GOVERNMENT INFRASTRUCTURE SPENDING AND ECONOMIC GROWTH IN KENYA: AN AUTOREGRESSIVE DISTRIBUTED LAG MODEL APPROACH

MATHEKA SUSAN K

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DECLARATION

Student's Declaration:

I hereby declare that this research project represents my own work which has not been previously presented to this or any other University for any degree award.

Matheka Susan K
Re. No: K102/CTY/PT/32681/2015

Sign: Date: 11 October 2023

Supervisor's Declaration:

This research project has been submitted for examination with my approval as Kenyatta University Supervisor.

Prof. Martin N. Etyang

Department of Economic Theory

School of Business, Economics and Tourism

Kenyatta University

Sign: Date:

DEDICATION

I dedicate this work to my parents, Joshua, and Janice, for laying a solid foundation for my education, and epitomizing hard work.

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I acknowledge God for blessing me abundantly. Of special mention is my supervisor Professor Martin Etyang for his guidance. Many thanks to all lecturers for training me in economic theory, quantitative techniques, and applied Economics, which form the base for this research project. Lastly, I acknowledge my family, friends, and classmates for their endless encouragement to pursue higher education.

LIST OF ABBREVIATIONS

ADF - Augmented Dickey Fuller Test

AIC - Akaike Information Criterion

ARDL - Autoregressive Distributed Lag

AU - African Union

CBK - Central Bank of Kenya

COVID - Corona Virus Disease

EAC - East Africa Community

ECM - Error Correction Model

ECT - Error Correction Term

FDI - Foreign Direct Investment

GDP – Gross Domestic Product

GNP - Gross National Product

GoK - Government of Kenya

HQIC - Hannan Quinn Information Criterion

ICT - Information Communication Technology

KNBS - Kenya National Bureau of Statistics

NARC - National Rainbow Coalition

OLS - Ordinary Least Squares

SBIC - Schwarz Bayesian Information Criterion

UN - United Nations

VAR - Vector Autoregression

VAR - Vector Auto Regression

VECM - Vector Error Correction Model

WB - World Bank

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OPERATIONAL DEFINITION OF TERMS

Economic Growth: Rise in the amount of goods and services produced by an economy by comparing one period to another mainly annually.

Government Spending: It entails any public expenditure undertaken either by a local or national government that make up or contribute to a significant fragment of the GNP. The expenditure is mainly composed of acquisitions, investments made in the future, and transfer payments. Future investments focus on the long-term, and thus funds are channeled into the infrastructure development such as roads, sewerage, airports, ports, and railways.

Infrastructure: The longer-lived, capital-intensive systems and facilities of a business or nation. It includes services and utilities traditionally offered by the government, such as roads and water and sewerage treatment plants, or the largely privately owned facilities, such as production of electricity, its distribution, and sales**.**

Government Infrastructure Components: Transport, ICT, and Energy and Fuel sectors. These sectors mostly entail high investments in terms of cost, and they are key to the growth and prosperity of any economy.

Transport Infrastructure Expenditure: The allocation of government spending in the transport sector.

Energy and Fuel Infrastructure Expenditure: The allocation of government spending in the energy and fuel sector.

Information and Communications Technology: The portion of government spending in the Information and Communications Technology sector.

Trade openness: The extent a country participates in international trade. It is the summation of the imports and exports of a country as a percentage of its GDP.

Foreign Direct Investment: The investment across boarder(s) where an investor in a particular country finds interest and business footing in a business enterprise in another country.

Inflation (Consumer prices): The overall rise in the goods and services price level in an economy over a given period.

National Expenditure: The total expenditure level in a certain economy.

Kenya Vision 2030: The long-term development road-map blueprint for Kenya. It is prompted by means of a collective aspiration for a higher society by 2030. Its goal is to build a state that is wealthy, can compete globally and offer high standards of living to the citizens by 2030. Its pursuit is to transform the Kenyan economic system right into a newly-industrializing, center-profits economy imparting all its citizens with a high quality of existence in an easy and relaxed environment. It is anchored on the economic, political, and social pillars.

ABSTRACT

Economic growth is one of the objectives the Kenyan government has been pursuing since independence. Economic growth has exhibited fluctuating growth rate in the last three decades. The fluctuating economic growth rate could be attributed to changes in government policies, external shocks, political shocks, and different sectoral performance. On the other hand, government expenditure has experienced a consistent upward growth. The Gross Domestic Product growth rate has experienced a slower growth rate compared to government expenditure. As part of the components of public spending, the infrastructure sector has received a consistently increasing allocation of government spending which has not been mirrored in the Gross Domestic Product growth rate. Thus, the need to analyse the impact that government infrastructure expenditure has on economic growth in Kenya focusing on transport, energy and fuel, and Information Communication and Technology sectors for the period 1990 – 2020. The specific objectives were to investigate the effect of transport, energy and fuel, and Information Communication Technology infrastructure expenditure on economic growth in Kenya. In addition, the Bounds F-test was used to test for cointegration while the Autoregressive Distributed Lag Model was employed to realize the objectives. The findings indicated that government infrastructure spending in the energy and fuel sector had negative and significant effect on economic growth in Kenya in the short run, and a positive and significant effect in the long run. Inflation rate had negative and significant effect on economic growth in Kenya in the long run. On the other hand, government spending on the Information Communication and Technology and transport infrastructure sectors exhibited insignificant effect on economic growth both in the short and long run. In addition, the short run findings of foreign direct investment exhibited a positive and insignificant coefficient while inflation rate, and trade openness had negative and insignificant coefficients. In the long run, the coefficient for trade openness was positive and insignificant, while the coefficients for inflation rate, and foreign direct investment were negative and statistically insignificant. Based on the empirical findings, the study recommends the need for the government to direct more resources towards financing infrastructure projects, thus improving economic growth. The study also recommends growing useful resource allocation in the energy and fuel sector hence creating more employment opportunities and increased productivity, thus increasing profitability, which would boost economic growth in response. Additionally, the study suggests that the government, through the Central Bank of Kenya, should ensure the inflation rate is always at favourable levels. The study further recommends that policymakers should push for domestic resource mobilization to finance the infrastructure projects instead of financing the same on external debt, which crowds out private investment. Finally, the study recommends that policymakers should develop favourable trade policies that boost trade openness and encourage investments to foster economic growth in the country.

CHAPTER ONE

INTRODUCTION

1.0 Background of the Study

African Union Agenda 2063, which is Africa's blueprint as well as a detailed plan on how to transform Africa, discusses extensively about infrastructure development. It details programs that boost Africa's economic growth and development, thus leading to a fast continent transformation. One of the goals highlighted in Agenda 2063 is the world-class infrastructure that crisscrosses Africa (Tella, 2018). This goal aims to improve connectivity among countries by developing initiatives linking the continent by air, rail, road, sea, and ICT. Thus, the priority sectors are infrastructure and communications connectivity (African Union, 2015). Additionally, Agenda 2063 goals marry with the UN Sustainable Development Goals (9), which aim to set up strong infrastructure, further inclusivity in continued industrialization, and advance innovation. Both the Agenda 2063 as well as the UN Sustainable Development Goals talk extensively about infrastructure in Africa and Kenya by extension.

The East Africa Community came up with Vision 2050, which communicates the vision and desires of the people of East Africa, then offers a blueprint towards the realization of those aspirations. It goes after the AU Agenda 2063, a document that highlights the vision of the African continent and her people. Additionally, the East African Community Vision 2050 takes up the UN Sustainable Development goals as well. The Community's desired future state is clearly articulated in the EAC Vision 2050. It provides a plan design that the EAC could use as they pull its efforts into realizing development both economically and socially. The document articulates the vision that illuminates the path that the EAC would take in

achieving their dream. The document also contains the future of the EAC in both social and economic development matters.

The third section of the document is titled "Pillars of Vision 2050," which highlights the main economic pillars that are the anchor of the EAC Vision 2050. The pillars include industrialization, infrastructure development, Agriculture, Natural resources, and Tourism. So, for the anticipated growth to happen and be retained, the countries that make up the EAC community should have tremendous growth in several sectors including transport, sewerage, water, and electricity. The growth in these sectors should be improved by the year 2050 together with boosting the values and dimensions needed for transformation both socially and economically. Integrating the different networks that include electricity systems, road, sea, air, and railways systems, will offer an essential appreciation of the region's interconnected infrastructure network. For trade growth and enhancement in the EAC member countries, good connection through infrastructure will be key as a critical goal in achieving regional integration, thus removing any barriers therefore enhancing more free flow of people, goods, and services across EAC countries. Further, EAC vision 2050 will act as a base in creating a sound background that would foresee the prioritization of project plans, development programs and projects, and activities in the region (East Africa Community Vision 2050, 2016). Kenya is a member of Africa Agenda 2063 and the East Africa Community Agenda 2050.

Infrastructure remains one of the sectors the GoK heavily spends on. The Republic of Kenya. (Various issues) show that infrastructure allocation is among the highest in every annual budgetary allocation to the various sectors in the Kenyan economy. Since infrastructure is a sector of interest to many, efforts to study it have been commendable over the years. Thus, various authors have advanced different meanings for the term infrastructure in different

studies, and reports. Ingram and Kessides (1994) recounted that infrastructure has no unique definition as it encompasses a couple of activities with related technical, economic, and financial capabilities. In their report, economic infrastructure was explained to include public functions such as public utilities (street lighting), public works (highways and water sewerage systems), and public transport infrastructure (ports and airports).

Additionally, Ascheur (1989) conducted a study that did not define infrastructure but focused on "core infrastructure," which the author highlighted to include roads, airports, water systems, and sewerage systems. According to Alberto et al. (2010), infrastructure can either be hard or soft infrastructure. Later, Kingombe (2014) adopted the exact definition in his paper exploring hard and soft infrastructure in Africa. Waweru (2014) defined infrastructure as a business or nation's longer-lived, capital-intensive systems and facilities. It includes strategies and facilities traditionally offered by the government which include roads, highways, and sewerage facilities, or the systems and facilities mainly owned privately, such as the production and distribution of electricity. The author identified four essential sectors of their classification: Transport infrastructure sector, Information Communication Technology (ICT), Mining and Quarrying, and Energy and Fuel infrastructure sectors.

Infrastructure is a crucial sector in the general good of any country, for it enhances efficiency in producing goods and services. As an observation from several studies over time, a boost in the expenditure of the government in the infrastructure sector causes an increase in the economic output which boosts demand leading to long term increase in productivity in the economy. Such an effect on economic output in the short term is determined by how it is financed and the state of the economy. Jeffrey (2018) asserts that in the long-term the way used in financing infrastructure projects affects the economic output following challenge of crowding out of private investment if such investments are financed through a deficit.

Further, different infrastructure types have other impacts on economic output. Also, any assets categorized under core infrastructure, including ports, roads, and railways, are anticipated to generate higher earnings in economic production as compared to the investments in the larger broader infrastructure categories, such as police stations, hospitals, and schools.

This study adopted three of the four essential sectors as identified in the study by Waweru (2014) that include Transport infrastructure sector, Information Communication Technology (ICT), and Energy and Fuel infrastructure sectors. These components of infrastructure spending is a selection based on the Kenya Vision 2030 Economic Pillar's emphasis, whose objective is to achieve a 10% average annual economic growth until 2030. Consequently, infrastructural development is part of the enablers and macro-foundations. Vision 2030 envisions Kenya to be well interconnected through infrastructural networks including good roads, modern railways, modern ports, airports, good water and sanitation facilities, reliable electricity, and good telecommunication. Thus, investment in the nation's infrastructure has been prioritized to achieve the above.

Government infrastructure expenditure and economic growth is an essential study area and analysis. According to Jerono, (2009), many studies conducted by scholars differ in their findings on how public spending and economic development relate particularly in Kenya. According to literature, there exists a multiplier effect from government expenditure exhibited on the economy. However, how public spending in an economy is financed remains an area of interest in matters research. In instances where borrowing is used as the main way of getting funds to back government expenditure, the public sector ends up competing with private investors for capital; thus, there is a high likelihood that private investment is crowded out, hence encouraging external borrowing and stifles economic growth (Muraya,

2013). On the flipside, the Mercantilist ideology advances the thought on government being involved in controlling externalities alongside market failures as well as in the supply of public goods.

Infrastructure development plays an integral part in economic growth. Infrastructure as a sector contributes greatly to the development of a country. The World Development Report (1994) tried to demonstrate the connection linking economic growth and infrastructure and showed that for an increase in economic growth, infrastructure is vital. While many scholars universally consent that infrastructure development is vital for development and growth, Estache and Garsous (2012) offer the view that categorizing subsectors according to their importance is not easy since different sectors get different investment allocations in other regions.

Over the past few decades, government spending on infrastructure components has increased significantly. For instance, data from The Republic of Kenya. (Various issues) show that the annual infrastructure spending by the GoK on transport (Ksh Million) averaged 4,921.35 in the 1990s and has risen to an average of 182,438.52 Ksh million in the 2010s. The same increment was witnessed in Energy & Fuel from 2,075.17 to 61,377.57 Ksh million, while ICT increased from 2,357.53 to 12,378.24 Ksh Million, respectively. During the same time (1990 - 2020), the annual GDP growth rate averaged -.94% in the first decade, increased to 1.20% in the second decade, and is currently at an average of 3.22% up to 2020. The GDP growth rate has been slower than infrastructure expenditure over the years. Measured as a percentage of GDP in Ksh Million, spending on the three infrastructure components has increased over the years, yet the GDP growth rate remained slower.

1.0.1 Overview of Government Expenditure in Kenya: 1990-2018

Government spending entails any public expenditure undertaken either by a local or national government that makes up or contributes to a significant fragment of the GNP. The expenditure is mainly composed of acquisitions, future investments, and transfer payments. The former addresses how the country can survive in the long-term, thus resources are channeled into infrastructure development projects including roads, sewerage, ports, railways, and airports (Landau, 1986). Acquisitions refer to any consumption expenditure on goods and services whether individually or publicly commonly referred to as final consumption expenditure. Such consumption expenditure may also include the imported goods, salaries paid by the government, expenditure in the education sector, spending on military acquisitions, all the administrative costs incurred by the government, and allocations or funds for the sector of defence (Mitchel, 2005).

Government spending can either be current or capital. Current government spending entails the government expenditure in providing goods and services on current basis, such as weekly, monthly, or annually. They include salaries and resources for state ministries, agencies, and departments such as education and defence, among others. Capital spending on the other hand includes expenditure on infrastructure investments including ports, railways, airports, schools, roads, hospitals, and markets.

Government spending is essential in guaranteeing the effortless operation of the economy. Since a free-market economy cannot efficiently provide some goods, while others may be under-provided, this calls for the government expenditure. The government must intervene to reduce the negative effects of externalities in a country, including controlling pollution, and offering subsidies to industries that need financial support and the private sector is unable to offer the same. The government can also pump extra money into the macro-economy and aid

in boosting the aggregate demand in an economy thus increasing economic activity. Christiano et al. (2011) noted that a stimulus of that type is one of the discretionary fiscal policies. As a fact, expenditure by the government on the essential sectors that produce goods and services to the citizenry such as health, education, and security among others, carries the greatest allocation of government spending (M' Amanja and Morrisey, 2005). Thus, we cannot overlook how significant government spending is for the economy to operate smoothly.

For the years under study (1990 – 2020), public spending in Kenya exhibits an upward trend. However, the growth in expenditure is not proportionate to the growth in revenue, thus leading to persistent budget deficits forcing the government to borrow externally to meet each year's budgetary allocations. The increase in government borrowing has further contributed to expanding the public debt (Ndungu, 1995). Thus, government spending has been on the rise for that period under study and so is the public debt.

In illustrating the upward trend exhibited by the government spending in Kenya in the recent past, data shows that there was a notable increase in government spending in Kenya to Kes 677,726.60 million in 2018 from Kes 670,758.50 million in 2017. Additionally, government spending showed an average of Kes 159,035.54 million from 1964 up to 2020, attaining the highest amount of Kes 677,726.60 million in 2018 and the lowest amount of 998 KES Million in 1964.

1.1 Composition of Government Infrastructure Expenditure by Components in Kenya

In terms of composition, government expenditure has favoured current spending compared to development expenditure. However, this study focuses on the development infrastructure

expenditure, which comprises three components, Transport, Energy & Fuel, and ICT, for the period 1990 - 2020. Figure 1.1 illustrates the three components of infrastructure expenditure.

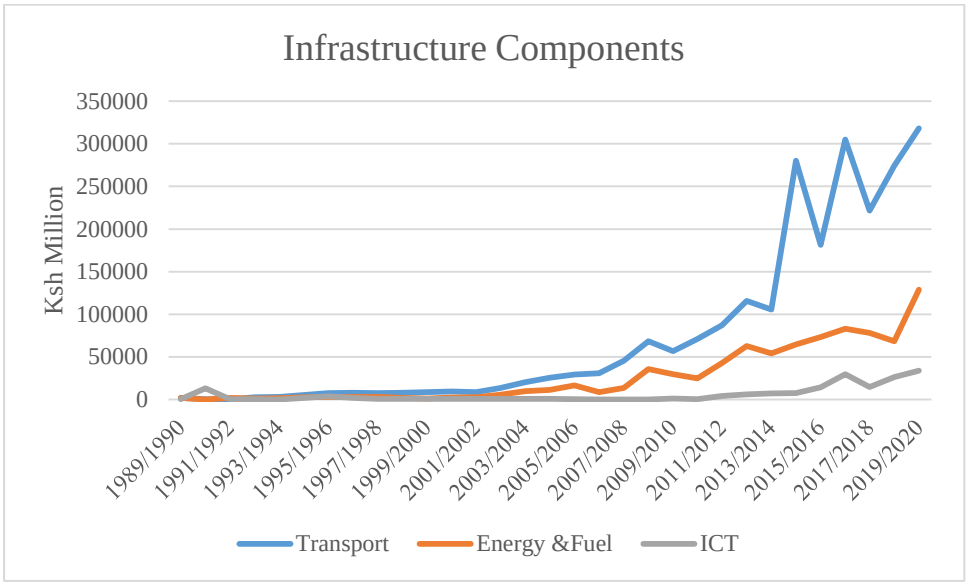

Figure 0:1.1: Components of Infrastructure Expenditure

Source: Author's calculation; data from Statistical Abstracts (1989-2020)

The various components of infrastructure expenditure in Million Kenya Shillings are presented in figure 1.1. According to the presentation, the transport function takes the largest share among the three sampled components throughout the study period, followed by fuel & energy, and ICT, respectively. Figure 1.1 also shows that transport and energy expenditure began to pick from 2003 while ICT expenditure has remained very low throughout the study period. Significantly, transport expenditure rose from Kes 5806 million in 2003 to Kes 274111 million in 2018, while spending on energy and fuel increased from Ksh 69 million to Ksh 68479 million over the same period. However, beginning in 2014, there has been a fluctuation in transport expenditure, mainly driven by the disputed 2013 general election. Thus, the components of public infrastructure expenditure in Kenya depicts the transport sector having had the highest government spending allocation, followed by the energy and

fuel sector, then ICT in that order for the period under study and more with a visible rise as from the year 2004.

1.2 Overview of Economic Growth in Kenya

Over the years, Kenya's economic growth rate has exhibited instability. The country's economic growth has been driven mainly by the agriculture, transport, forestry, ICT, manufacturing sectors (Maingi, 2010). However, the overall economic growth as a percentage of GDP has not been at par with the ever-increasing government spending. While the recurrent and development expenditure has been steadily increasing, the economic growth has always fluctuated to even negative rate, as in the illustration below.

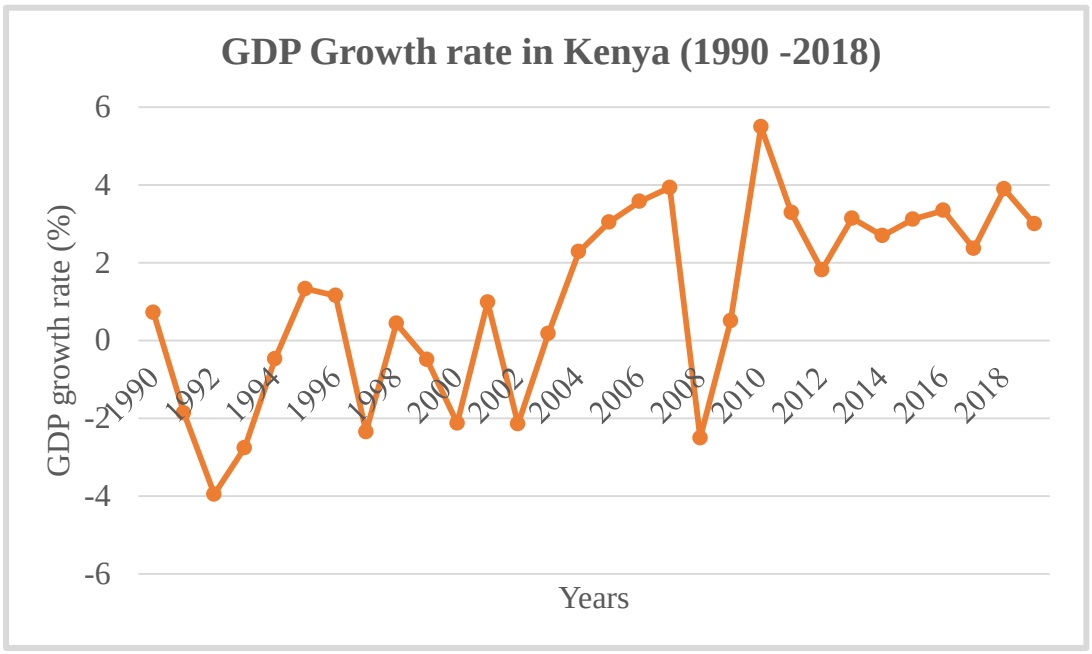

Figure 1.2 The GDP growth rate in Kenya (1990-2018)
Source: The World Bank Database (1990-2018)

The annual GDP growth rate from 1990-2018 is illustrated in figure 1.2. The GDP growth rate averaged 0.7 percent in 1990 before plummeting to a negative 3.9 percent in 1992, which is attributable to the political instability the country experienced in 1992 that led to a sharp decline in economic activities in all sectors.

After that, the economic growth increased steadily to about 1.5 percent in 1996. However, between 1997 and 1998, the economic growth declined to a negative 2.3 percent. The decline in economic performance was mainly attributed to anxiety due to political tension and the 1997 general elections, which escalated into violence. Kenya's economic growth registered tremendous growth from 2003 to 2007, reaching a high of 3.9 percent. However, due to the disputed 2008 general election, the economy decelerated to a negative 2.5 in 2009. The creation of the unity government comprising the ruling party NARC and the opposition ensured a stable environment, thus stimulating performance in various sectors of the economy. The economy's stability favoured investment, and increased productivity in diverse sectors that led the economy to record a GDP growth of 5.5 percent in 2010. Since 2011, the GDP growth has fluctuated from 1.8 in 2012 to about 3.8 in 2018. Corona Virus Disease (COVID-19) is also expected to negatively affect overall economic growth from the year 2020. The fluctuating economic growth rate could be attributed to changes in government policies, external shocks, political shocks, and different sectoral performance.

1.3 Statement of the Problem

Over the years, persistent variations in both the economic growth rate and government expenditure in Kenya have been increasing. As indicated in figure 1.1, transport expenditure rose from Kes 5806 million in 2003 to Kes 274111 million in 2018, while spending on energy and fuel increased from Ksh 69 million to Ksh 68479 million over the same period. The GDP growth rate exhibits a slow but fluctuating rate over the period under study. There are variations between GDP growth rate and government expenditure. But there is minimal research conducted on the subject to establish the causes of the variations. The subject of government spending on infrastructure components and economic growth has not been well explored. Scholars have researched on this field over time and come up with varied findings.

Several factors would be attributed to these diverse findings. From theory, a rise in government spending on some sectors including infrastructure, education, and health, is anticipated to exhibit rise in economic growth, however, this is rarely observed Kenya. Several studies have been conducted looking into this subject including Landau (1983), Davarajan et al. (1993), Tanzi and Zee (1997), Njuguna (2009), Maingi (2010) among others. The findings are inconclusive and unconvincing hence the need for this study.

Further, Tanzi and Zee's (1997) findings showed no connection between government size and economic development. Aschauer's (1989) found out that public stock that is non-military is more significant in establishing productivity as compared to the flow of military or non-military spending. The findings also showed that military capital has a minimal connection to productivity while infrastructure investment in airports, street lighting, roads, water systems and sewers contribute greatly to productivity. The findings are contradicting. However, according to existing theory by Keynes (1936), SolowSwan (1956) and Musgrave and Musgrave, (1989) government spending positively affects economic growth.

In Kenya, government spending on infrastructure has been on an upward trend for the last three decades as GoK tries to boost economic growth alongside fostering the achievement of the Vision 2030 economic pillar. The impact that such a rise in government spending on components of infrastructure on economic growth is little, demonstrated by a constant but moderate economic growth rate with some significant fluctuations as shown in figure 1.2. The GoK spends significant sums of money each year on physical infrastructure (Transport, ICT, and Energy & Fuel), as evidenced by the reports in the statistical abstracts over the years. However, there is minimal empirical work showing how government spending affect Kenya’s economic growth. Theory presents such an upsurge in government spending on infrastructure components is anticipated and that the economic growth rate responds rapidly

and positively. However, according to Colombier (2011), this does not take place mainly because of some expenditures that do not enhance growth, but crowds out private investments thus decrease economic growth. Therefore, the current study investigated the effect government spending on infrastructure components has on economic growth in Kenya using the ARDL Model Approach.

1.4 Research Questions

The study sought to answer the following questions.

i. What is the effect of transport infrastructure expenditure on economic growth in Kenya?
ii. What is the effect of energy & fuel infrastructure expenditure on economic growth in Kenya?
iii. What is the effect of ICT infrastructure expenditure on economic growth in Kenya?

1.5 Objectives of the Study

The general objective of this study is to examine the relationship between government infrastructure spending and economic growth in Kenya using an Autoregressive Distributed Lag (ARDL) model approach.

The specific objectives addressed included.

i. To determine the effect of transport infrastructure expenditure on economic growth in Kenya.
ii. To find out the effect of energy & fuel infrastructure expenditure on economic growth in Kenya.
iii. To investigate the effect of ICT infrastructure expenditure on economic growth in Kenya.

1.6 Significance of the Study

The existing connection linking infrastructure components and economic growth in Kenya is brought out in this study. The study explores government expenditure effect on the various infrastructure components (transport, ICT, and energy and fuel) on GDP growth rate. Further, the study informs policymakers on the components of infrastructure that are the key contributors of economic growth and their contribution to achieving vision 2030. The study offers recommendations on the infrastructure components that require more investment than the others. The findings contribute to the existing body of knowledge on infrastructure and economic growth.

1.7 Scope of the Study

The years 1990-2020 were covered by the study. The period is long enough to fully accommodate the responsiveness of economic growth following expenditure of the government on the three infrastructure components. In addition, this period is long (30 years) to fully grasp the trend and behaviour of the infrastructure components (transport, energy, and ICT) following annual budgetary allocations to the sectors. Further, during this period, Kenya witnessed her economic growth journey, with the Vision 2030 blueprint being developed and implementation starting during this period. Lastly, reliable data is available in the different statistical abstracts published annually by Kenya National Bureau of Statistics for government expenditure on infrastructure. In this study, the data covers three sectors: energy, transport, and ICT.

1.8 Organization of the Study

The study is organized in five chapters. The first chapter introduces the study, states the problem and highlights the objectives. In chapter two, the relevant theoretical and

empirical literatures are reviewed and then overview of the theoretical framework presented. The research design and methodology are presented in chapter three. Chapter four present data analysis and interpretation while chapter five will give the summary, conclusion of the study and draw policy recommendations as pertains the research findings.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

The chapter has three parts; part one examines the theoretical literature that is applicable to this current study and the theoretical framework of the model; part two reviews the studies undertaken on the subject, while part three is the mix of the two sections to give literature overview.

2.1 Theoretical Literature

Varied explanations on economic growth and government expenditure have been offered by various theories. Those theories are discussed below.

2.1.1 Solow – Swan Growth Model (neo-classical model)

Robert Solow and Trevor Swan came up with this theory in the year 1956 and it addresses the long-run economic growth. The theory states that economic growth results from labour, capital, and technology. It aims at explaining the long run economic growth by looking into capital build-up, growth of population, and increased productivity mainly directed by progress in technology. Since saving and investment forms an integral part of economic growth, a rise in either, causes a rise in the stock of capital, and thus increases the full employment of the national income and product. In circumstances where countries have similar population growth rate (g), the same rate of savings (s), and similar rate of capital depreciation (d), then they are said to have similar constant state thus able to converge. Thus, the conditional convergence is predicted by the Solow Growth Model.

Further, according to this model, expanding population growth rate boosts aggregate output growth rate, though it lacks permanent impact on the rate of growth of per capita output. Thus, increase in population slows the per capita output level stability. The model concludes that physical capital build-up should not be considered in the expansive growth covering some period in per capita output, and in the long-term, accumulated capital generates growth to the level that it embraces the improved technology, (Solow, 1956). The Solow-Swan model is a growth model; however, it cannot satisfactorily explain growth in the long run, thus forming the model's limitation. Therefore, there is no long run growth of per capita income, and there is an exogenous rate (n) that is given on which the aggregate income grows at but no attempt by the model to explain it.

2.1.2 The Peacock and Wiseman Theory

Peacock and Wiseman (1890-1935) developed this theory based on an empirical study conducted in Great Britain. The theory focused on the pattern of public expenditure and concluded that public expenditure does not rise in a smooth and continuous manner. Linked to the theory are three concepts including displacement effect, inspection effect, and concentration effect. The political theory of determination of government spending forms the backbone of the theory. It states that the public sector keeps spending more money, however, the citizens dislike paying taxes. The model carries an assumption that some taxation level that is tolerable to the citizens acts a limitation on government behaviour. According to Peacock and Wiseman, (1961) the continued growth in the economy causes a rise in the tax revenue, thus increasing government spending alongside the GNP. In periods when an economy experiences disruptions socially including famine or war times, the slow but consistent upward government expenditure trend would be distorted by being displaced upwards. The government is forced to raise the taxation level to fund the increased

government expenditure. According to Peacock and Wiseman, (1961), the citizens would accept the policy during the period of crisis period forming the displacement effect. This births a new tax tolerance level among the citizens. The new level of taxation is easily embraced by the citizens though it was intolerable previously. Furthermore, there is an expectation by the public that the government should ensure that the economy fully heals and adjusts into the new level of taxes and social ideas, otherwise this would lead to an inspection effect. The combined outcome of the inspection and displacement effects is the sporadic short-term leaps occasioned in government expenditure within an increasing long-term movement.

The theory is significant to the economy of Kenya as the nation has gone through several displacements including famine, tribal wars, and election violence. According to The Republic of Kenya (2003), during such periods, the government expenditure showed an upward increase in the periods that follow without fail. However, in some years government expenditure goes up without experiencing any war or famine thus making the theory incomprehensive.

This theory poses some shortcomings; first, it side-lines the fact that an upward displacement in the public spending can be financed by the government using various sources of finances such as funds from donors, borrowing externally, or proceeds from the sale of government fixed assets. The result is that there would no upward trend effect on taxes. This theory has faced criticism for it accords political influences effect on government expenditure less importance. However, the theory gives little explanation on what happens to spending after the war period. Displacement effect is not experienced in the long-run situations where civilian government expenditure in the periods after such war disturbances go back to the former path of growth. The same applies to instances where a short-term rise in after war

civilian spending up to the point the original trend line is attained. Also, after the occurrence of the postponed civilian public expenditure after the war, public outlays are seen to bounce back to the original level before the war happened.

2.1.3 Musgrave Theory of Public Expenditure Growth

Musgrave established it in 1989 while analysing the income elasticity of demand variations. According to Musgrave (1989), per capita income is grouped into three levels upon which public goods and services demand is credited to. While addressing this first level which is the per capita income low level, Musgrave postulates that public services demand is little mainly because the available income is fully used in meeting primary needs. Rising per capita income in the economy past the low-income levels, causes a rise in the demand of the services offered by the government including health, security, defence, among others. Consequently, the government is forced to increase the expenditure allocation on such sectors.

The third category is the high per capita levels. Musgrave further explained that at this level, which is mainly in the developed economies, there is a decline in growth rate of the public goods as the citizens already have their basic needs met (Musgrave, 1989). Further, Musgrave and Musgrave (1989) highlighted that in the economy, the share of public sector rises progressively as nations continue to experience industrialization. This theory asserts that economic growth and government activities in any economy have a correlation. This translates to the sectors of the government experiencing a faster growth than the economy (Musgrave, 1989). Therefore, the theory concluded that all types of government spending, regardless of their level, size, or intention, show the exact pattern in raising public spending.

In summary, Musgrave's theory suggests that the per capita income of any economy increases alongside growth of the public spending relative size. Thus, there will be rise in towns and cities following the growth in the economy as well as the increase in the social vices linked to the increase in urban centres such as crime, and drug abuse. The social crimes call for government intervention to aid in curbing or reducing such vices to very minimal levels. In ensuring law and order in a country is maintained as well as curb external security threats, internal security services as well as defence services are employed by the government. Such government interventions in the economy push the government to incur costs that in return increase government expenditure in the economy.

According to this theory, a rise in the government capital expenditure boosts both economic growth and recurrent government expenditure. However, a rise in recurrent expenditure by the government does not translate to a meaningful growth of the economy. Moreover, it shows the impact of government development expenditure is of higher importance compared to recurrent government expenditure on economic growth.

2.1.4 The Keynesian Theory

Keynes (1936) states that public expenditure is a positive contributor to economic growth. It assumes public expenditure to be an exogenous capable of being used as a policy instrument in boosting economic growth. Consequently, government spending is observed to augment the aggregate demand, resulting to increased output which solely depends on the economic expenditure multipliers, (Keynes, 1936). Therefore, increasing government spending will most likely cause a rise in employment, boost profitability, thus creating more investment opportunities using the multiplier effect on the aggregate demand.

In addition, Keynes (1936) noted that the economy is subjected to variations, thus the supply and demand have the capacity to balance out fully at an equilibrium. However, there is no full employment delivered by this balancing out of the forces of demand and supply. Keynes offered the macroeconomics foundation, a discipline that assumes the economy to be an aggregate with the focus on how the government uses fiscal policy spending, taxes, and deficits. To deal with this problem, the government should replace private investment which is missing with public investment that can be well financed by intentional deficits. This means that the government borrows externally then spends the money providing goods and services for example, in the provision of street lighting, and in the construction of roads. In return, the deficit spending creates more employment opportunities thus raising the purchasing power of citizens. Any efforts to balance the government's budget in periods of a recession could worsen the situation. To add weight to this argument, Keynes deployed a variety of new tools that were used for standardized national income accounting leading to the GNP concept; the no aggregate demand notion, and government expenditure multiplier which leads to creation of more job opportunities. The national income accounting tools could be employed in managing aggregate demand. The tools ensure that full employment is attained. After achieving full employment, the government would trim its spending on the economy during the periods of regaining and growth (Knack and Keefer, 1995).

According to the Keynesian theory, the government has the responsibility of market intervention, offering subsidies, and controlling market failures and externalities. Therefore, the government should be in the forefront in matters revolving around the economy. This applies to Kenya as it is the anchor upon which the economy operates to promote economic growth as a very efficient policy instrument. The high levels of employment witnessed in most of the developed economies can be attributed to the universal acceptance of the Keynesian theory. Consequently, the change in perception and attitudes on the state’s role in

the welfare of an economy is also attributable to this theory (Knack and Keefer, 1995). However, the Keynesian theory has a great limitation in that it does not fully factor in the problem of inflation for which the increase in government spending might bring about**.** Therefore, the relevance of the theory to the Kenyan situation is critical as it is the anchor upon which the economy operates in a bid to promote economic growth as a very efficient policy instrument.

2.2 Empirical Literature

Devarajan et al. (1993) while covering 14 developed countries between the year 1970 to1990, used OLS on panel data, and a five-year gap moving average to investigate the subject of government expenditure and economic growth. The study employed several functional categories of public spending including education, health, and transport among others as the independent variables. Expenditure was grouped into productive and non-productive. The results indicated that the coefficients of three sectors (health, transport, communication) are significant and exhibit a positive effect on economic growth, but defence and education negatively affect economic growth.

Kalio (2000) while studying government expenditure and Kenya's economic covering the years 1970-1992 then employed OLS on the time series data. Government expenditure on some sectors like defence, education, and agriculture positively affected GDP growth. Health, transport, and communication had an inverse relationship with economic growth.

Bose et al. (2003) investigated the growth effect of sectoral government expenditure, on thirty developing countries, by using panel data covering the years 1970-1980. The results were in two stages. First, the capital expenditure's allocation in GDP was significant and

directly correlated with economic growth, while current expenditure showed insignificance results. At stage two which is the sector level, government investment expenditures on education sector were positively associated with economic growth after considering budget limitations and excluded variables are considered at level one.

Jerono (2009) studied the impact of government spending on economic growth in Kenya. The findings show government spending on education is directly correlated to economic growth; however, it did not stimulate meaningful change in economic growth. There is a mismatch between expansion in higher education and growth in job creation in Kenya, a scenario that contributes to the availability of limited job opportunities for university graduates. The findings indicated that education as a sector was responsible for the excess graduates produced each year and the prolonged delays for jobs from the government. The conclusion was that a rise in government expenditure does not solely trigger economic growth.

Maingi (2010) examined the impact of government expenditure on economic growth in Kenya (1963 – 2008) with a focus on defence, security, physical infrastructure, healthcare, education, government investment, and government consumption as the components. VAR estimation method was applied on the annualized time series data from 1963 – 2008. The results highlighted that expenditure on economic affairs, defence, physical infrastructure, and education, positively impacts economic growth in the long term. Security, health, and public order influence economic growth positively, whereas public debt servicing negatively impacts economic growth. Additionally, the findings showed that reforms in government expenditure affect economic growth. The conclusion was that the various government spending components and public expenditure reforms are key to Kenya's economic growth.

Muthui et al. (2013) undertook a study in Kenya on the impact of the public spending composition on economic growth (1964-2011). They investigated some government

expenditure components, including education, infrastructure, health, and defence. The study employed VECM in estimating the data. Further, the study findings demonstrated that education was positively related with economic growth but triggered a very insignificant change in economic growth. Nevertheless, expenditure on education showed a higher effect on economic growth. Further, expenditure on health boosts labour productivity. Finally, the survey showed that to boost spending on public utilities, including defence and public order, the government would encourage private and public investment and regulate the same through policies to create balance.

Gisore et al. (2014) researched on the effect of government expenditure on economic growth in East Africa covering the years between 1980 and 2010. The disaggregated model was employed, and it concentrated on three countries: Kenya, Uganda, and Tanzania. Using the balanced panel fixed effect model, the study aimed at determining the expenditures that have some effect on economic growth in the three countries. Findings indicated that expenditure on agriculture, and trade openness were positive and statistically significant in their relationship to economic growth. Contrary, there were insignificant findings on the expenditure on education and agriculture though it hurt economic growth. The survey concluded by advocating for more policies that boost government expenditure on some sectors including health and defence thus enhancing economic growth in the three countries but spend less on the other sectors, including agriculture.

Muguro (2017) researched on this subject in Kenya covering the period 1963 to 2015 and used annualized time series data. Two categories of government expenditure were used: recurrent and development. The study used VAR estimation method for the period under. Further, the Distributed Lag Model was adopted by lagging X-variables while establishing the link between the two. The outcome depicted an insignificant effect on economic growth.

Therefore, the conclusion was that the Kenyan government should stir up programs that boost public investment, thus spurring increase in economic growth.

Mukui et al. (2019) while studying public spending and economic growth in Kenya covered the years between 1980 and 2014. ARDL and Granger causality was employed. The study used various components of public expenditure, including development expenditure, government purchases, education, infrastructure, health, domestic savings, and trade openness. The ARDL results indicated that development expenditure boosts economic growth but purchases by the government purchases exhibit an insignificant impact on GDP. Further, spending education and health increases economic growth. Moreover, domestic savings and infrastructural investment positively impacted economic growth. As per the study, the government should allocate more resources to the infrastructure investment and education sectors, thus enhancing the general economic performance and labour productivity consecutively.

Njiru et al. (2020) researched on government infrastructure investment effect on the economic growth of Kenya between the years 1990 and 2017. The independent variables used were economic infrastructure, social infrastructure, private investment, and labour force. This study used ECM in estimation and OLS in conducting the regression analysis. The Granger causality test findings showed that economic infrastructure investment is among Kenya's causes of economic growth while social infrastructure investment was positively correlated to economic growth. Moreover, the findings highlighted that government investment in economic infrastructure positively and significantly affected the economy’s growth rate. Contrary, social infrastructure investment negatively and insignificantly affect economic growth. This study recommended that a conducive business environment is critical

to encourage investment from the private sector which in return creates employment opportunities in the country.

2.3 Overview of Literature

The studies reviewed show that the subject of government expenditure and economic growth is of great importance in any economy, Kenya not an exception. Whether public expenditure stimulates economic growth or not has been of great interest for both theoretical and empirical studies for a long time. As indicated, some scholars believe that government expenditure promotes growth, while others believe that government operations hurt economic growth. The variations in the outcome of the findings can be accredited to usage of different explanatory variables by various studies, their combinations, and their application in different studies undertaken in different areas. Additionally, the empirical literature available focused on the already developed countries until, in the recent past, studies in developing countries, particularly Kenya, have been undertaken. The results do not show a similar relation that exist connecting economic growth rate and government spending. The methodologies used are diverse, hence the varied outcome. In Kenya, there are few studies carried out in this area. Also, the available ones have reported inconsistent findings about government spending and economic growth (Jerono, 2009). The studies undertaken on Kenya investigated public expenditure and economic growth, with some focusing on the budget apportioning allocated yearly to different ministries as a GDP ratio, while the others focusing on public expenditure as an aggregate or as either capital, current, or development expenditure.

Additionally, most of the studies used time series data over the years covered (Kalio, Maingi, Muthui, et al., Gistore et al., and Mukui et al.), while the others used panel data. While most of the studies focused on government expenditure components, including education, defence, healthcare, agriculture, government investment, and trade openness, the current study focuses

on the infrastructure components (transport, energy and fuel, and ICT). In estimating the model, the studies reviewed used different methods, mostly VAR and OLS, while the current study uses ARDL. Specifically, the studies undertaken in Kenya did not explore the effect of public expenditure on infrastructure components, mainly known as economic affairs (energy, ICT, and transport) on economic growth, employing time series data covering 1990 - 2020, and using ARDL as the estimation method. No single study has employed a combination of the above; annual time series data between the year 1990 to 2020, ARDL as the estimation model, and the three infrastructure components (transport expenditure, ICT, and energy and fuel expenditure).

Moreover, no study has explored government spending on infrastructure sectors (transport, ICT, and energy and fuel sectors) and economic growth in Kenya, making the current study unique. Specifically, the use of Bounds F-test for cointegration, ADF test for stationarity, and ARDL-ECM in the estimation technique adds on its uniqueness. These tests prequalify the data to be used in the ARDL estimation model based on the assumptions of the ARDL model.

Thus, the current study sought to close that gap and add knowledge about the effect government infrastructure spending has on economic growth in Kenya. It employs annualized time series data between years 1990 - 2020. The Bounds F-test is used in testing for cointegration, ADF test for stationarity of the time series data, and the ARDL – ECM estimation method to analyse the findings.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter presents the theoretical framework as well as the methodology. Also discussed are the variables used, the data sources, and the analysis procedure.

3.1 Research Design

A longitudinal research design was adopted to identify trends over long the study period (30 years). Annual time-series data covering 1990 – 2020 for the three sampled components of infrastructure was used. Time-series data helps in describing the time variation of historical data over time which is ideal in this study. The period under study (thirty years) is long enough to fully accommodate the responsiveness of economic growth following expenditure of the government on the three infrastructure components. In addition, reliable data is available in the different statistical abstracts published annually by Kenya National Bureau of Statistics for government expenditure on infrastructure. Several tests were undertaken on the time series data, then ARDL used in the analysis.

3.2 Theoretical Framework

The theoretical framework was founded on the Keynesian theory, which asserts that economic growth is dictated by public spending (Keynes, 1936). During depression, Keynes suggested that an expansionary budgetary policy should be rolled out. This in return increases the economy’s aggregate demand, which in effect boosts GDP, employment increases, income rises, and the firms' profits shoot as well. Consequently, it pushes more workers into joining the firms to fill in the employment opportunities available and participate in producing goods and services required in the economy. Thus;

$Y = f(GoVEXP)$…….. [3.1]

Y represents the economic growth rate that is measured by the annual increase in GDP growth rate, while *GoVEXP* represents total government expenditure. The above framework assumes that government spending and economic growth rate are directly related. The rationale behind Keynesian theory supports this study. It asserts that there exists a linear relationship between government spending and economic growth rate in the economy. Thus, an increase in government spending leads to a rise in economic growth rate.

3.3 Model Specification

The general empirical estimation model employed is given as follows.

$Y = f(TINF, EINF, ICTINF)$…….. [3.2]

Y is the economic growth rate, TINF is the Transport infrastructure expenditure, EINF is the Fuel and Energy infrastructure expenditure, and ICTINF is the Information Communication Technology infrastructure expenditure. As a proxy for economic growth, the annual GDP growth rate was used in analysing the data. All variables were expressed in percentage form (as a ratio of the National Expenditure). Further, this study factored in three control variables, which include inflation rate, trade openness and foreign direct investment (FDI). Control variables help in enhancing the validity of the study. They also limit the effect confounding and other extraneous variables might have thus help in establishing a correlational or causal relationship between the study variables and avoid research bias (Barro, 1990). Equation 3.3 appears as follows.

$Y = f(TINF, EINF, ICTINF, INFL, TRO, FDI)$…….. [3.3]

3.4 Estimation Methodology and Procedure

The study applied the ARDL model in estimation. ARDL is suitable for estimating the long-run relationship among variables using time series data. Pesaran and Shin (1999) and Psaran et *al*. (2001) developed ARDL. The model is applicable to variables even when they are not integrated in the same order (integrated either to order 0 or 1). This makes it possible to use ARDL instead of the Johansen and Juselius procedure which requires that for its application, variables should be integrated to the same order.

Further, ARDL procedure is quite efficient when used for a relatively small and finite sample size as opposed to Johansen cointegration which requires a large sample size as a condition to ensuring that the test results are valid. Moreover, the ARDL model is applicable when the variables have an equal number of lag lengths or with different order lag lengths with no effect on how the asymptotic test statistics are distributed (Pesaran *et al*., 2001).

ARDL operates on some assumptions including the absence of autocorrelation, there should not occur any heteroscedasticity in the data, and the data should have stationary either on I(0) or I(1) or on both.

As per the above points, ARDL is superior to the other cointegration procedures including Engle and Granger (1987) or even the Johansen and Juselius (1990). Thus, this expresses the main innovation for this study compared to the previous studies of the subject matter.

The basic ARDL regression model is expressed as:

$$y_t + \beta_1 y_{t-1} + \cdots + \beta_p y_{t-p} = \lambda + \alpha_0 x_t + \alpha_1 x_{t-1} + \cdots + \alpha_q x_{t-q} + \varepsilon_t \quad [3.4]$$

Or $$\sum \beta(L) y_t = \lambda + \sum \alpha(L) x_t + \varepsilon_t \quad [3.5]$$

Where L denotes the distributed lag component and ε_t the error term that is serially independent. The model is autoregressive since y_t is clearly explained by the values of itself that are lagged.

3.5 Diagnostic Tests

3.5.1 Unit Root Test

The variables were subjected to this test to determine stationarity before estimation. Generally, the model does not reflect the underlying patterns in the time-series data if it is non-stationary, and the findings will be erroneous. Time series data should be stationary before analysis. If the variables in the regression model are not stationary, then the standard assumptions for asymptotic analysis will be invalid.

The study applied the ADF test, upon which the regression was estimated.

$$y_t = \alpha + \beta y_{t-1} + \delta_t + \sum_{j=1}^{p} \psi_j \Delta y_{t-j} + \varepsilon_t \quad \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots . \dots \dots \quad [3.6]$$

Where Δy_{t-j} is the lagged difference term used for approximating the error term. δ_t denote a drift that takes care of trends, while $\psi_j \Delta y_{t-j}$ shows the lagged dependent variable (Y) coefficient. The ADF test established the order of integration since ARDL assumes the variables to be integrated to order 0 or order 1 ($I(O)$ or $I(1)$). In circumstances where variables are integrated to order $I(2)$, the application of ARDL would produce spurious results. The null hypothesis indicates the presence of a unit root thus being non-stationary (cannot come back to equilibrium, $I(O)$. Accepting the null hypothesis means the variable is a $I(1)$ thus integrated to order 1.

3.5.2 Lag Selection Criteria

It is common knowledge about a time lag involved for past investment to influence GDP growth. To this end, there are various ways proposed to determine the maximum number of lags, among them Akaike Information Criterion (AIC), Hannan and Quinn Information Criterion (HQIC), and Schwarz's Bayesian Information Criterion (SBIC). The variables were subjected to the three lag selection methods. The one that gave a combination of the lowest values, and the maximum lags would be applied in the analysis.

Upon ascertaining the order of integration, the ARDL model to be estimated appeared as.

$$\Delta LY_t = \alpha_{01} + \sum_{i=1}^{n} \beta_{1i} \Delta LY_{t-1} + \sum_{i=0}^{n} \beta_{2i} \Delta LTINF_{t-1} + \sum_{i=0}^{n} \beta_{3i} \Delta LEINF_{t-1} + \sum_{i=0}^{n} \beta_{4i} \Delta LICTINF_{t-1} + \sum_{i=0}^{n} \beta_{5i} \Delta LINFL_{t-1} + \sum_{i=0}^{n} \beta_{6i} \Delta LTRO_{t-1} + \sum_{i=o}^{n} \beta_{7i} \Delta LIFDI_{t-1} + \delta_1 LY_{t-1} + \delta_2 LTINF_{t-1} + \delta_3 LEINF_{t-1} + \delta_4 LICTINF_{t-1} + \delta_5 LINFL_{t-1} + \delta_6 TRO_{t-1} + \delta_7 LFDI_{t-1} + \varepsilon_t \dots\dots\dots\dots\dots\dots [3.7]$$

Y is the dependent variable that represents economic growth rate while *TINF*, *EINF*, *ICTINF*, *INFL*, *TRO*, *FDI* are independent variables representing transport infrastructure expenditure, energy and fuel infrastructure expenditure, ICT infrastructure expenditure, inflation rate, trade openness, and FDI respectively. β_{1i},β_{2i},β_{3i}, β_{4i}, upto β_{7i}, are the short run coefficients, $\delta_1 \dots - \delta_7$ represent the long run coefficients, while n represents the optimal lag length. The logarithm operator is denoted by *L*, while Δ is the first difference operator. ε_t is the error term with an assumption that it is independent and identically distributed.

3.5.3 Cointegration Test

The Bounds F-test was used to examine the absence of a long-run relationship between the variables under study. It implies that the variable's lagged levels (LY_{t-1}, L$TINF_{t-1}, LEINF_{t-1}, LICTINF_{t-1}, LINFL_{t-1}, LTRO_{t-1}, LFDI_{t-1}$) must have zero coefficients. Rejecting the null hypothesis implies the variables exhibit a long-run relationship. The (Ho) null hypothesis stands for no cointegration existing amongst the variables in equation 3.7. Thus $H_{0:}\ \delta_{11} = \delta_{21} = \delta_{31} = \delta_{41} = \delta_{51} = \delta_{61} = \delta_{71} = 0$ against the alternative $H_1: \delta_{11} \neq \delta_{21} \neq \delta_{31} \neq \delta_{41} \neq \delta_{51} \neq \delta_{61} \neq \delta_{71} \neq 0$ (presence of cointegration).

The F-test require asymptotic critical value bounds, which depend on whether the variables are $I(O)$ or $I(1)$. In each case, the lower bound operates on an assumption that all variables are $I(O)$, and $I(1)$ for the upper bound. As a rule, when the computed F-statistic is less than the lower bound, the variables are $I(O)$, thus no cointegration. When F-statistic is higher than the upper bound, there is cointegration, and the test is inconclusive if it falls between the bounds.

In circumstances that the bounds test confirms cointegrated, a dynamic ECM is obtained out of the ARDL bounds via linear transformation to get the dynamic parameters in the short-run connected with the long-run ARDL model. Estimating of an unrestricted ECM or conditional ECM linked with the long-run estimates achieves it. The ECM illustrates the time taken for a disequilibrium in the previous period before it is corrected or undergoing an adjustment in the current period t. For instance, if the ECM= 1 it indicates that complete (100%) adjustment happens within the current period, while if the $ECM = 0.5$ then that illustrates that 50% of the adjustment happens each period or year. If it is 0, then that shows that there is no adjustment, and the claim that there is cointegration between the variables does not make any

sense at all. Equation 3.8, which incorporates the unrestricted ECM model to be estimated, appears as follows:

$$\Delta LY_t = \alpha_{01} + \sum_{i=1}^{n} \beta_{1i} \Delta LY_{t-1} + \sum_{i=0}^{n} \beta_{2i} \Delta LTINF_{t-1} + \sum_{i=0}^{n} \beta_{3i} \Delta LEINF_{t-1} + \sum_{i=0}^{n} \beta_{4i} \Delta LICTINF_{t-1} + \sum_{i=0}^{n} \beta_{5i} \Delta LINFL_{t-1} + \sum_{i=0}^{n} \beta_{6i} \Delta LTRO_{t-1} + \sum_{i=o}^{n} \beta_{7i} \Delta LFDI_{t-1} + \lambda_1 ECM_{t-1} + \varepsilon_{1t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots [3.8\ ]$$

Where ECM_{-1} is the ECT which should be negative as well as statistically significant. Further, ECM indicates the adjustment speed; how speedily the variables return to equilibrium in the long run following a shock in the system.

3.6 Types of Data and Sources

Quantitative data from the years between the years 1990 and 2020 was analysed to achieve the research objectives. The variables used are the three sectors of government infrastructure expenditure alongside three control variables: Energy and Fuel, Transport, ICT, inflation rate, trade openness, and FDI are the study variables. Data sources were the World Bank Database, and the various Statistical Abstracts published by KNBS. Stata statistical software was used in analysing the data.

3.7 Description and Measurement of Variables

Table 3.1: Description and Measurement of variables

Variable	Description	Measurement unit
Economic Growth (GDP)	Rise in the amount of goods and services produced by an economy by comparing one	Annual percentage

	period to another mainly annually.	
Transport Infrastructure Expenditure (TINF)	The allocation of government spending in the transport sector.	Percentage of National Expenditure
Energy and Fuel Infrastructure Expenditure (EINF)	The allocation of government spending in the energy and fuel sector.	Percentage of National Expenditure
Information and Communications Technology (ICT)	The allocation of government spending in the Information and Communications Technology sector.	Percentage of National Expenditure
Trade Openness (TRO)	The extent a country participates in international trade. It is the summation of the imports and exports of a country as a GDP ratio.	Ratio
Foreign Direct Investment (FDI)	The investment across boarder(s) where an investor in a particular country finds interest and business footing in a business enterprise in another country.	Percentage of GDP
Inflation (INFL), Consumer prices	The overall rise in the goods and services price level in an economy over a given period.	Rate

CHAPTER FOUR

EMPRICAL FINDINGS

4.0 Introduction

This chapter presents the findings and discussion on ADF test for stationarity, lag selection criteria, cointegration test, Breusch-Godfrey Test for serial correlation, Breusch-Pagan Test for Heteroscedasticity, and Variance Inflation Factor test for Multicollinearity. The regression results are discussed in this section as well.

The Unit Root Test for stationarity, the lag selection criteria, and the cointegration test were carried out first before running the regression analysis on the data. This was to ascertain that the time series data used in the study met the requirements of ARDL Model. The model assumes that the data is integrated to order 0 or 1, the study variables have an equal number of lag lengths or with different order lag lengths with no effect on how the asymptotic test statistics are distributed, and the variables are cointegrated. After confirming the above requirements, the regression analysis was carried out.

4.1 Diagnostic Tests

4.1.1 Unit Root Test

ADF test was applied in testing for stationarity. It was carried out on the time series data to establish its properties prior to estimation. To avoid spurious findings, the stationarity of the data was established.

Table 4.1: Unit root test results

Variable	Unit Root Test – ADF Test			
	Levels		Fist Difference	
	t-statistic	**Critical Value (5%)**	**t-statistic**	**Critical value (5%)**
GDP (Y)	-3.530*	-2.986	-6.058	-2.989
Transport Infrastructure Expenditure (tinf)	-1.969	-2.986	-11.321**	-2.989
Energy & Fuel Infrastructure Expenditure (einf)	-3.232*	-2.986	-9.547	-2.989
ICT Infrastructure Expenditure (ictinf)	-5.294*	-2.986	-15.816	-2.989
Inflation Rate (infl)	-2.877	-2.986	-5.912**	-2.989
Trade Openness (tro)	-2.032	-2.986	-4.496**	-2.989
Foreign Direct Investment (fdi)	-3.793*	-2.986	-7.637	-2.989

Source: Personal computation from study data: *(**) show stationarity at $I(0)$ (levels) & $I(1)$ (after differencing once) respectively. Reject the null hypothesis at 5% critical value. (H0: No unit root)

GDP, energy & fuel infrastructure expenditure, ICT infrastructure expenditure, and FDI are stationary in levels; integrated to order $I(0)$ as presented in table 4.1. Transport infrastructure expenditure, inflation rate, and trade openness show non-stationarity in levels but exhibit stationarity after differencing once thus integrated to order $I(1)$.Therefore, reject null hypothesis (Ho: no unit root) in levels.

4.1.2 Lag Selection Criteria

The data was subjected to Akaike Information Criterion (AIC), Hannan and Quinn Information Criterion (HQIC), and Schwarz's Bayesian Information Criterion (SBIC) lag selection criteria.

Table 4.2: The lag selection criteria

Lag	LL	LR	df	p	PPE	AIC	HQIC	SBIC
0	-263.71				1.20646	**20.0526**	20.1525	20.3886
1	-194.835	137.75	49	0.000	.314572	**18.5804**	19.3796	21.268
2	-128.362	132.95	49	0.000	.204433	**17.2861**	18.7845	22.3254
3	1022.9	2302.5	49	0.000	2.5e-35*	**-64.3626**	-62.1649	-56.9716
4	5942.71	9839.6*	49	0.000	.	**-426.201***	-423.504*	-417.13*

Source: Owner's computation from study data (used Stata)

The study employed AIC lag selection criteria. The outcome from the selection criteria is presented in table 4.2, with AIC having the lowest values against HQIC and SBIC. AIC gave a combination of the lowest values, and the maximum lags thus chosen. The AIC lag selection criteria results in table 4.2 indicated an optimal lag length of 4.

4.1.3 Cointegration Test

This study used Bounds test procedure to establish any cointegration between the study variables. An ARDL bounds test for cointegration involves an extra F-test on the lagged levels of the independent variable(s) in the ARDL equation. When the computed F-statistic is less than the lower bound, the variables are $I(0)$, thus no cointegration. When F-statistic is higher than the upper bound, there is cointegration, and the test is inconclusive if it falls

between the bounds. H_0 denotes no cointegration. The bounds test was conducted on the level form of the variables.

Table 4.3: Cointegration test

F-Statistic	Critical Values						Decision
	Lower Bound			Upper Bound			
	1%	5%	10%	1%	5%	10%	
4.554	2.12	2.45	3.15	3.23	3.61	4.43	Cointegration

Source: Owner's computation from study data (used Stata)

The findings indicated that the calculated F-statistic is 4.554 as presented in table 4.3. It is above all the upper bound values thus exhibiting significance at the three significance levels (1%, 5%, 10%). Thus, the null hypothesis (no cointegration computed F-statistic) was rejected and concluded that the variables are cointegrated.

4.1.4 Serial Correlation

The Breusch-Godfrey Test was used to test for autocorrelation. Serial correlation is the relationship between a variable before applying lags and the lagged version of the said variable at different times (Shukur, 2000). The presence of serial correlation causes the estimated variances of the regression coefficients to be biased. The t-statistics appear to be more significant than they really are.

Breusch-Godfrey test allows the use of several lags. The null hypothesis denotes no serial correlation.

Table 4.4. Breusch-Godfrey test for autocorrelation

Lags (p)	Chi2	df	Prob>chi2
1	0.293	1	0.5882
2	2.752	2	0.2525

H_0: no serial correlation

Source: Owner's computation from study data (Used Stata)

The findings as given in table 4.4 show no serial correlation at lag 1 and 2, hence rejecting the alternative hypothesis. The absence of serial correlation means that there is no observable relationship that exists between the current value of a variable and its value during previous time periods.

4.1.5 Heteroscedasticity

Deals with unequal variances. It refers to disturbances (errors) whose variances are not constant in each model. It influences the variances and standard errors of the estimates. The availability of heteroscedasticity yields low standard errors as well as causing very high values of t and f statistic and yields statistically significant coefficients (Rigobon 2003). The null hypothesis states that; $H_{0:}\ \delta_1 = \delta_2 \ldots \delta_k = 0$ (homoscedasticity) while the alternative hypothesis states that, $H_1: \delta_1 \neq \delta_2 \ldots \delta_k \neq 0$. Therefore, reject the null hypothesis if the test statistic surpasses appropriate critical values (p-value$<$0.05).

Breusch-Pagan Test was used to examine the presence or absence of heteroscedasticity. According to Baum and Wiggins (1999), this test is like the White Test. It is a joint significance approach with flexible test equation specification and requires normality

assumption for OLS errors in small samples. Upon testing the independent variables for heteroscedasticity using the Hettest.

Table 4.5: Breusch-Pagan Test for Heteroscedasticity

Chi2 (6)	2.82
Prob>chi2	0.8306

Ho: no heteroscedasticity

Source: Owner's computation from study data (used Stata)

The decision for the findings in table 4.5 is rejecting the alternative hypothesis and conclude that no existence of heteroscedasticity.

4.1.6 Multicollinearity

Tests for correlation between two or more independent variables. According to Farrar (1967), a high correlation between the explanatory variables underestimates their statistical significance and results into a large standard error. The null hypothesis signifies no correlation. The assumption that the explanatory variables are not highly correlated is determined by Variance Inflation Factor test.

Table 4.6: Variance Inflation Factor (VIF) Test for Multicollinearity

Variable	**VIF**
Tro	1.33
Infl	1.31
Einf	1.29
Ictinf	1.20
Fdi	1.08

Ho: no multicollinearity

Source: Owner's computation from study data (used Stata)

VIF equal to 1 denotes that the variables are not correlated, while VIF between 1-5 signifies that the variables are correlated moderately, while VIF greater that 5 indicates that the explanatory variables are highly correlated (Farrar (1967). In interpreting the VIF findings in table 4.6, the findings show that all the independent variables are not correlated.

4.2 Regression Results

The variables are cointegrated as per the findings in table 4.3. After this confirmation, a dynamic Error Correction Model was obtained out of the ARDL bounds using linear transformation to get the short-run dynamic estimates linked to the long-run ARDL model. To achieve this, an unrestricted ECM linking to the long-run estimates. Upender (2003) stated that ECM is key in determining if there exists a disequilibrium or equilibrium between the short and long-run estimates.

The functional form of the model used is equation 3.3 which includes transport infrastructure expenditure (TINF), Energy and Fuel infrastructure expenditure (EINF), and ICT infrastructure expenditure. Three control variables are also incorporated in the equation: Inflation (INFL), Trade Openness (TRO), and Foreign Direct Investment (FDI). Further, the optimal lag length used is four as the AIC lag selection criteria findings (Table 4.2). The equation appears as

$$Y = f(TINF, EINF, ICTINF, INFL, TRO, FDI).$$

The ECM regression results obtained from error correction equation 3.8 are well represented in table 4.4. The ECT should be negative and statistically significant thus signifying the presence of an equilibrium relationship. Table 4.4 shows the ECM results from the variables in both long run and short run.

Table 4.7: Error Correction results

Variable	Coefficient	Standard Error	t-value	p-value
Constant	-3.128235	3.699295	-0.85	0.410
Transport_SR	.3797293	.727594	0.52	0.609
Transport_LR	-1.081768	1.089039	-0.99	0.355
Energy/Fuel_SR	-6.476645	2.148908	-3.01	0.008***
Energy/Fuel_LR	7.656182	3.12518	2.45	0.026**
ICT_SR	.0100143	.4174708	0.02	0.981
ICT_LR	-.8722209	.6308236	-1.38	0.186
Inflation_SR	-.0051791	.0563067	-0.09	0.928
Inflation_LR	-.1389261	.0644933	-2.15	0.047**
TradeOpenness_SR	-.0243641	.0693453	-0.35	0.730
TradeOpenness_LR	.1118657	.0740108	1.51	0.150
FDI_SR	.1244386	.4129655	0.30	0.767
FDI_LR	-.4629704	.6213138	-0.75	0.467
Error Correction Term (ECT)	-.9003439	.2028631	-4.44	0.000***

****[**] shows significance at levels 1% and 5% respectively; R^2= 0.7747; Adj. R^2 = 0.5916*
Source: Owner's computation (Statistical Abstracts data)

From the findings in table 4.7, the R squared is 0.7747, which implies that 77.47 percent of the economic growth variations were described by transport expenditure, energy and fuel expenditure, ICT expenditure, inflation rate, trade openness, and FDI. The difference of 22.53% is attributable to variables not included in the model. The p-value is 0.000 and is less than 0.005 (<0.05). This shows the model is statistically significant in analysing the relation between GDP growth rate and the explanatory variables.

The estimated equilibrium correction coefficient is negative (-.9003439), and statistically significant at 1 percent. Therefore, after a systemic shock, the adjustment speed to the equilibrium is high. The ECM coefficient shows 90 percent adjustment speed from the previous year's actual growth to equilibrium economic growth rate. Further, the ECM coefficient means that there is an existence of a relationship between GDP growth rate

(dependent variable) and transport expenditure, energy and fuel expenditure, ICT expenditure, inflation rate, trade openness, and FDI (the independent variables).

4.3. Discussion of the Results

The regression findings in table 4.7 exhibit the presence of a relationship between economic growth and the infrastructure components. This is indicated by the ECT coefficient (-.9003439) which is negative and statistically significant at 1 percent. Thus, as per the results, government expenditure on infrastructure components affects Kenya's economic growth.

The ECM regression results reported that in the short term, the coefficients for government spending in transport infrastructure sector, ICT infrastructure sector, and FDI are positive but insignificant while, the coefficients for inflation rate, and trade openness are negative and insignificant. The long run coefficient for trade openness is positive and insignificant, while the coefficients for transport infrastructure expenditure, ICT expenditure, inflation rate, and FDI are negative and insignificant.

Government spending in the energy and fuel sector was found to affect short run GDP growth rate negatively and significantly as denoted by coefficient of -6.475 and a p-value of 0.008 which is less than 0.05. Thus, a one percent rise in government spending in the energy and fuel sector would cause GDP growth rate to decline by 6.476 percent. Therefore, government spending in energy & fuel negatively affects economic growth in the short run. Since the p-value is less than 0.005, the null hypothesis was rejected, and concluded that government spending on the energy and fuel sector has a statistically significant effect on economic growth in Kenya. In the long run, the coefficient for energy and fuel sector is 7.6561 which is positive and a p-value of 0.026 which is less than 0.05 thus statistically significant. Thus, a one percent increase in energy and fuel sector, would cause GDP growth rate to increase by

7.565 percent. Reject the null hypothesis since p-value< 0.05. Therefore, government spending on energy and fuel sector decreases short run economic growth but increases it in the long run. The long run coefficient for inflation is negative (-1.3892) and significant (p-value is 0.047 < 0.05). Thus, one percent rise in inflation rate brings about GDP growth rate to decline by 1.139 percent. This infers that increased government expenditure in the infrastructure components negatively affects inflation.

The findings support the Keynesian theory that public spending dictates economic growth as indicated by the ECT coefficient (-.9003439) which is negative and statistically significant. Such findings align with Keynes's assertion that a rise in public expenditure brings about an increase in economic growth. The results concur with the empirical works of Aschauer (1989), that found out that government investment in infrastructure boosts private sector productivity, and Maingi (2010) findings that public spending on physical infrastructure affect economic growth. Mukui et al., (2019) findings indicated development expenditure promotes economic growth, but inflation had a negative effect.

Paradoxically, public expenditure on transport and ICT sectors insignificantly economic growth. The coefficient and p-value of ICT were 0.100 and 0.981 in the short run and -0.8722 and 0.186 in the long run respectively. The short run coefficient and p-value of transport sector were 0.3797 and 0.609 respectively while in the long run were -1.0817 and 0.355 respectively. Since the p-values are greater than 0.05, the study failed to reject the null hypothesis thus concluding that government spending on the transport and ICT infrastructure sectors does not significantly determine economic growth in Kenya. This is because the transport and ICT infrastructure sectors are very capital intensive and are mainly financed through external borrowing. Such debts incur interest rates on the loans which negatively affect economic growth. In addition, the two sectors experience a high rate of depreciation

due to the nature of their assets and investment. The depreciation negatively affects economic growth. These results concur with Mukui et al., (2019) but differ with Njiru et al. (2020).

Moreover, the results indicated the short run coefficient of energy and fuel sector is negative and significant. Therefore, an injection of resources to finance the energy and fuel sector, negatively impacts short run GDP growth. Additionally, transport infrastructure and ICT infrastructure components have positive coefficients. The long run coefficient of energy and fuel component is significant and positive. Thus, positive contribution of public spending on infrastructure components, always, supports the theoretical findings that if countries attain sustainability in economic growth, then investment in infrastructure networks remain key. From the theoretical perspective, development in infrastructure is observed to reduce transport costs, which then lowers the overall private production cost in the economy, thus automatically boosting the profits accruing to the firms.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter presents the summary, conclusions, and recommendations. Further, the policy inferences drawn from the results, research gaps, and suggested further research areas are highlighted.

5.1 Summary

The ARDL model was used in analysing the data. The explanatory variables used included transport, energy and fuel, ICT, inflation rate, trade openness, and FDI while GDP growth rate was the dependent variable.

ARDL model was used in analysing the data over the period covering 1990 to 2020. Upon testing for unit root using ADF, the findings showed all variables were $I(0)$ and $I(1)$, allowing the use of ARDL. Additionally, the Bounds F-test to cointegration established the variables were correlated in the long-run, thus used ECM in analysing the data.

As per the ECM regression results, only government infrastructure spending in the energy and fuel sector significantly affected economic growth in Kenya both in short run and in long run. Government spending on the ICT and transport sectors insignificantly affected economic growth. Among the three control variables, only inflation rate negatively and significantly affected economic growth in the long term while trade openness and FDI had insignificant effect. Moreover, the findings indicated the absence of heteroscedasticity, serial correlation, and multicollinearity among the study variables. Therefore, the government should add more resources to the energy and fuel sector thus creating more employment opportunities which

boosts economic growth. Also, the government through the CBK should ensure inflation rate is maintained at favourable levels.

5.2 Conclusions

From the regression results, government infrastructure spending in the energy and fuel sector was found to affect economic growth negatively in the short run and positively in the long run. The coefficients were negative in the short run and positive in the long run. This pointed to the fact that the investments in the sector need a lot of capital which negatively affect economic growth but, beneficial in the long run. This is because through the sector, firms get access to fuel and energy that is needed in production, which in return increases productivity and opens employment opportunities thus the long-term consequence on economic growth. Consequently, the study concluded that government expenditure in energy and fuel decreases economic growth rate in the short term but promotes economic growth in Kenya in the long term. In the long term, inflation rate negatively and significantly affected economic growth in Kenya in the long run. As a result, the study concluded that high inflation rate slowed economic growth in Kenya.

Since government spending on ICT and transport infrastructure sectors insignificantly affected economic growth, the conclusion made was that government expenditure in the sectors does not significantly determine economic growth in Kenya. The ECT coefficient was negative and statistically significant. Therefore, government expenditure on infrastructure components affects economic growth in Kenya. Following the findings illustrated above, a conclusion was arrived at that government spending structure is critical in fostering economic growth in Kenya.

5.3 Recommendations

The study suggests that the government should grow the resources allocated in the energy and fuel sector. There is need to incorporate policies that fit well in enhancing efficiency in the operations in this sector, for it has the potential to create employment and sustainability in the long run. In return, this would boost productivity and create employment opportunities.

This study recommends a reduction on financing project in transport and ICT sectors through loans with a high-interest rate that eventually and negatively affect economic growth. Further, encouraging the adoption of new technology, improving skills, and developing human capital in the economy is vital.

Trade openness positively impacts economic growth, indicating that the government should fully embrace any policies that foster trade with fewer restrictions. This study recommends that the government should also embrace the AU Agenda 2063, the UN SDG (9), and the EAC Vision 2050 and develop policies in line with the same. This is anchored on the fact that trade openness positively impacts long term economic growth, thus indicating the need to fully embrace any policies that foster trade with fewer restrictions.

The study proposes development of policies appropriate for either reducing or curbing the government from competing with private investment. This would discourage the crowding out of the private sector thus ensuring FDI is always of benefit to the economy. Further, through CBK, the government should put up measures through the monetary policy that control the prevailing inflation rate in the economy all the time since it negatively effects on economic growth. Policymakers should thus develop policies geared towards encouraging public-private partnerships, reducing the external borrowing ceiling, and increasing resource allocation towards infrastructure networks in general.

The study suggests the development and application of controls that ensure the increased resources assigned to the infrastructure sectors are utilized in the most prudent way possible to ensure the achievement of the vision 2030 economic pillar goals alongside increased growth of the economy.

5.4 Limitations and Areas for Further Research

ARDL is anchored on some assumptions; it applies to small finite data, variables that are $I(O)$ or $I(O)$, the variables must have a long run cointegration, and the study duration limited to thirty years. The results would have been different if the assumptions were relaxed.

Secondly, the government may have other objectives to pursue apart from fostering economic growth. Such objectives may include reducing the inequalities in income distribution, creating employment opportunities, promoting devolution, and ensuring a 100 per cent transition from primary education to secondary education, among other objectives. These other objectives explain the behaviour of government expenditure on economic growth alongside the reason some sectors like energy and fuel receives low budgetary allocation despite their potential. In future studies, increasing the sample size and undertaking more diagnostic tests on the test results would be critical.

Finally, although the study investigated the impact of government infrastructure spending on Kenya's economic growth covering the years between1990 to 2020, focusing on three infrastructure components (transport, ICT, and energy and fuel), a key subject that can be addressed in research in the future is the factors that influence government decision on the levels of budgetary allocation on the various infrastructure sectors. Further, the causal movement among the various infrastructure components and economic growth in Kenya would be an area further research.

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APPENDIX

STUDY DATA

year	gdp	tinf	einf	ictinf	infl	TRO	FDI
1990	4.19205	0.963711	0.916296	0.183575	17.7818	57.06	0.666
1991	1.43835	0.261135	0.003418	5.90795	20.0845	55.58	0.231
1992	-0.79949	0.028006	0.7533	0.222453	27.3324	52.98	0.078
1993	0.353197	0.90157	0.468972	0.167202	45.9789	72.87	2.532
1994	2.63278	0.797257	0.428359	0.034471	28.8144	71.33	0.104
1995	4.40622	1.09067	0.560792	0.427354	1.55433	71.71	0.467
1996	4.14684	1.05272	0.460252	0.537049	8.86409	57.34	0.902
1997	0.474902	0.956547	0.386448	0.264727	11.3618	54.04	0.473
1998	3.29021	0.818657	0.319779	0.086476	6.72244	48.9	0.188
1999	2.30539	0.815625	0.20283	0.084041	5.742	48.22	0.403
2000	0.599695	0.825444	0.131842	0.093678	9.98003	53.27	0.873
2001	3.77991	0.810927	0.203754	0.067186	5.7386	55.97	0.041
2002	0.54686	0.771818	0.234124	0.067032	1.96131	55.13	0.21
2003	2.93248	1.08575	0.459191	0.0614	9.81569	54.16	0.548
2004	5.1043	1.46737	0.711547	0.054959	11.624	59.44	0.286
2005	5.90667	1.64303	0.729211	0.049549	10.3128	64.46	0.113
2006	6.47249	1.44209	0.82849	0.027833	14.4537	55.25	0.196
2007	6.85073	1.31514	0.37936	0.006128	9.75888	53.88	2.281
2008	0.232283	1.66305	0.496375	0.001453	26.2398	57.58	0.266
2009	3.30694	1.99223	1.04509	0.007804	9.23413	50.86	0.314
2010	8.05847	1.47657	0.77724	0.038058	3.96139	54.23	0.445
2011	5.12111	1.54889	0.539489	0.012121	14.0225	60.45	3.457
2012	4.56868	1.66803	0.819678	0.079174	9.37777	55.23	2.738
2013	3.79785	1.96786	1.06975	0.104548	5.71749	51.28	2.031
2014	5.02011	1.55784	0.799568	0.110669	6.87815	50.26	1.336
2015	4.96772	3.68608	0.851562	0.103016	6.58217	52.16	0.968
2016	4.21352	2.2063	0.889674	0.175514	6.29716	55.44	0.981
2017	3.81551	3.23907	0.88351	0.315786	8.00572	64.32	1.603
2018	5.6291	2.18176	0.76878	0.144233	4.68982	55.86	1.852
2019	4.98113	2.45439	0.613166	0.236585	5.23586	53.25	1.395
2020	-0.31618	2.74218	1.11166	0.291204	5.40481	31.42	1.624