International Journal of
Economics
(IJECON)

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

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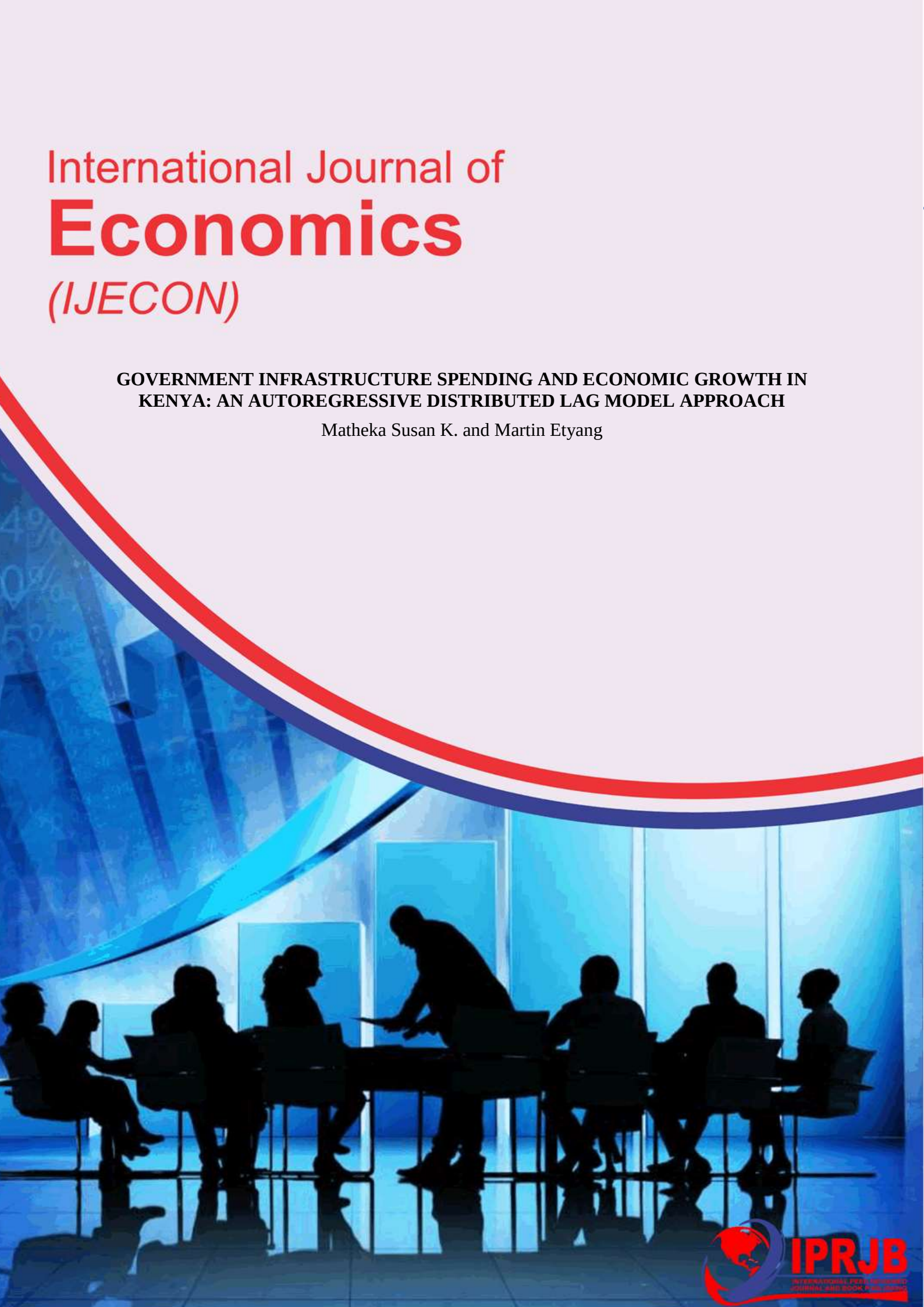

IPRJB

International Journal of Economics

ISSN 2518-8437 (Online)

Vol.8, Issue 1, No.1. pp 1 - 29, 2023

www.iprjb.org

Government Infrastructure Spending and Economic Growth in Kenya: An Autoregressive Distributed Lag Model Approach

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Article History

Received 19th January 2023
Received in Revised Form 10th February 2023
Accepted 20th February 2023

Abstract

Purpose: Since independence, the Government of Kenya has pursued many objectives, one being economic growth. Over the previous few many years, government expenditure has been developing faster than the GDP growth. Infrastructure, one of the components of public spending, has also experienced tremendous growth in government spending and development, which has not been directly reflected in the GDP growth rate. Following such situation, it calls for analyzing the impact that government infrastructure expenditure has on economic growth in Kenya with a focal point on three sectors beneath infrastructure that the public sector spends closely on; transport, energy and fuel, and Information Communication and Technology (ICT). The study's overall objective is to find out the effects of government spending on the three sampled sectors of government infrastructure on economic growth in Kenya and then draw policy implications from the findings. The specific objectives were; to investigate the effect of transport infrastructure expenditure on economic growth in Kenya, to examine the effect of energy & fuel infrastructure expenditure on economic growth in Kenya, and to examine the effect of ICT infrastructure expenditure on economic growth in Kenya. Further, Bounds F-test to cointegration as well as the Autoregressive Distributed Lag Model (ARDL) were used to realize the objectives.

Methodology: The data was collected covered 1990 – 2020 for the three sectors of infrastructure: transport, energy & fuel, and ICT. Several tests on the time series data were carried out on the secondary data obtained, after which (ARDL) was employed in analysing the data.

Findings: The outcome showed that government expenditure on transport, energy, fuel, and ICT infrastructure sectors affected economic growth either in the short or the long run. Based on the ECM regression findings, the long-run regression outcome revealed that expenditure on energy and fuel promotes economic growth. On the contrast, the findings showed that government expenditure on transport and ICT sectors exhibited a negative effect on GDP growth rate. Public expenditure on transport and ICT infrastructure sectors positively impacted economic growth in the short term, while the energy and fuel sectors exhibited a negative impact on GDP. Other control variables inclusive of trade openness and FDI showed either a positive or negative effect on economic growth either in long or short run. Inflation, particularly, exhibited a negative effect on GDP in the long run, in addition to within the short run.

Unique Contribution to Theory, Practice and Policy: Based on the empirical findings, this study validates the Keynesian theory which stipulates that public expenditure positively contributes to economic growth. Based on this theory, public expenditure is an exogenous factor capable of being applied as a policy instrument in promoting economic growth.

Keywords: *Infrastructure, Spending, Economic Growth, ARDL*

INTRODUCTION

Africa Union Agenda 2063, Africa's blueprint and a detailed plan for transforming Africa, talks massively 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. 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 (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 (Union, 2015). 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 in to realize development both economically and socially. This 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 (East Africa Community Vision 2050, 2016).

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 resource, and Tourism. So as the anticipated growth to happen and be retained, the countries that make up the EAC community must have a tremendous and included, including transport, sewerage, water, and electricity, which ought to be improved by 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. 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 has 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 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 increased productivity in the long term 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 critical components of infrastructure spending, 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 idea that the government ought to be involved in the economy in order to control market failures, externalities, and the supply public goods.

Infrastructure development plays an integral part in economic growth. Infrastructure as a sector offers a very crucial contribution to economic growth and development. The World Development Report (1994) tried to demonstrate the connection linking infrastructure and economic growth and showed that infrastructure is vital for economic growth. 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 to change 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, 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 2011s. 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. As a percentage of GDP measured in Kshs Million, spending on the three infrastructure components has increased over the years, yet the GDP growth rate remained slower (The Republic of Kenya,Various issues).

Overview of Government Expenditure in Kenya: 1990-2018

Government spending 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 build of acquisitions, future investments, and transfer payments. By definition, the former addresses how the country can survive into the long-term, thus resources are channeled into infrastructure development projects including as roads, sewerage, ports, railways, and airports (Landau, 1986). Acquisitions refers 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 sector of defense (Mitchel, 2005).

Further, government spending can either be current or capital. Current government spending entails the government spending 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 defense, among others. Capital spending on the other hand includes expenditure on infrastructural projects such as ports, railways, airports, roads, hospitals, markets, and schools.

Government spending is essential in guaranteeing the effortless operation of the economy. Since a free-market economy cannot provide some goods while others may be under-provided, this calls for the government expenditure. The government has to intervene to reduce the

International Journal of Economics

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negative effects of externalities in a country, including controlling pollution, and offering subsidies to industries that are in need of 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 policy. 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 the significance government spending has on the smooth running of the economy.

For the years covered, 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 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.

Composition of Government Infrastructure Expenditure by Components in Kenya

In terms of composition, government expenditure has favored current spending compared to development expenditure. However, this study focused on the development infrastructure expenditure, which comprises three components, Transport, Energy & Fuel, and ICT, for the period 1990 -2020. Figure 1.1 illustrates these components of infrastructure expenditure

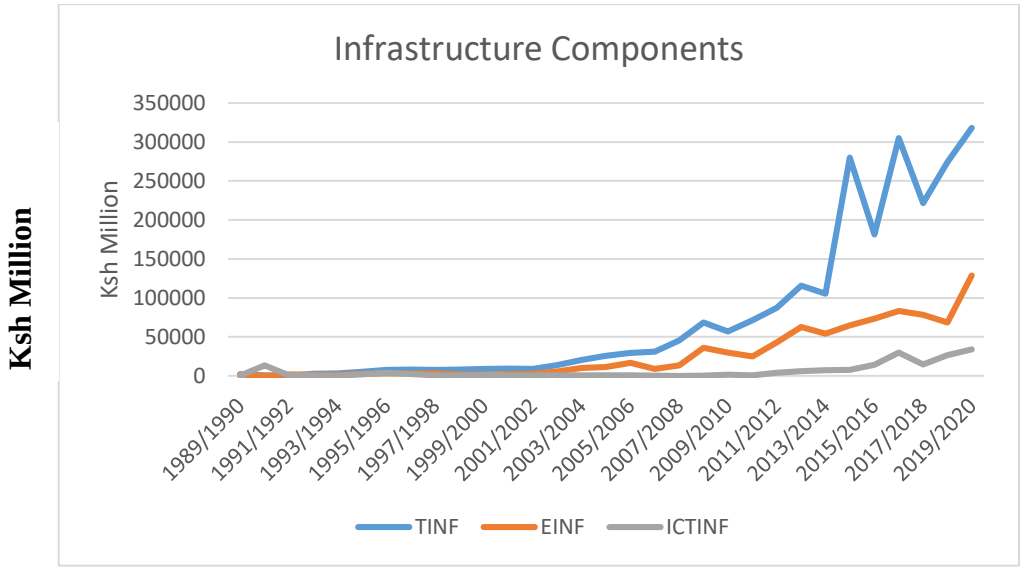

Figure 1: Components of Infrastructure Expenditure
Source: Author's Calculation; Data from Statistical Abstracts

International Journal of Economics

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In figure 1 shows the various components of infrastructure expenditure in Million Kenya Shillings. The figure shows that the transport function takes the largest share among the three sampled tasks 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.

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. However, the overall economic growth measured as a percentage of GDP has not been in tandem with the ever-increasing government spending (The Republic of Kenya, Various issues). While the recurrent and development expenditure has been steadily increasing, the economic growth has always fluctuated to even negative growth rate in some of the years under analysis, as illustrated in figure 2.

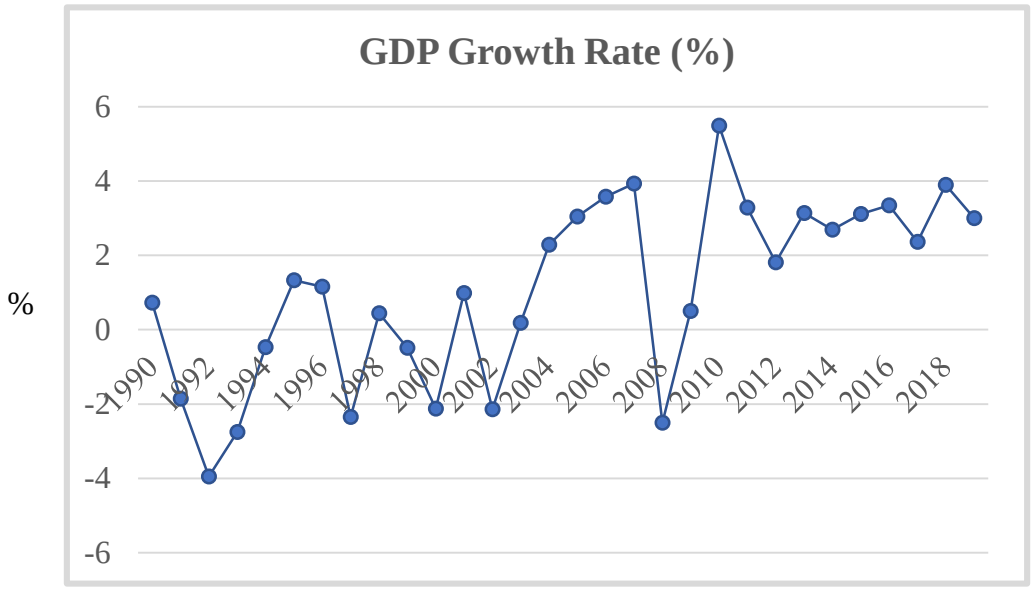

Figure 2: GDP Growth Rate in Kenya (1990-2018)
Source: World Bank Database

Figure 1.2 highlights the annual GDP growth rate from 1990-2018. 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 led the economy to register a GDP growth of 5.5 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 affect overall economic growth from the year 2020 negatively.

Statement of the Problem

Persistent variations in both the economic growth rate and government expenditure increase in Kenya has been rampant over the years, but the causes are not well understood. Government spending on infrastructure components and economic growth have not been well explored. Very few scholars have researched 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 scenario rarely take place in Kenya. Several studies conducted looking into the "effect of government expenditure and economic growth in Kenya" including Landau (1983), Davarajan et al. (1993), Tanzi and Zee (1997), Njuguna (2009), Maingi (2010) among others. The findings are inconclusive and unconvincing.

Further, Tanzi and Zee's (1997) findings showed no connection linking government size and economic development. Further, 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, existing theory shows that government spending positively affects economic growth (Keynes, 1930; SolowSwan, 1956; Musgrave and Musgrave, 1989).

In Kenya, government spending on infrastructure has been on an upward trend for the last three decades as the government tries to boost economic growth and foster the achievement of the Vision 2030 economic pillar. The impact that such an increase in government spending on infrastructure components has on economic growth is observed to be little, demonstrated by a constant but moderate economic growth rate with some significant fluctuations as shown above (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 the impact government spending has on Kenya's economic growth. Theory presents such an upsurge in government spending on infrastructure components is anticipated 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 that increase economic growth. Thus, this study investigated the effect government

spending on infrastructure components has on economic growth in Kenya using an Auto-Regressive Distributed Lag Model Approach.

Research 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 infrastructure expenditure on economic growth in Kenya?

Objectives of the Study

The key objective was to analyze the "impact of government infrastructure spending on economic growth in Kenya". This study sought to address the following specific objectives.

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.

LITERATURE REVIEW

Theoretical Review

Varied explanation on government expenditure and economic growth has been offered by various theories. Below is a brief discussion of some of those theories.

Solow – Swan Growth Model (Neo-Classical Model)

Robert Solow and Trevor Swan introduced this theory in 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 economic growth in the long-term 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 per capita growth rate of output. Thus, increase in population growth rate reduces the stability of per capita output level. The Solow growth model concludes that the build-up of physical capital 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, R. M. 1956). The Solow-Swan model should be a growth model; however, it cannot satisfactorily explain the long-run growth, thus forming the limitation of the model. Therefore, in the long-

term, there is no 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.

The Peacock and Wiseman Theory

The theory was developed by Peacock and Wiseman (1890-1935) and analyzed the government expenditure time path pattern and came up with the displacement effect. The theory is established on the political theory of determination of government expenditure which 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 behavior. The continued growth in the economy causes a rise in the tax revenue, thus increasing government spending alongside the GNP (Peacock & Wiseman, 1961). In periods of social disruptions including war or famine, 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 & 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 in situations where civilian government expenditure in the periods after such war disturbance goes back to the former path of growth or 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, then public outlays bounce back to the original level before the war happened.

Musgrave Theory of Public Expenditure Growth

The theory was established by Musgrave while analysing the income elasticity of demand variations. According to Musgrave (1969), per capita income is grouped into three levels upon which the demand for public goods and services is credited to. While addressing the first level which is the low level of per capita income, Musgrave postulates that demand for public services 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, then there is a rise in the demand of the services offered by the government including health, security, defense, among others. Consequently, the government is forced to increase the expenditure allocation on such sectors. The third category is the high per capita levels whereby 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, 1969). Further, Musgrave and Musgrave (1989) highlighted that the public sector's portion in the l economy rises progressively as the 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, 1969). 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 centers 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 defense 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 economic growth. It also signifies that the impact of government development expenditure on economic growth is of higher importance compared to of recurrent government expenditure.

The Keynesian Theory

Keynes stipulates that public expenditure positively contributes to economic growth. Based on this theory, public expenditure is an exogenous factor capable of being applied as a policy instrument in promoting 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, 1930). Hence, 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.

Additionally, Keynes (1930) 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's offered the macroeconomics foundation, a discipline that assumes the economy to be an aggregate with the main 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 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, government expenditure multiplier which leads to creation of more job opportunities. The national income accounting tools could be employed in managing aggregate demand and which ensures 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, offer subsidies, control market failures and externalities, thus it should 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 and also the change in perception and attitudes on the role the state plays in the welfare of an economy (Knack and Keefer, 1995). However, the Keynesian theory has a great limitation in that it does not fully factor in the problem of inflation which the increase in government spending might bring about**.** Further, 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.

Empirical Review

Devarajan et al. (1993) while using panel data covering 14 developed countries between the years 1970-1990, used OLS, and a five years gap moving average. 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 three sectors (health, transport, communication) are significant and exhibit a beneficial effect on economic growth while education and defense negatively affect economic growth.

Kalio (2000) studied the “effect of various government expenditures on GDP growth, on time series data covering 1970-1992 using OLS in Kenya”. Government expenditure on some sectors like defense, education, and agriculture positively affected GDP growth. Health, transport, and communication were inversely related to 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 share of capital expenditure in GDP was directly related to economic growth and was significant, while current expenditure showed insignificance results. At stage two which is the sector level, Secondly, government investment expenditures on education sector was positively associated with economic growth after considering budget limitations and excluded variables are considered at the sector level.

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 for the period (1963 – 2008)" with a focus on defense, 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 outcome highlighted that expenditure on economic affairs, defense, 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 outcome stipulates 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) studied the impact of the public spending composition on economic growth (1964-2011) in Kenya. They investigated some government expenditure components, including education, infrastructure, health, and defense. 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 it boosts labor productivity in health. Finally, the survey showed that to boost spending on public utilities, including defense 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 the "effect of government expenditure on economic growth in East Africa covering the years 1980 – 2010". The disaggregated model was employed and it concentrated on three countries: Kenya, Uganda, and Tanzania. Employing the balanced panel fixed effect model, they aimed at determining the expenditures effecting economic growth in the three countries. Findings indicated that spending on agriculture, and trade openness were positively related relationship to economic growth as well as statistically significant. 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 while spend less on the other sectors, including agriculture.

Muguro (2017) researched on the "effect of public spending on the economic growth in Kenya from 1963 – 2015, using time series annual data". Two categories of government expenditure were used: recurrent and development. The study used VAR estimation method for the period under study in the analysis. Further, the Distributed Lag Model was adopted by lagging X-variables while establishing the link between the two. The outcome depicted the impact on the economic growth of the government spending components was insignificant. Therefore, the study concluded that the Kenyan government should stir up programs that boost public investment, thus spurring increased economic growth.

Mukui et al. (2019) undertook to establish the link between public spending and economic growth in Kenya from the year 1980 – 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 on both education and health increases economic growth. Also, domestic savings and infrastructural investment positively impacted economic growth. The study concluded by recommending that the government increase resource allocation on infrastructure investment and the education sector, thus enhancing general economic performance and labor productivity consecutively.

Njiru et al. (2020) researched on the "effect of government infrastructure investment on Kenya's economic growth from 1990 to 2017". The study used the independent variables of economic infrastructure, social infrastructure, private investment, and labor 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. Social infrastructure investment positively correlated with economic growth. Moreover, the findings highlighted that government investment in economic infrastructure positively and significantly affect the economic growth. 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.

Overview of Literature

From the review of the studies, the "impact of government expenditure on economic growth" is important 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, others believe that government operations hurt economic growth. The mix in the outcome of the findings could be because the explanatory variables and their combinations, and are applied in different studies undertaken in different areas. Truth is that government expenditure greatly impacts the growth rate of an economy. Additionally, empirical literature available focused on the already developed countries until, in the recent past, a few 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 on the subject (Jerono, 2009). The few studies on Kenya investigated public expenditure and economic growth, with some focusing on allocation of the annual budget to different ministries as a ratio of GDP, others focusing on public expenditure as an aggregate or as either capital, current, or development expenditure.

Additionally, most 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. Also, while most of the studies focused on government expenditure components, including education, defence, healthcare, agriculture, government investment, and trade openness, the current study focused on the infrastructure components (transport, energy and fuel, and ICT). In estimating the model,

International Journal of Economics

ISSN 2518-8437 (Online)

Vol.8, Issue 1, No.1. pp 1 - 29, 2023

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the studies reviewed used different methods, mostly VAR and OLS, while the current study used ARDL. Specifically, the studies undertaken in Kenya did not investigate 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, using ARDL as the estimation method. No single study employed a combination of the above.

Moreover, no study has investigated government spending on infrastructure components and economic growth in Kenya, then employed the ARDL – ECM estimation technique, thus making this study unique from the previous studies. It used the Bounds F-test for cointegration, ARDL-ECM in the estimation technique. In addition, ADF was used as the test for stationarity.

Thus, this study sought to fill in that gap and add knowledge about the impact government infrastructure expenditure has on economic growth in Kenya by employing time series annual data between year 1990 - 2020, then using the Bounds F-test in testing for cointegration and used the ARDL – ECM estimation method to analyze the findings.

METHODOLOGY

Research Design

The objective was to establish the "effect of public spending on infrastructure components on economic growth in Kenya". Further, data covered 1990 – 2020 for the three sectors of infrastructure: transport, energy & fuel, and ICT. Several tests on the time series data were carried out on the secondary data obtained, after which (ARDL) was employed in analysing the data.

Theoretical Framework

The theoretical framework was founded on the Keynesian theory, which asserts that economic growth is dictated by public spending. During depression, Keynes suggested that an expansionary budgetary policy should be rolled out, thus increasing the economy's aggregate demand, which in effect boosts GDP, employment increases, income, and the firms' profits shoot as well, which 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;

$$Y = f(GoVEXP) \quad \text{[3.1]}$$

Y represents the economic growth rate that can be determined 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.

Model Specification

In analyzing the contribution of infrastructure to economic growth, this specification was used.

$$Y = f(TINF, EINF, ICTINF) \quad \text{[3.2]}$$

Y is the economic growth rate, TINF is the total Transport infrastructure expenditure, EINF is the total Fuel and Energy infrastructure expenditure, and ICTINF is the total Information Communication Technology infrastructure expenditure. The GDP growth rate was used as a proxy for economic growth in analysing the data. All variables were expressed in percentage form (as a ratio of the Gross National Expenditure). Further, this study factored in three

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ISSN 2518-8437 (Online)

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additional control variables, which include inflation rate, trade openness. Equation 3.3 appears as follows.

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

Estimation Methodology and Procedure

This study applied the (ARDL) model in estimation. ARDL is suitable for estimating the long-run relationship among time series variables. ARDL was developed by Pesaran and Shin (1999) and Pesaran et *al*. (2001). The model is applicable to variables even when they are not integrated in the same order, thus making it possible to use ARDL instead of the Johansen and Juselius procedure which requires that for its application, variables should have the same order of integration.

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 perfectly 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).

The above points make ARDL superior to the other cointegration procedures including Engle and Granger (1987) or even the Johansen and Juselius (1990), thus expressing the main innovation for this study compared to the previous studies of the subject matter.

The basic ARDL regression model is expressed as:

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

Or $\beta(L) y_t = \lambda + \alpha(L) x_t + \varepsilon_t$..... [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.

Unit Root Test

All the variables were subjected to this test to determine stationarity before estimation. The study applied the ADF test, upon which the regression was estimated.

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

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

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Lag Selection

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 AIC, HQIC, and SBIC. The variables were subjected to the three-lag selection method. Finally, 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;

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

Where 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 coefficients in the short run, $\delta_1 \dots - \delta_7$ represent the coefficients in the long-run, while n represents the optimal lag length of the ARDL model. The logarithm operator is denoted by *L*, while Δ is the first difference operator. ε_t is the error term assumed to be independently and identically distributed.

Cointegration Test

The bounds testing procedure is applied in the form of an F-test to examine the absence of a long-run relationship between the variables. It implies that the lagged levels of the variables (LY_{t-1}, $LTINF_{t-1}, LEINF_{t-1}, LICTINF_{t-1}, LINFL_{t-1}, LTRO_{t-1}, LFDI_{t-1}$) must have zero coefficients. Rejection of the null hypothesis signifies that the variables exhibit a long-run relationship. Thus, the null hypothesis stands for no cointegration (no long-run relationship) existing amongst the variables in the equation [3.7] is that $H_{0:}\ \delta_{11} = \delta_{21} = \delta_{31} = \delta_{41} = \delta_{51} = \delta_{61} = \delta_{71} = 0$ 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 ccointegration).

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 assumes that all the variables are *I(0),* while the upper bound assumes that all the variables are *I(1).* As a rule, when the computed F-statistic is falls below the lower bound, the conclusion is the variables are $I(O)$, hence no possibility of cointegration is possible. When F-statistic falls above the upper bound it denotes presence of cointegration, and when it lies between the bounds; the test is inconclusive.

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In circumstances that the bounds test confirms the variables are cointegrated, a dynamic Error Correction Model 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. This is achieved by estimation of an unrestricted ECM or conditional ECM linked with the long-run estimates. The ECM illustrates the extent to which a disequilibrium in the period before 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, which appears as follows:

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

Where ECM_{-1} is the error correction term. It should be negative and statistically significant. Further, ECM indicates the adjustment speed; how speedily the variables bounce back to the long-run equilibrium.

Types of Data and Sources

Quantitative data from 1990 – 2020 was analysed to achieve the research objectives. The variables used are three sectors of government infrastructure expenditure alongside the three control variables: Energy and Fuel, Transport, ICT, inflation rate, trade openness, and FDI. Data was extracted from the World Bank Database, and the Statistical Abstracts published by KNBS.

Description and Measurement of Variables

Table 1: Description and Measurement of Variables

Variable	Definition and Measurement	Unit of measurement
Economic Growth (GDP)	The rise in the ability of an economy to generate goods and services by comparing one period to another mainly annually	Annual percentage
Transport Infrastructure Expenditure (TINF)	The portion of government spending in the transport sector	Percentage of Gross National Expenditure
Energy and Fuel Infrastructure Expenditure (EINF)	The government spending ration in the energy and fuel sector	Percentage of Gross National Expenditure
Information and Communications Technology (ICT)	The government spending divide in the Information and Communications Technology sector	Percentage of Gross National Expenditure
Trade Openness (TRO)	The extent a country participates in international trade. It entails the exports, imports, and GDP	Index
Foreign Direct Investment	The investment across boarder(s) where an investor in a particular countries 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 time period	Rate

FINDINGS

Unit Root Test

The ADF test was employed in testing for stationarity. In a bid to avoid spurious results, it was of great importance to establish the stationarity of the data, which is establishing the order of integration for the study variables.

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Table 2: Unit Root Test Results

Variable	Unit Root Test – ADF Test			
	Levels		Fist Difference	
	t-statistic	Critical Value at (5%)	t-statistic	Critical value at (5%)
GDP	-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: *(**) signifies reject the null hypothesis at 5% critical value. (H0: No unit root)				

From results in table 2, GDP, energy & fuel infrastructure expenditure, ICT infrastructure expenditure, and FDI are stationary in levels integrated to order I(0). Further, 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 in levels.

Lag Selection Criteria

The data were subjected to the three-lag selection criteria; AIC, HQIC, and SBIC. The study employed the AIC lag selection criteria.

Table 3: 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*

The outcome from the AIC selection criteria is presented in table 3, with AIC having the lowest values against HQIC and SBIC. The AIC lag selection criteria results in table 3 indicated an optimal lag length of 4.

Cointegration Test

This study used the Bounds test procedure to determine any long-run relationship between the study variables. H_0 denotes no cointegration. The bounds test was carried out on the level form of the variables and not on their first difference.

Table 4: 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

The results in table 4 show the calculated F-statistic for the equation was 4.554. These results indicated that the calculated F-statistic fall above all the upper bound values thus exhibiting significance at 1, 5, and 10 percent levels. Thus, the null hypothesis was rejected thus the presence of a long-run relationship between the variables.

Regression Results

The variables are cointegrated as per the findings in table 4. 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 associated with the long-run estimates was estimated. According to Upender, (2003) ECM is key in determining the presence of disequilibrium or equilibrium between the short-run and long-run.

The ECM regression results obtained from error correction equation 3.8 are well represented in table 5. The ECT should be negative and statistically significant thus pointing to the presence of an equilibrium relationship. Table 5 shows the ECM results.

Table 5: Error Correction Results

Variable	Coefficient	Standard Error	t-value	p-value
Constant	-3.128235	3.699295	-0.85	0.410
$tinf_{SR}$	.3797293	.727594	0.52	0.609
$tinf_{LR}$	-1.081768	1.089039	-0.99	0.355
$einf_{SR}$	-6.476645	2.148908	-3.01	0.008***
$einf_{LR}$	7.656182	3.12518	2.45	0.026**
$ictinf_{SR}$	.0100143	.4174708	0.02	0.981
$ictinf_{LR}$	-.8722209	.6308236	-1.38	0.186
$infl_{SR}$	-.0051791	.0563067	-0.09	0.928
$infl_{LR}$	-.1389261	.0644933	-2.15	0.047**
tro_{SR}	-.0243641	.0693453	-0.35	0.730
tro_{LR}	.1118657	.0740108	1.51	0.150
fdi_{SR}	.1244386	.4129655	0.30	0.767
fdi_{LR}	-.4629704	.6213138	-0.75	0.467
ECT	-.9003439	.2028631	-4.44	0.000***

****[**] shows significance at levels 1% and 5%; R-Squared = 0.7747; Adj. R Squared = 0.5916*

Source: Owner's Computation

From the findings in table 5, the R squared, which measures of the goodness of fit, was 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. Additionally, the model has a constant of -3.128235, indicating a decline in economic growth by negative 3.1 units holding all other factors constant.

The ECM findings indicated that transport infrastructure expenditure, ICT infrastructure expenditure, and FDI exhibited a positive correlation with GDP in the short run. Contrary, energy infrastructure expenditure, inflation rate, and trade openness showed a negative short-term relationship. In the long run, the ECM findings showed the energy infrastructure expenditure and trade openness positively correlated with GDP. In contrast, transport infrastructure expenditure, ICT infrastructure expenditure, inflation rate, and FDI in the long-run had an inverse relationship with economic growth.

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The estimated equilibrium correction coefficient is negative (-.9003439), which is statistically significant and indicates that after a shock in the system, high speed of adjustment to the long–run equilibrium. The ECM coefficient suggests a speed of adjustment of 90% from the actual growth in the previous year to equilibrium economic growth rate. Further, it means that there is an existence of both short-run and long-run relationships between economic growth and transport infrastructure expenditure, energy and fuel infrastructure expenditure, ICT infrastructure expenditure, inflation rate, trade openness, and FDI.

Diagnostic Tests

Two diagnostic tests were carried out: serial correlation and heteroscedasticity.

Serial Correlation

The Breusch-Godfrey Test was used to test for autocorrelation. It refers to the relationship between a variable before applying lags and the lagged version of the said variable at different times. It allows the use of several lags. According to Shukur (2000), in this test, the null hypothesis denotes no serial correlation of any order up to p. The findings are given in table 6.

Table 6. 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

The findings as given in table 6 indicate that at lag 1 and 2, there is no serial correlation, hence rejecting the alternative hypothesis.

Heteroscedasticity

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 that is if the p-value < 0.05. Also, using F-statistic or the LM Chi-square statistic is allowed.

In testing for heteroscedasticity, the Breusch-Pagan Test was used. 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, the outcome is given in Table 8.

Table 7: Breusch-Pagan Test for Heteroscedasticity

Chi2 (6)	2.82
Prob>chi2	0.8306

The decision for the results in table 7 is rejecting the alternative hypothesis with a conclusion that no presence of heteroscedasticity.

Discussion of the Results

The regression results showed presence of a relationship between economic growth and the infrastructure components, either in short or the long run, as indicated by the ECT which is significant at 1%. These results suggest that government expenditure on infrastructure components affect economic growth.

The ECM regression results reported that in the short run, a one percent increase in the transport infrastructure sector, ICT infrastructure sector, and FDI in the short run would bring about a 0.38%, 0.01%, and 0.1245 increase in GDP growth respectively. On the other hand, a one percent rise in energy & fuel sector, inflation rate, and trade openness would cause GDP growth to decrease by 6.476%, 0.005%, and 0.024% respectively. In the long run, a one percent increase in the energy and fuel sector, and trade openness would cause GDP growth to increase by 7.565%, and 0.119% respectively. However, a one percent increase in transport expenditure, ICT expenditure, inflation rate, and foreign direct investment would cause GDP growth to decrease by 1.082%, 0.872%, 0.139%, and 0.463%, respectively.

The empirical results support the Keynesian theory, which asserts that public spending dictates economic growth. The findings presented in table 5 showed that economic growth is positively affected by government spending in the transport sector, ICT, and energy and fuel sectors either in the long run or short run. This aligns with Keynes's assertion that an increase in public spending causes a rise in economic growth. This study's findings are in agreement perfectly with the empirical works carried out by Aschauer (1989), which found out that government investment in infrastructure boosts private sector productivity, and Maingi (2010), who found out that government expenditure on investment and physical infrastructure affect economic growth, while Mukui et al., (2019) whose results showed development expenditure promotes economic growth, but inflation negatively affect economic growth. However, this study's findings differ from Njiru et al. (2020), whose findings indicate that social infrastructure investment negatively yet insignificantly affect economic growth in Kenya.

Moreover, the results indicated the coefficient of energy & fuel sector is negative and statistically significant in the short-run, implying an injection of resources to finance the energy and fuel sector, negatively impacts economic growth rate. Additionally, the coefficients of transport infrastructure and ICT infrastructure components are positive. The coefficient of energy and fuel component is significant and positive in the long run. Thus, the positive contribution of government spending on infrastructure components, always, supports the theoretical findings that if countries attain sustainability in economic growth, then investment in infrastructure networks remains 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.

The findings also align with the findings of Aschauer (1989) which indicated that investment in public infrastructure boosts to a great extent the productivity in the private sector.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The ARDL model was used in analysing the data. The GDP growth rate was used as the dependent variable. Three government infrastructure components (transport, energy and fuel, and ICT), which form part of the economic affairs in the statistical abstracts and three control variables (inflation rate, trade openness, and FDI) were used as the independent variables.

The ARDL model approach was adopted to analyse the impact on economic growth that government expenditure on infrastructure sectors has in Kenya 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 use of ARDL. Additionally, the Bounds F-test to cointegration established the variables were correlated in the long-run, thus allowing use of ECM technique in analysing the data. Following the empirical results illustrated above, this study concludes that the structure of the government spending is critical in fostering economic growth.

The ARDL ECM model showed that in the long run, public spending on the energy and fuel sector and trade openness positively impacted economic growth. Contrary, government spending on ICT and transport sectors, alongside inflation rate and FDI, exhibited an inverse relationship with negative economic growth. Government spending on transport and ICT sectors as well as FDI positively impact economic growth in the short run. However, spending on the energy/fuel sector, as well as inflation and trade openness, were inversely related to economic growth.

The composition of government expenditure affects economic growth in the long and short run. Additionally, the findings indicate that the effect of government spending on transport expenditure in the short run, is positive but negative in the long run. Such change is attributable to the reality that the government finances most transport infrastructure projects through external loans. In the long run, such loans incur interest that the government has to service alongside the loan, thus negatively impacting economic growth. Depreciation of the said transport sector infrastructure has a hand in the negative correlation in the long run on economic growth. That same concept would apply to the ICT infrastructure sector. In the short run, Foreign Direct Investment positively effect on economic growth while in the long term, a negative effect is exhibited, which would be ascribed to crowding out of private investment as a key issue that the government needs to deal with to ensure FDI positively influences economic growth in short and long run. Moreover, economic growth is affected negatively by Energy and fuel in the short run but positively affects GDP in the long term. The behaviour points to the capital-intensive nature of investments in the sector but is very beneficial in the long run as more people get employed. In contrast, firms get access to fuel and energy, increasing productivity, thus the long-term consequence on GDP.

Additionally, trade openness negatively affected economic growth in the short, but exhibited a positive outcome eventually because when trade restrictions and bureaucracies are relaxed, factors of production move freely and ease of trade in and out of the country. This then translates to the economy benefiting in the end and positively influencing GDP. Moreover, the inflation rate exhibited an inverse correlation with economic growth at all times. The

government, through the CBK, should take measures that ensure that the inflation rate is always maintained at an averagely low level always.

Recommendations

This study suggests that the government should consider both maintaining at the current level or growing the resources allocated in the energy and fuel sector as well as incorporating policies that fit well in enhancing efficiency in how this sector is operated since 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 that the government cut down on financing the transport and ICT sector's projects 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 economic growth in the long-term, thus indicating the government need to fully embrace any policies that foster trade with fewer restrictions.

The study recommends that the government ought to develop policies geared towards either reduce or curb the government from competing with private investment, thus crowding out the effect 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 recommends that the government ought to set measures to guarantee the increased resources assigned to the infrastructure sectors are utilized in the most prudent way possible with minimal corruption involved to ensure the achievement of the vision 2030 economic pillar goals alongside increased economic growth.

Limitations and Areas for Further Research

ARDL is anchored on some assumptions that it applies to small finite data, the variables should either *I(0)* or *I(1)*, 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, for example, 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. Such other objectives explain the behaviour of government spending on economic growth and the reason some sectors like energy and fuel receives low budgetary allocation despite its potential.

In future studies, increasing the sample size and undertaking more diagnostic tests on the test results would be critical.

Finally, although the study was investigating the impact of government infrastructure spending on economic growth in Kenya covering the period 1990 - 2020, with a close focus 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 movement of causality between the various infrastructure components and economic growth in Kenya would be an area further research.

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