*, London: Macmillan, 1958.

Wahid, M.N. (2008). An empirical investigation on the nexus between tax revenue and government spending: The case of Turkey. *International Research Journal of Finance and Economics*, 16, 46-51.

Wawire, N.H.W. (2011). *Determinants of value added tax revenue in Kenya.* A paper presented at the CSAE Conference, on 20th-22nd March 2011, at St Catherine's College.

Wilcox, D.W. (1989). The sustainability of government deficits: Implications of the present value borrowing constraint. *Journal of Money, Credit and Banking*, 21(3), 291 – 306.

Yule, G.U. (1926). Why do we sometimes get nonsense correlations between time series? A study in sampling and the nature of time series. *Journal of the Royal Statistical Society*, 89, 1-64.

Zapf, M., & Payne, J. E. (2009). Asymmetric modelling of the revenue-expenditure nexus: evidence from aggregate state and local government in the US. *Applied Economics Letters*, 16, 871 – 876.

APPENDICES

Table A1: Descriptive Statistics: Public debt, tax revenue and government expenditure

Variable	Observations	Mean	Std. Dev	Minimum	Maximum
Public Debt	52	213218.9	308543.6	-9032.1	1160538.0
Tax Revenue	52	103824.7	160399.1	639.9	647356.6
Government Expenditure	52	143568.6	222854.2	1006.2	885490.2

Table A2: ADF and PP Unit Root Test Results: Public debt, tax revenue and government expenditure

Variable	Level			First difference		
	PD	GR	GE	PD	GR	GE
ADF	2.52	4.36	4.74	-1.07	-	-
ADF (with trend)	0.74	4.05	4.12	-2.67	1.49	-0.37
PP	4.58	6.69	6.31	-29.34*	-25.12*	-49.97*
PP (with Trend)	2.02	6.33	5.31	-32.51*	-40.18*	-59.01*

Key: PD - Public debt GR - Tax revenue GE - Government expenditure ADF - Augmented Dickey Fuller PP - Philips Perron. Asterisk indicates the coefficient is statistically significant at 1 percent level of significance.

Table A3: Johansen Cointegration Test Results

Trend: constant			Number of observations		=	49
Sample: 1963 -2011			Lags		=	3
Max Rank	Parms	Eigenvalue	Trace Statistic	1% Critical Value	Max Stat	1% Critical value
0	21	.	109.04	35.65	63.86	25.52
1	26	0.73	45.17	20.04	42.91	18.63
2	29	0.58	2.26*	6.65	2.26	6.65
3	30	0.05				

AIC = 68.77 SBIC = 69.89 HQIC = 69.19. Asterisk indicates a coefficient is statistically significant at 1 % level of significance

Table A4: Eigenvalue stability condition

Eigenvalue	Modulus
1	1
0.8740169 + 0.3762147i	0.951548
0.8740169 -0.3762147i	0.951548
-0.1353427 + 0.9177048i	0.927631
-0.1353427 - 0.9177048i	0.927631
0.2772741 +0.8730082i	0.915983
0.2772741 -0.8730082i	0.915983
-0.6755261 +0.5443591i	0.867561
-0.6755261-0.5443591i	0.867561
-0.4140733+0.733528i	0.84233
-0.4140733-0.733528i	0.84233
-0.814884+0.1187002i	0.823484
-0.814884 - 0.1187002i	0.823484
0.3907655 + 0.6308599i	0.742079
0.3907655-0.6308599i	0.742079

Table A5: Results for Granger causality tests: Public debt, tax revenue and government expenditure

Hypothesis	Coefficient	ECT	
		Probability	R-squared
Public debt does not granger cause tax revenue	-0.24*	0.01	0.61
Tax revenue does not granger cause public debt	-0.15*	0.00	0.79
Public debt does not granger cause government expenditure	-0.12*	0.00	0.57
Government expenditure does not granger cause public debt	-0.15*	0.00	0.63
Tax revenue does not granger cause government expenditure	1.31	0.17	0.72
Government expenditure does not granger cause tax revenue	-1.62*	0.00	0.81

ECT denotes the error correction term. 1% level of significance was used. Four lags were chosen by the AIC. Asterisk indicates the ECT coefficient is statistically significant at 1% level of significance.

Table A6: Results for correlation analysis: Public debt, tax revenue and government expenditure

Variable	Public debt	Tax revenue	Government expenditure
Public debt	1.000		
Tax revenue	0.741*	1.000	
Government expenditure	0.515*	0.686*	1.000

Note: Correlation between a variable and itself equals unity. Correlation among the variables was evaluated at first difference since the ADF and PP unit root tests indicated that the variables were non stationary at level. Asterisk indicates the coefficient is statistically significant at 1 percent level of significance.

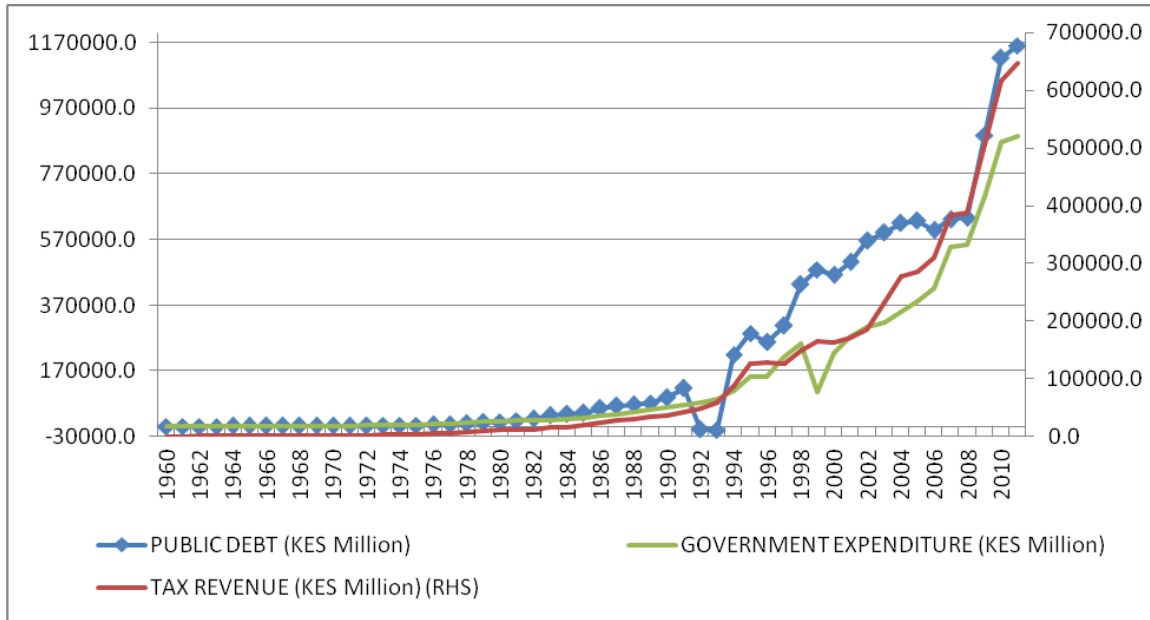
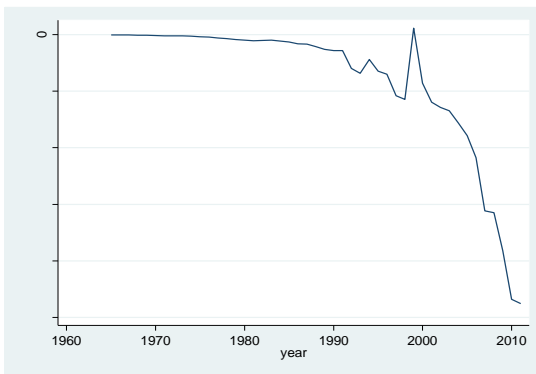


Figure A1: Trends in Public debt, tax revenue and government expenditure, 1960-2011

Cointegration equation 1



Cointegration equation 2

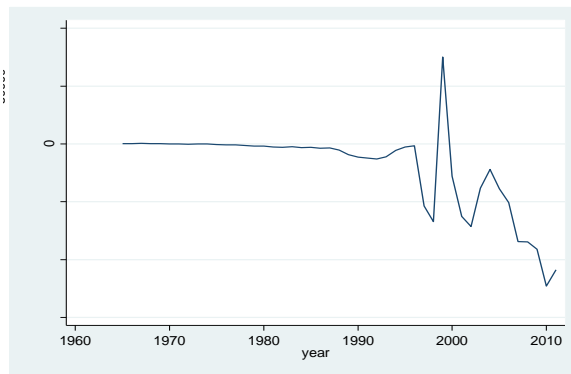


Figure A2: Residual plots for cointegration equations

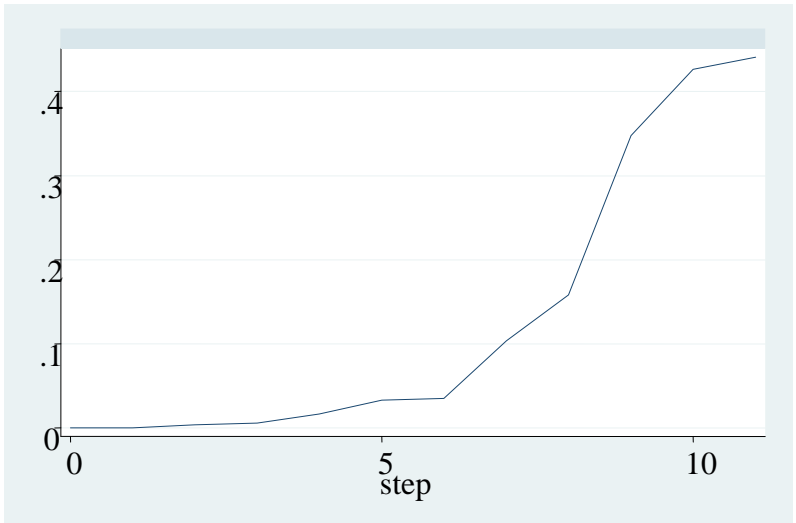


Figure A3: Graph for response of public debt to innovations in tax revenue

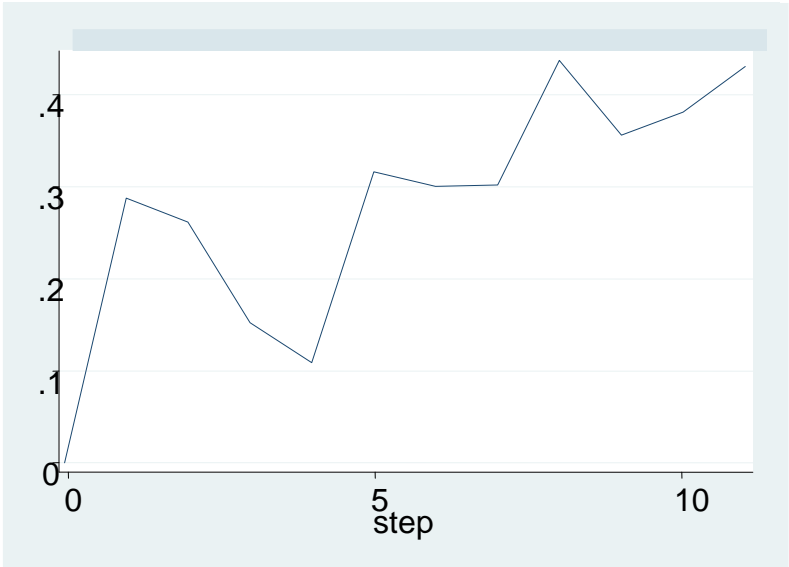


Figure A4: Graph for response of tax revenue to innovations in public debt

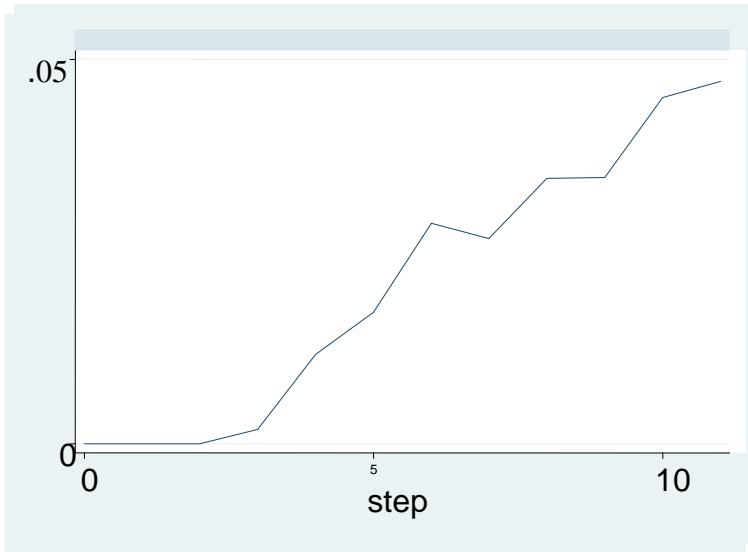


Figure A5: Graph for response of public debt to innovations in government expenditure

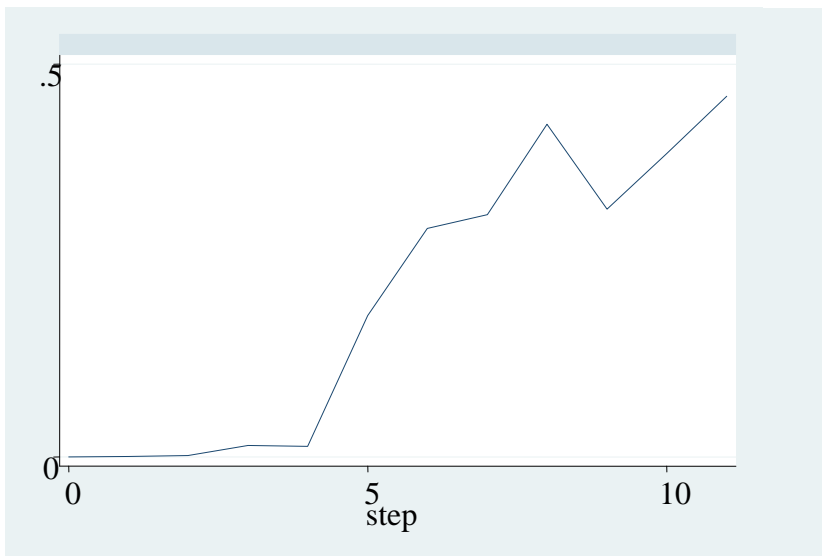


Figure A6: Graph for response of government expenditure to innovations in public debt

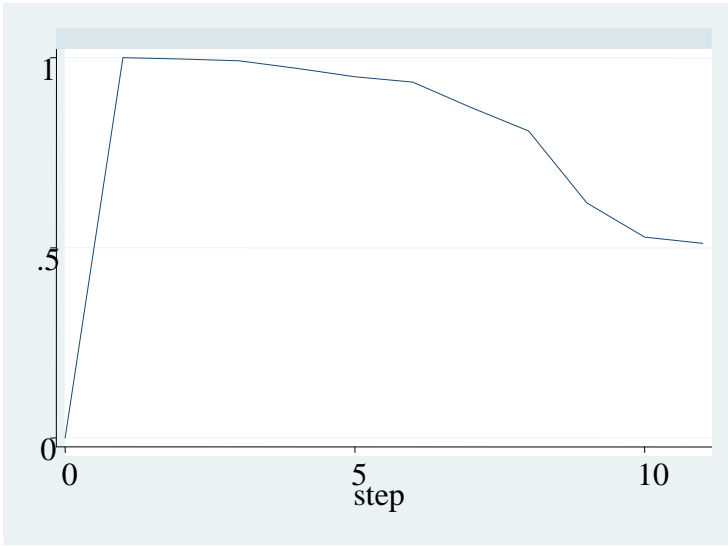
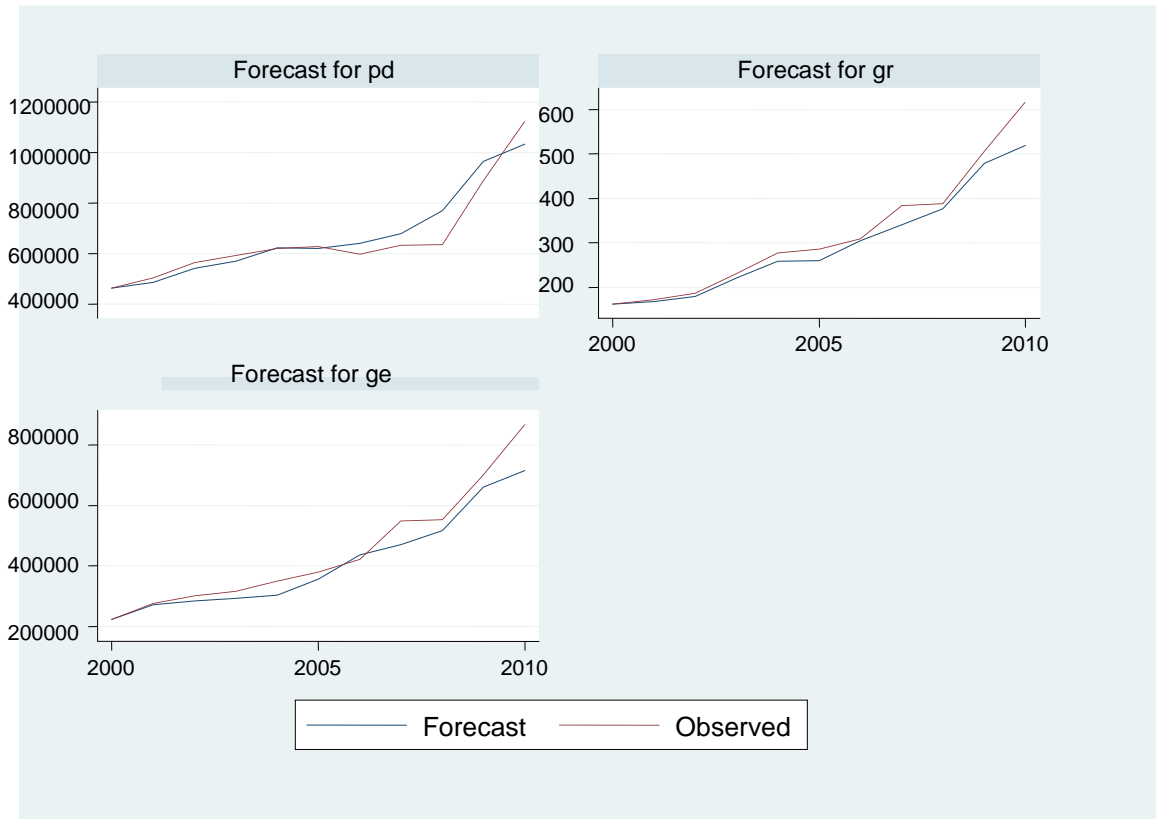
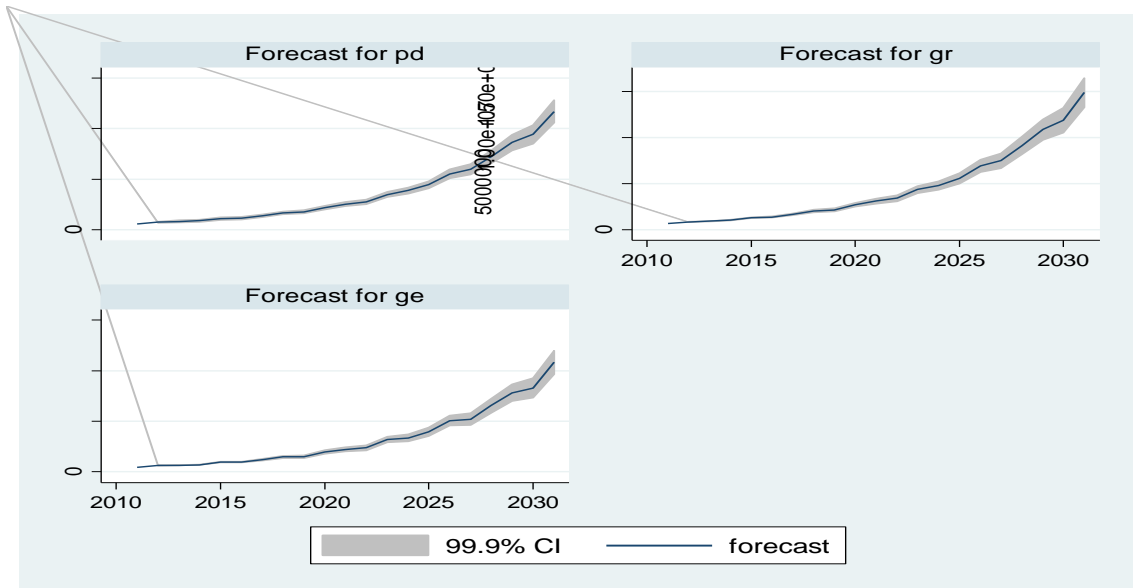


Figure A7: Graph for response of public debt to innovations in public debt



Note: Values for government revenue (gr) in the y-axis are in thousands.

Figure A8: Ex ante forecasts, public debt tax revenue and government expenditure components, 2001-2011



Note: The values for public debt (pd) and government expenditure (ge) on the y-axis lie between 0 and 3.00e+07 and between 0 and 1.50e+07 for tax revenue (gr).

Figure A9: Out-of sample dynamic forecasts, 2011-2030

Table A7: Data for Public debt, tax revenue and government expenditure, 1960-2011.

YEAR	PUBLIC DEBT (KES Million)	TAX REVENUE (KES Million)	GOVERNMENT EXPENDITURE (KES Million)
1960	1302.9	639.9	1006.2
1961	1401.4	657.5	1059.3
1962	1512.0	717.7	1116.5
1963	1643.6	794.5	1309.4
1964	1770.9	854.8	1454.6
1965	1873.4	905.5	1496.5
1966	1968.2	1038.8	1620.0
1967	1893.9	1130.8	1679.2
1968	2288.0	1390.1	2085.3
1969	2592.3	1588.1	2395.8
1970	2725.5	1847.2	2878.9
1971	2929.4	2158.8	3442.6
1972	3433.3	2375.7	3824.5
1973	4309.1	2837.9	4175.7
1974	4564.4	3400.9	4785.2
1975	5156.6	4001.3	6001.0
1976	6314.9	4953.4	7406.6
1977	6953.5	6451.7	9171.0
1978	10041.4	7804.1	11577.2
1979	13879.6	9659.8	14346.6
1980	15123.4	11010.2	15938.5
1981	19637.1	12847.4	18972.1
1982	25064.0	12754.2	19107.3
1983	35654.5	15028.0	21241.5

1984	39326.9	17026.3	24387.8
1985	42603.3	19283.5	26830.7
1986	56158.5	25118.2	34447.6
1987	63128.2	27681.6	37344.0
1988	66784.4	30784.6	43123.5
1989	73302.6	34079.2	51454.1
1990	89263.0	37264.8	57905.5
1991	117505.1	42552.0	65048.7
1992	-9003.4	48630.2	72864.7
1993	-9032.1	59430.1	83328.3
1994	219862.6	87596.8	109893.9
1995	284089.0	126789.0	152343.8
1996	257300.6	127983.7	152405.5
1997	307043.1	127257.3	212463.6
1998	433040.9	147764.5	252142.7
1999	478407.4	164966.2	105885.4
2000	462017.1	162349.9	223424.1
2001	502262.6	171976.8	275451.3
2002	565204.2	186527.4	302487.1
2003	590805.4	231878.9	316714.3
2004	619002.0	277124.7	350665.8
2005	627068.9	285786.4	380528.0
2006	598435.6	309572.1	422301.2
2007	631793.3	383692.5	548378.1
2008	635856.5	387591.7	553392.8
2009	887633.9	506791.3	700288.2
2010	1122952.7	617181.3	866484.5
2011	1160537.5	647356.6	885490.2

