

**THE EFFECT OF INFRASTRUCTURE INVESTMENTS ON THE ECONOMIC
GROWTH OF KENYA**

BY

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DECLARATION

I declare this dissertation as my original work and has not been published nor submitted elsewhere for award of a degree. I also declare that this contains no material written or published by other people except where due reference is made and author duly acknowledged.

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DEDICATION

This dissertation is dedicated to my beloved family for their unfailing support, consistent encouragement, motivation and unconditional love throughout the pursuit of my academic endeavors. Thank you.

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ABBREVIATIONS AND ACRONYMS

CBK	Central Bank of Kenya
FDI	Foreign Direct Investments
GDP	Gross Domestic Product
GOK	Government of Kenya
KNBS	Kenya National Bureau of Statistics
LAPSSET	Lamu Port, South Sudan, Ethiopia Transport
OLS	Ordinary Least Squares
PPP	Public Private Partnerships
UNCTAD	United Nations Conference for Trade and Development

ABSTRACT

The past decade witnessed highest development expenditure dedicated towards improvement and development of new infrastructure corridors and networks in Kenya. This trend extended two decades of public reforms in development expenditure stretching back to 2003, when government reforms focused on domestic sourcing of development funding from tax collections. The past decade was unique in that efforts towards infrastructure development were anchored on the vision 2030 strategic development plan. This portended resolute dedication towards infrastructure development, integrating diverse source of financing such as development aid inform of grants, concessional loans, commercial loans and even Public-private-partnerships (PPPs). In the same period, very little evidence has come out to show what such efforts in infrastructure development has yielded for the citizens in regard to household income and quality of lives. Therefore, the current study seeks to determine whether infrastructure investments impact on economic growth from the household perspective. The analysis looks into investments into infrastructure notably; roads infrastructure, energy generation, public amenities and public utilities and the impact on per-capita income of the country. The study shall adopt, descriptive survey design. Secondary data, shall be obtained from published budgetary and public expenditure reports as published by the treasury ministry, parliament reports and the central bank of Kenya (CBK). Further, data on per-capita income shall be extracted from publications of the Kenya National Bureau of Statistics (KNBS). Data analysis will utilize time series data (2001 – 2021) which will cover 30 years. In addition, linear regression technique and panel regression model will be employed in the study.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Infrastructure investments form a critical pillar that lays down the foundation necessary for the industrial takeoff of any economy (Chen, 2018; Nguea, 2020). Infrastructure systems link-up various facets of diverse economic sectors hence forming the platform for economic productivity. Network components for infrastructure system include; roads and rail, ports and airports, social amenities such as schools, universities and polytechnics, public utilities such as; dams, electricity connections, telecommunication systems etc (Michiels, 2018). These infrastructure components are financial intensive thus requiring government level Investments to effectively develop them (Brooks & Liscow, 2019; Curry, 2019). Government investments on infrastructure are policy guided, with primary objectives centered on the stimulation of economic activities (Calia, 2018; Kruse, 2014).

Infrastructure systems comprise the hardware component that economic sectors are founded upon which highlights the significance in laying the foundation for economic progression in parallel to industrial take-off (Fazekas & Tóth, 2018). Requirements for comprehensive infrastructure development are all hinged on planning and resources. Resources in capital, land and human capacity are central in infrastructure planning and implementation but are often scarce which further highlights the difficulty in conceptualizing infrastructure development. In addition, a fully comprehensive infrastructure network requires interconnection of mega-systems which all require substantial financial capital to accomplish (Brooks & Liscow, 2019; Chen, 2020). Longevity of infrastructural systems and its impact in driving positive growth of economic sectors is the optimal reward for effective infrastructure investments (Michiels, 2018).

Global evidence as captured in past studies (Calia, 2018; Chen, 2020; Danau & Vinella, 2021; Kruse, 2014; Nguea, 2020) demonstrates the role of government willingness to pursue formulation of supporting policies and legislative framework as foundational incentive for attracting infrastructure investments. Government policies are anchored on political manifestos. As such, governments determined to pursue infrastructure development, commit significant portion of public expenditure towards infrastructure projects (Chen, 2020). Past evidence (Leduc & Wilson, 2013; Magnier, 2015) show that gains of infrastructure investment is accrued in the long-term. However, short-term operational setbacks on infrastructure projects implementation such as cost overruns highlight the necessity of infrastructure feasibility (Stupak, 2017). Consequently, rapid technical advances in diverse industrial fields, present some of present infrastructure systems with risk of being rendered obsolete within few years. This will render massive investments on such infrastructure projects wasteful. This highlights the need to integrate feasibility evaluation as precursor of infrastructure investments so as to develop viable and sustainable infrastructure projects.

Regionally, many countries in Africa have embraced policies of infrastructure development as the means towards spurring economic growth (Gutman, Amadou & Chattopadhyya, 2015; Jedwab & Storeygard, 2019). However, analysis by Holtz and Heitzig (2021) revealed that the overall infrastructure expenditure in Africa is still pegged at 3.5% of Africa's GDP per annum, which is short of 4.5% per GDP needed to inject positive and sustainable economic growth. Further, comparative analysis of Africa's infrastructure against peers in the developing world such as India presents a stark shortfall. Evidence by Jedwab and Storeygard (2019), shows that only a quarter of all roads in Africa are paved, with only 3,700 km of highways in comparison to 60% of paved road network in India with a 24,000km of highways. In addition, even though more investments on infrastructure have been made in the past decade, Africa still has high incidence of

extreme poverty, standing at 34% in 2019 (UNCTAD, 2020). The remaining 66% portion of African population, over 80% translating to over 600 million people still living in middle to low income bracket. This data indicates low economic growth for Africa within the period of increasing investments on infrastructure.

Locally, evidence on public development expenditure shows increasing investments on infrastructure but with marginal corresponding effect on economic growth. Data for 2020 puts total expenditure on all infrastructure projects at over Ksh. 600 Billion, with about Ksh. 400 billion dedicated on road, rail and ports infrastructure (World Bank, 2020). This represents over 160% increase in infrastructure investments for the last decade, in comparison to an estimated 5% average GDP annual growth.

1.1.1 National Infrastructure Investment

Infrastructure concept ranks as one of the most discussed by scholars drawn from diverse academic fields and professions. According to Lelei (2020) infrastructure is the broad network of transport, communication, energy and industrial hubs critical in driving the economic sectors of a country. Further, Wekesa, Wawire and Kosimbei (2016) defined infrastructure as the wheels and engine that drives an economy. This study adapts definition by Michiels (2018), who defined infrastructure as the network of Roads, railways, ports, airports, electricity transmission lines, pipelines, telecommunication cabling, digital systems and wires which make it possible for people, goods, commodities, water, energy and information to move about efficiently.

Injection of capital towards infrastructure development often tracks development policies pursued by national government. As already established, cost benefit factor is a moderating determinant in infrastructure investment due to the simple fact massive financial resources are needed to deploy comprehensive infrastructure projects (Lelei, 2020). Infrastructure

investment involves deliberate efforts seeking to consolidate financial resources towards feasibility, design and implementation of infrastructure projects for a country (Bonfatti & Poelhekke, 2017). In view that infrastructure is a network of vast economic entities; its development is limited to the prevailing and necessary needs. The current study identifies 4 main pillars of infrastructure investments, including; roads and rail investments, energy production investments, public amenities investments and public utilities investments.

In the last decade, Kenya's government expenditure on infrastructure has been substantial, with records showing that; for the years 2015, 2016 and 2017 the total infrastructure development expenditure stood at Ksh. 224 Billion, Ksh. 367 Billion and Ksh. 443 Billion respectively (Lelei, 2020; ROK, 2017). This is a significant increase in infrastructure investment expenditure in comparison to the year 2010, where total government expenditure on infrastructure stood at Ksh. 88 Billion, a ten-fold upward fluctuation. Besides the public expenditure, additional Ksh. 200 Billion annual infrastructure expenditure in Kenya is injected through international tools such as concessional loans, development grants and FDI in the PPP framework. Existing data on public development expenditure shows that, infrastructure investment has consumed the lion's share of exchequer development financing for the whole decade (Mbataru, 2018).

1.1.2 Infrastructure Projects in Kenya

Government spending on infrastructure development in Kenya tops public development expenditure (Njiru, Simiyu & Bunde, 2020; Lelei, 2020). Infrastructure attribute of economic driver is hinged on the aspect of Mega-scale denominator of critical infrastructure projects. These include critical transport, production and trading hubs that are central to the industrial development of the country (GOK, 2017). In the frontiers of transport infrastructure, the last 10 years include recorded multiple mega-projects in road and rail. These projects include; Standard Gauge Railway

Network, Mega-Dams, Kipevu oil terminal, Konza technology City, Tatu City, Nairobi Express Way, Turkana-Lamu pipeline, Dongo-Kundu Bypass etc (Thuita, 2022).

The major significance of investing in infrastructure projects is in a bid to spur and trigger economic growth. The arguments for and against the relationship between the economic growth of a country and investments in infrastructure are infinite. Past empirical studies by various scholars that date as early as 1989 by Ausher, have studied this relationship in a bid to demonstrate that infrastructure investments are actually a big variable in factor productivity of a country (Ombara Isaac, 2019). Park, (2021) noted that investments in energy related projects such as the Garissa Solar Energy facility has not gone unnoticed and especially so by the policy makers and the political class. The injection of Chinese development funding into the coffers of the Kenyan government has seen an unprecedented level of reliability and affordability of power to the people of this region. This has consequently help in increasing the levels of economic activity in the region. The government has also embarked on the raising to bitumen standards the roads that connect different areas of the same region. This points towards the government's commitment to investing in infrastructure in a bid to open up the region to economic activity and growth.

In addition, the development of the Kenyan secondary port of Lamu, graced the new transport corridor within the East Africa region commencing in Northern sections of Kenyan Coast towards the South Sudan and Ethiopia formally. This project coined Lamu Port, South Sudan, Ethiopia Transport (LAPSSET) Corridor is valued at US \$ 25 Billion (Kabukuru, 2016; United Nations, 2016). Roads sub-sector has witnessed substantial upsurge in the past 7 years. The government ambitious R2000 program seeks to attain a national record of 4300Km nationwide tarmac roads connectivity within 5 years. At the end of 2019, the R2000 roads program had reported completion of 1,400 Km of roads construction (Ndaiga, 2021).

On Energy production and Telecommunication infrastructure systems, the national government has committed substantial resources towards boosting the present capacity. In Energy sector, investments in sustainable clean energy sources including; Ngong Hills Wind Power Projects and Turkana wind Power Project. Additionally, in the past decade, Kenya's investments in geothermal energy production have peaked 870 MW as of 2019. This incredible fit ranked Kenya as largest geothermal producer in Africa and 8th largest producer in the world (Yee, 2018). In the telecommunication scene, Kenya has invested heavily in areas of internet penetration, digital cable television and access to mobile network infrastructure. At the end of 2020, Kenya's internet penetration stood at 85.2%, which is the highest in Africa (Statista, 2020).

1.1.3 Economic Development of Kenya

In the last three decades, economic outlook of Kenya recorded mixed performance with fluctuations positive high and devastating lows. The year 1992 remains a dark economic period for modern Kenya, when GDP fluctuation returned a negative growth of -0.799%, worst economic slump for 22 years of growth (World Bank, 2021). Similarly, a record high of 8.02% GDP growth in 2008 highlights potential of positive economic growth backed by government goodwill to aggressively pursue economic reforms. Studies by Chen et al. (2020) and Nyambane (2020) Kenya's economic progression tracks government policies on critical economic sectors. Notably, in Kenya prevailing government policies are time-bound due to political calendars, as with every administrative transition, new administrations pursue their own manifestos on economic development. As evidenced in studies by Hussain (2014) and, Montes and Nogueira (2021) political uncertainty and administration transitions negatively impact on consistent economic growth. In effort to avert economic progression disruption, Kenya adopted the Vision 2030 strategic plan, a long-term national development policy.

The vision 2030 framework encompasses national economic blue print of Kenya which lays down ambitious economic growth objectives for transforming the country into a middle-income industrialized economy by the year 2030 (Leshore & Minja, 2019; Macharia, 2019; Mwenzwa & Misati, 2014). This economic plan was designed with objective of creating a long-term economic policy framework which is immune from political transitions. The Vision 2030 framework was conceptualized at the backdrop of slow economic growth, with desire to inject reforms in economic planning through adoption of long-term transformative strategic plan. Infrastructure development was identified as one of the main pillars that laid the foundation for the Vision 2030 framework (Mkutu, Müller-Koné & Owino, 2021). As such, economic progression was anchored on development of infrastructure systems, since all economic reform programs were predicated on the existence of supporting infrastructure (Leshore & Minja, 2019). In light of need for revitalized infrastructure systems, government policy was tuned toward the consolidation of financial resources to kick start economic reforms journey.

Data on the World Bank shows that, Kenya's economic growth has fluctuated between 3% and 6.5%, which aggregates to average of 5% in the past 21 years. In the year 2000 Kenya's GDP stood at US \$ 36.631 Billion, to a GDP of US \$84.125 Billion dollars in the year 2019, which translates to an expansion of 129% (World Bank, 2020b). However, with notable progress in GDP expansion, household economic indicators still show high levels of income inequality, with significant portion of Kenyan population about 20% still living in extreme poverty bracket (Statista, 2020). Further, annual progressive growth economic growth for Kenya is estimated to stand at 5%. This remains so even with massive capital injection towards investments on infrastructure development, with an annual average of US \$ 4 Billion for the past 10 years, translating to about Ksh. 4 Trillion expenditure on infrastructure from public finance, development aid and Public Private Partnership framework. Therefore, the study sought to examine evaluate the

effect of infrastructure investments on the economic growth of Kenya (Makhathini, Mlambo, & Mpanza, 2020).

1.2 Statement of the Problem

Historical imperatives of infrastructure investments and its outcome in rallying economic revolution are evident in both ages of Agrarian and Industrial revolution. First-time capital injection towards infrastructure projects have objective of opening up of economic opportunities. As shown in past studies (Jedwab & Storeygard, 2019; Kruse, 2014; Magnier, 2015; Stupak, 2017) infrastructure forms a foundation of networks for economic corridors that facilitate trade, transport, storage, communication, energy transmission vital in igniting activities that open up economic sectors. Equally, whereas dedication of investments towards infrastructure projects buoys economic potential, there also lingers the likelihood of failure. Evidence in studies by Chen (2020), Leduc and Wilson (2013), and Magnier (2015) portrays the risks of unmet goals and cost overruns for large infrastructure investments. This fact highlights the value of infrastructure investments feasibility and sustainability.

Economic transformation as outcome of infrastructure investment is tied to dynamics of interconnectivity that drive the facets of industry and trade (Cigu, Agheorghiesei & Toader, 2019). According to Danau and Vinella (2021) infrastructure systems that complements trade and industrial productivity is greatly inclined to driving growth and attract various economic opportunities. In addition, submissions by Njiru et al. (2020) warned that, infrastructure systems development should be informed by the needs of socio-economic growth for its sustainability to be optimized. Past global literature on infrastructure systems development have shown its potential in driving industrial development which sets foundation for igniting economic activities. However, the diverse constructs of infrastructure and its impact on national economic growth of Kenya is less studied hence informing the need for this study.

Kenya has however experienced household income disproportion whose outcome has been slow economic growth. His study sought to understand how economic policies which are meant to steer economic growth have been discharged regardless of Kenya not showing convincing and satisfactory levels of economic growth and especially so at sub-national levels. According to World Bank, Kenya has been one of the most developed countries and especially so in the East African region boasting huge economic sectors Agriculture and especially in the farming of tea, flowers and coffee which also accounts for 22% contribution to GDP. Manufacturing has also been a significant contributor to Kenya's GDP accounting for about 11%. GDP per capita in Kenya has been considerably low averaging \$1172.36 in the years 1960 to 2021. World Bank data has however showed significant growth in GDP per capita income in the 2021 of 7.2% to \$2006.8

Regional studies by scholars (Michiels, 2018; Nguea, 2020) explored on the subject of infrastructure investments and its impact on economic development. Michiels(2018)examined the impact of infrastructure development on attracting FDI in African countries. Three facets of infrastructure notably; roads, communication and electricity were found to wield marginal effect in attracting FDI. Similarly, the study by Nguea (2020) investigated the effect of infrastructure development on attracting foreign direct investment for Cameroon. Three facets of infrastructure development including; communication, energy and transport were examined. Results deduced, showed that both communication and energy negatively impacted on attracting FDI. Furthermore, transport infrastructure was found to be insignificant factor in attracting FDI.

Locally, studies by Lelei (2020), Njiru et al. (2020) and Wekesa et al. (2016) probed the subject of infrastructure systems development. Lelei(2020)performed an analysis seeking to understand the effect of infrastructure investments on the manufacturing sector taking into consideration three infrastructure dimensions; communication, energy and transport. The study found significant influence of transport and communication on manufacturing sector growth.

Energy factor was found to wield a negative effect on manufacturing growth. The study by Njiru et al. (2020) adopted Ordinary Least Square (OLS) method and Granger causality technique in analysis of economic and social infrastructure investments on the economic growth of Kenya.

Njiru et. al. (ibid), found that economic infrastructure boosted economic growth, whereas social infrastructure deduced neutral effect on economic progression of the Country. The study by Wekesa et al. (2016) employed multiple regression analysis to examine the effect of infrastructure investment in transport, energy, communication, water and waste management towards attracting FDI in-turn igniting economic growth. The findings found positive impact of transport, energy, communication, water and waste management investments in boosting FDI inflows. From the past literature canvassed in the preceding text, the impact of infrastructure investments on the economic development falls short on detailing how economic progress attributed to infrastructure investments can be reflected on household level. Thus, the study sought to examine infrastructure investments and economic development from the household income perspective.

1.3 Objectives of the Study

1.3.1 Main Objective

The main purpose of this study was to determine the influence of national infrastructure investments on the economic growth of Kenya.

1.3.2 Specific Objectives

The study thus was guided by the following objectives;

- i) To determine the influence of road network investments on economic growth of Kenya.
- ii) To evaluate the effect of energy production investments on economic growth of Kenya.
- iii) To assess the influence of social amenities investments on economic growth of Kenya.

iv) To examine the effect of public utilities investments on economic growth of Kenya.

1.4 Study Hypotheses

The study therefore sought to test the following Hypothesis;

Ho₁: Infrastructure investments on the development of road networks have no statistically significant effect on economic growth of Kenya.

Ho₂: Infrastructure investments on the energy production systems have no statistically significant effect on economic growth of Kenya.

Ho₃: Infrastructure investments on construction of social amenities have no statistically significant effect on economic growth of Kenya.

Ho₄: Infrastructure investments on installation of public utilities have no statistically significant effect on economic growth of Kenya.

1.5 Significance of the Study

The findings in this study wielded significance on the following entities; legislators and policy makers in government, development partners and academicians. Legislators and policy makers in government would gain an understanding on the existing legal, structural and strategic national plans shortfalls in relation to infrastructure investments and household income status. This will be critical towards informing reforms in infrastructure investment policies and existing regulatory and legislative framework and be aligned with needs at the household level. This way development planning will always consider economic developments that can be accrued at the household level.

Development partners will gain an understanding on the existing pitfalls in regard to investments on infrastructure development and economic growth through economic empowerment of the

household. This will trigger reforms aimed at designed more comprehensive PPP investment programs on infrastructure development with outcome of impacting household economic growth.

Researchers and academicians will benefit from literature contribution on the discussion centered on infrastructure investments and household economic empowerment. The report of this study therefore was intended to form an important source of reference in regard to the subject of infrastructure investments in Kenya and the outcome in spurring economic growth.

1.6 Scope of the Study

The study was ultimately delimited to the subject of infrastructure investments in a comprehensive format across four main sub-sectors of infrastructure development. These included; road infrastructure, energy production infrastructure, public amenities infrastructure and public utilities infrastructure. In the past 5 years of present government administration, there has been increased collaboration on infrastructure development under the PPP arrangements. As such massive infrastructure projects are presently on-going within finance from national treasury, commercial loans, grants and PPPs. The study therefore aggregated all investments on infrastructure development per annum as cumulated from all sources of financing. The study period taken into consideration was 30 years, starting from the year 1991 through 2021. The 30-year timeline was to enable the researcher embrace time series analysis by employing Auto Regression Distributed Lag (ARDL) model in data analysis. Further, the metric indicators for economic growth were limited to per capita income, which offered a picture on the status of variables of average household income in the country.

1.7 Limitations of the Study

As indicated in the preceding text, the study employed 30-year time series in the analysis of infrastructure investments and economic growth. During this period, three government

administrations had happened with each administration pursuing different models of infrastructure financing. As such, data on PPP, grants and commercial loans may not be available for some of the years in the 30-year period. This limitation was amended by employing both error correction model to aggregate data and gain average estimates for yearly expenditures on the 4 infrastructure investment variables.

CHAPTER TWO

LITERATURE REVIEW

2.1 Theoretical Framework

The theoretical framework explores on the existing theoretical evidence on the subject of infrastructure investments and its effect on economic growth. The theoretical frameworks assist in underpinning the literature significance between existing theoretical facts and empirical correlation. The theories adopted in this study included; Schumpeterian theory, Keynesian theory, Resource Based View and the classical theoretical model

2.1.1 Schumpeterian Theory

The Schumpeterian theory is credited to the works of Joseph Schumpeter (Mehmood, Alzoubi & Ahmed, 2019; Prasetyo, 2019). The Schumpeterian model for economic growth is anchored on the Schumpeter theory for innovation which advances the concept of disruption and economic growth. The theory submits that, sum productive output in a nation, industry or an organization is based on the interaction of factors of production (Rambe & Khaola, 2021). Advocates of Schumpeter theory argue that, cumulative progress in the total productive output is moderated by the volume and changes in the factors of production. The Schumpeterian theory identifies material and immaterial factors, which influence innovation and drives growth (Bodrožić & Adler, 2018). Material Schumpeterian factors include primary factor of production including; land, capital, labor and markets whereas immaterial factors include; technical knowhow and innovative capacity.

The foundation of Schumpeterian model centers on the role of innovation towards replacing existing processes of industrial output. Further, changes in immaterial factors notably innovations driven by technical capacity and creating new markets yields effect of boosting

overall output, which further translates to economic growth (Prasetyo,2020). Schumpeterian model favors disruptive entrepreneurship which creates new products which attracts market demand hence boosting consumption. Schumpeterian model also details the blueprint of attracting new market by identifying the existing gap and serving it with desired production of new innovative products that serves current needs (Bodrožić & Adler, 2018).

It is critical to recall that Schumpeter observed the cyclical variations as crucial and necessary representations of the capitalistic development (Zou, Shen, Zhang, & Lee, 2021). According to him, increase in economic activities is as a result of of the application of new technological advancements. He goes further and observes that entrepreneurs brave enough to make technological advancements in their ventures and production techniques set a trend that can result to a high uptake of the same advancements resulting in an upswing economic activity.

Schumpeterian theory was relevant in this current study as it underpinned the framework for business process towards boosting productivity through innovation and the introduction of new techniques and capacity. Equally, for material factors of production, aspects such as land, capital, labor and entrepreneurship are recognized as critical drivers of economic growth (Prasetyo, 2020). Similarly, factors such as capital, land and entrepreneurship (markets) are government centric (Mehmood et al.2019). Public investments in frontiers such as amenities, utilities, energy and roads wield a direct effect on boosting productive capacity and creating channels, networks and infrastructure which is necessary for entrepreneurship.

2.1.2 Keynesian Theory

The Keynesian model, often cited as Keynesianism macroeconomics theory is credited to the works of John Maynard Keys, who demonstrated how overall citizenry expenditure influenced recession and inflation (Murakani, 2018; Twinoburyo & Odhiambo, 2018). According to Gukat

and Ogboru (2017), the Keynesian theory demonstrates the volatility of macroeconomic factors driven by fluctuations in spending within a population. Such fluctuations, wield an effect on the overall direction in economy as national output and markets track macroeconomic determinants. These determinants include; volume of national industrial output and total household expenditure. The Keynesian model details approach to intervention in preventing economic instability by utilizing fiscal policy economic reforms (de Jesus, Araujo & Drumond, 2018).

Keynesian model is significant in economic development, in regard to detailing the value of statutory incumbency by government agencies towards stabilizing the economy in the face of concerted aggregate extremes of recession and inflation. According to Murakani(2018) interventions through fiscal and monetary policies wield an influence on the economic growth. Introduction of transformative fiscal policies through government investments in strategic sectors impacts on other factors such as labor market and household income. Investments that spur industrial productivity equally impacts on the demand for labor. Increased workforce means a growing aggregate income which impacts on the household expenditure (Dutt, 2017). This results in driving national output which cumulatively wields an effect on the economic progression.

The Keynesian theory was relevant in this study, as it underpinned the initiative of national governments towards boosting economic stability through public driven investments. Keynesian model highlights the influence of macroeconomics in moderating recession and inflation (Murakani, 2018). To avert these extremes, the Keynesian principles offer an intervention through government action of policy revision (de Jesus et al., 2018). Investments in sectors such as utilities, energy and amenities play a critical role in transforming the state of macroeconomic extremes. Therefore, the current study adopted the Keynesian model so as to highlights the relevance of government's intervention in boosting economic growth through fiscal policies directed at expanding industrial productivity.

This study there adopted the Keynesian model as stated below

$$Y = A + mpc(Y)$$

Whereby Y is National Income (GDP), A is the Autonomous Expenditure, and mpc is the marginal propensity to consume

Autonomous Expenditure (A) is a function of Consumption expenditure by households (C), Investments by households and business ventures (I), and Government Expenditure on goods and services (G).

$$\text{Thus } Y = C+I+G+(X-M)$$

Where X-M denotes the net exports.

2.1.3 Resource Based View Theory

The resource-based view model (RBV) is accredited to seminal paper on firm resources and sustained competitive advantage published by Jay Barney in 1991 (Chahal et al., 2020; Collins, 2021). The RBV model is founded on firm-level administration action through effective utilization of resources to reinforce existing competitiveness. Firm strategic resources include; tangible and intangible assets that contribute directly in the productive capacity of the firm (Radjenović & Krstić, 2017). Nason and Wiklund (2018) posits that internal firm resources encompass, unique capacities, processes, assets, procedures, administrative talent that places the firm's operational execution at optimum. In addition, firm resources include internal strategies for knowledge management which is a critical process for maintaining firm's intellectual facets which drive its unique brand.

Infrastructure investments are distinguished by their scale of resource allocation, complexity, long lifecycles and not forgetting their economic impact in a country which can often result to failure of these megaprojects (Chen, Locatelli, Zhang, Gong, & He, 2021). In order to evaluate the outcomes of these infrastructure investments, employing the RBV model is crucial as it provides a theoretical view in which competitive advantage and how the outcomes of these infrastructure investments are achieved by employing firm resources and capabilities. Chen et. al (2021) in his study demonstrated that successful economic growth can be achieved through innovative capabilities in resource allocation by a country and these innovative ways would enable a country to wisely identify such projects that will bring an upswing in both economic activities and economic growth and ultimately achieving superior productivity for a country.

The theory significance in economic growth emerged from the aspect of resources management, utilization and optimization of its capacity towards generating value that is unmatched. This factor of offering unmatched value is the highlight of RBV attribute of retaining market position. Mitra, O'Regan and Sarpong (2018) posited that fundamental principle of RBV is its advocacy on building unmatched internal capacities that's are unmatched by any competition. This is relevant in economic development front, in the premise that for a country to boost its total output and growth, internal capacities must be equally developed (Campbell & Kubickova, 2020). This particularly highlighted the importance of boosting national capacity for productive sectors to drive industrial growth with cutting edge quality, which would guarantee sustained growth. Furthermore, capacity development is a factor of skills, knowledge and technical mastery which require considerable institutional framework and public investments (Collins, 2021). Therefore, RBV model supported the role of public investments in capacity building infrastructure and amenities which are necessary in building critical capability as resource for industrial takeoff.

2.1.4 The Classical Structural Model

The classical structural model was based on the volume of surplus production in an industry, capital injection, and population of the productive labor force and the value of wages. In the structural model, key pointers of critical significance include the surplus generated, which is measured in terms of profits estimated for industrial productivity (Munim & Schramm, 2018). According to advocates of classical structural model, the growth of an economy is pegged on the volume of surplus, which in turn triggers capital formation process (Lawanson & Evans, 2019). According to Khan et al. (2020) increased access to capital boosts industrial productivity thus requiring an expanded production factor which refers to the labor force or production population. The structure model submits that increased workforce demand results in positively boosting salaries and remuneration for the absorbed workforce. Increased pool of salaried people boosts expenditure which in-turn reflected in structural economic growth.

The classical structural model submitted that total wages continue to increase until an equilibrium is reached where national output equalizes total wages thus reaching a stagnation and potential decline in economic growth (Yusliza et al., 2020). In the neoclassical structural model, growth in economic front is moderated by capital accumulation in response to the state of labor and technology (Khan et al., 2020). Capital injection inform of investments in infrastructure, energy, amenities and utilities seeks to achieve an economic growth by boosting industrial expansion. These investments serve as means of building the foundation for industrial takeoff, through boosting productivity enablers.

Lawanson and Evans (2019), who supported the Solow-Swan growth model, postulated that increasing industrial productivity overtime responds to population changes and the trends in labor demands and capital accumulation which also impacts on the socio-demographic attributes of a country. Thus, the growth model, offers a foundation which explained how capital

such as government investments can influence economic growth through increased industrial output. The structural growth theory supported the use of capital (public investments) in creating avenues for boosting output such as energy and infrastructure installations with an equal share of increased cash flow in the economy through salaries paid to labor-force which is driving industrial productivity.

2.1.5 Solow's Growth Theory

Solow Model of economic growth was originally developed by Robert Solow of Massachusetts Institute of Technology (MIT) in the year 1956. His contribution in the neo-classical theories was in a bid to understand the various factors that can effectively contribute towards economic growth of a nation. This model attempts to demonstrate that growth can be sustained through the use of the basic physical factors of production, labour and capital, with various other inputs such as innovation and technological innovations changing in the model. Solow model also doesn't rule out the effects of other variables such as savings and investments which are also big contributing factors in capital formation (Matara, Odada, & Obere, 2021). Major insights gained from Solow Growth Model is that an increment in the savings rate, which in turn is observed as an increment in investment, thus an increase in capital consequently leads to an increase in per capita, not forgetting that this rise would also be a function of technological advancements. Solow also noted that if the increment of one unit of capital consequently leads to the rise in the marginal output, then eventually the rate of consumption also rises.

Solow model also demonstrated that the effect of diminishing returns to capital and suggested that nations without big savings and investments that form capital would tend to grow faster than those with big amounts of savings (Broughel & Thierer, 2019). Another shortcoming of the Solow Growth Theory is that the model fails to demonstrate the growth process and

especially so where the main catalyst in growth is technological advancements that usually result to steady economic growth.

This therefore made the model makes the model a better fit for the demonstration of the role of public sector investments as a driver of economic growth since these investments are often viewed as the primary factors of growth in this model.

This study therefore adopted the basic Solow Growth Model of 1956 which demonstrates economic growth rate as a function of Capital (K), Labour (L) and total factor productivity.

$$g_{ct} = g(L_{ct}, K_{ct}, A_{ct})$$

Whereby g_{ct} is GDP per capita of country c on period t , L is labor input as a factor of production in country c in period t , K is capital investments as factor of production in country c in time period t , and A is the total factor productivity in country c in time period t .

2.2 Empirical Review

2.2.1 Road Infrastructure Investments and Economic Growth

A global study by Ng et al. (2019) sought to determine the impact of road infrastructure development on spurring economic growth of a country. The study employed fixed-effects panel linear regression analysis that leveraged on time-series cross-sectional data that covered about 60 countries for a 3-decade period, 1980 to 2010. The factors of growth examined included, physical capital stock, urbanization, export and education expenditure. The findings showed that increasing length of paved roads per thousand positively impacted on improving per capita export growth, expenditure on education and improved incomes. Further, the findings revealed a U-shape dependency outcome of urbanization and economic growth, where low urbanization tracked

positive economic growth to a certain level, where it begins to dip with surge in urbanization pressure.

Maparu and Mazumder (2017) studied the triple concepts of transport infrastructure, economic development and urbanization. The study leveraged on existing India development data for a period of two decades between 1991 and 2011. The study employed Granger causality to test for relationships between, infrastructure investments and economic growth. Vector Auto-regression test and Error correction model were employed in examining short-run and long-run causality relations. The results showed existence of long-run causality between transport infrastructure and economic development of India. However, the analysis further revealed that the causality direction trended towards transport infrastructure investments from economic development. In regard to causality between transport infrastructure and spurring aspects of economic growth, Nguea (2020) similarly found that insignificant evidence on transport infrastructure towards moderating economic growth.

A study by Nguea (2020) in Cameroon examined the impact of infrastructure development on foreign direct investments as a strategy to spur-up economic growth. The study utilized time-series data based on Cameroon economic data for a period of 3 decades, 1984 to 2014. The study model utilized Auto-Regressive Distributed Lag (ARDL) for analysis to examine causal association of infrastructure development and FDI inflow. The model plotted three indicators to assess infrastructure investments notably; communication infrastructure, energy infrastructure and transport infrastructure. Results tabulated showed insignificant short-term and long-term impact of transport and energy infrastructure in attracting FDI. However, communication infrastructure returned positive short-run on attracting FDI which in-turn boosted business climate thus spurring economic growth.

A study in Uganda, by Muvawala, Sebukeera and Ssebulime(2021) looked into the subject of urban transport infrastructure and its effect on the economic growth. The study utilized data drawn centered on overall public investments towards the development of transport infrastructure across urban economic hubs in Uganda. The model leveraged on ARDL, with model fitness seeking to examine the aspect of co-integration and the doable effect of short-run and long-run effect on economic growth. The results showed that, commitment of investments on transport infrastructure yielded a significant effect on economic growth. The findings showed that, in the case of short-run, negative effect on economic growth was noted which was attributed to over-expenditure on infrastructure. However, in the long-term, the results showed that transport infrastructure yielded positive effect on boosting economic development.

Locally, a study by Lelei (2020) performed an examination into the impact of infrastructure development on the growth of manufacturing share of the GDP. The study employed a time series analysis to compile economic data for a 2-decade period, 1997 to 2017. Data analysis employed Ordinary List Squares (OLS) in evaluation of investments data on transport infrastructure, energy and telecommunication. The results showed that, investments in transport infrastructure, communication and information technology system impacted positively on boosting manufacturing growth portfolio of the GDP.

Njiru et al. (2020) carried out a study investigating the effect of government infrastructure investments on economic growth of Kenya. The study leveraged on secondary data on economic development metrics with objective of estimating a causal relationship of time series data. The study employed logarithmic modeling with ordinary list squares (OLS) technique for data analysis. Four measures of economic analysis notably; economic infrastructure investment, social infrastructure investments, labor force and private investments. The results showed that public infrastructure investments contributed significantly towards the GDP growth of a country.

However, the study found that private investments, social infrastructure investments and labor force had negligible to negative effect on economic growth.

2.2.2 Energy Infrastructure Investments and Economic Growth

A study by Ahmad and Zhao (2018) investigated the existence of causal links between national driven investments on energy and the economic growth in China. The study leveraged on common correlated effects group (CCEG) technique for variable estimation. The method is selected as it makes it prevents cross-sectional dependency for error terms parameter. The secondary data was gathered from published reports across 31 provinces in China. The results showed existence of significant causal association between investments in energy investments and economic growth. The findings further showed that, positive shocks attributed to investments on energy systems, resulted in significantly boosting economic productivity, thus boosting economic growth. These findings contradicted conclusions by Nguea (2020) whose analysis detailed that energy investments yielded insignificant outcome on positive economic growth.

Al-Darraj and Bakir (2020) examined the effects of clean energy investments towards boosting economic growth. The study leveraged on combined causality tests based on ARDL, OLS and co-integration techniques. Causality test employed Wald T-statistic test, to evaluate existence of causal relations between investments in clean energy and the economic growth. The results showed that investments in clean energy wielded a significant positive effect on the GDP of a country. Further, the findings showed that clean energy effects on economic growth were also inelastic. In addition, incremental gains in GDP growth attributed to clean energy were found to trigger, increase in labor-force and capital investments.

A study by Zakari and Khan (2022) examined the aspect of energy consumption towards boosting economic growth of African countries that are recipient of Chinese FDI. The study

adopted panel corrected standard error (PCSE) econometric procedure for a selected 21 sub-Saharan Countries. The study examined the interaction of factors notably energy consumption, fixed capital, technology adoption, labor force and the inflow of Chinese FDI. The results showed existence of equilibrium between energy aspect and GDP of a country. Further, the findings indicated that under quality institutional regime, energy consumption positively impacted on the growth of GDP.

Regionally, a study by Masha, Gwenthure and Odhiambo (2018) in Ethiopia sought to investigate whether national energy consumption wielded any causal linkage to the economic growth. The study utilized Auto-Regression Distributed Lag (ARDL) and Granger-causality scale to evaluate for casual linkages between energy consumption and economic growth in Ethiopia. A time-series data extending for a 42-year period (1971 through 2013) will be utilized. The results showed existence of unidirectional outcome between energy consumption and economic growth within short-term and in the long-term. This meant that both in short-term and long-term, energy consumption accounted for significant moderation on the state on national economic growth. In a similar analysis by Zakari and Khan (2022), the results showed existence of potential equilibrium between energy consumption and economic growth. Both studies support the aspect that, energy consumption in an economy tracks economic growth thus exposed to fluctuations driven by macro-economic factors.

Locally, Gakuo (2015) conducted a study evaluating the impacts of government investments in the development of energy infrastructure on the economic growth of Kenya. The study employed quantitative survey technique, utilizing secondary data in the analysis. Data on energy investments and economic trends were analyzed using regression analysis technique. The results showed that energy investments accounted for a 67% variability in the economic

performance of Kenya. The study found that, increased investments in diverse energy sources, wielded a positive effect on the economic growth of Kenya.

2.2.3 Social Amenities Investments and Economic Growth

Yu, Zhang, Tao and Liang (2019) conducted a study which examined the concepts of amenities, economic opportunities and migration across cities in China. Secondary economic data on migration, economic standards of the population and the state of amenities was collected across China. Multivariate linear regression was utilized to measure relationship between pull factors for attracting migration including; state of amenities and prevailing economic situation. The findings showed that, urban areas which were characterized by existence of sufficient amenities, served as a key pull factor which saw increased migration of people. This migration was also attributed to the aspect of better economic prospects in towns with good social amenities as it was viewed to offer comfortable living. Further, Yu et al. (ibid) postulated that, economic opportunities tracked development of advanced social amenities which attracted productive population.

Hakim et al. (2022) conducted a study which evaluated the effects of amenities and economic factors on driving migration trends across Indonesian Cities. The study utilized cross-sectional survey. Factors of data assessment included, state of social amenities, economic opportunities and overall movements of people from remote to urban regions across Indonesia. The results showed that, existence of amenities alongside other attributes notably; state of minimum wage, regional GDP and access to tertiary centers was critical in driving urban to rural migration. The element of regional GDP in tracking amenities growth was evident, thus showing how increasing economic potential of areas attracted improvement in amenities investments. Amenities in developed urban areas were found to be appealing for productive members of society who also seek rewarding jobs and higher remuneration.

A study by Turok and McGranahan (2019) examined the effect of urbanization on the economic growth of African Countries. The main factor of analysis was determination of the expanded access to sufficient amenities served as a catalyst for economic development. The study utilized empirical literature survey, covering array of past studies in African countries on the arguments and studies centering on urbanization. The analysis scrutinized whether development of public amenities and urbanization contributed in tracking economic development. The analysis found that, there was no significant association between urbanization and economic growth. The results showed that linear correlation between factors of urbanization such as expanded access to public amenities didn't influence economic development. Furthermore, the findings showed that, in aspects of urbanization that concurrently featured advances in strategic infrastructure such as roads positively tracked economic growth.

Regionally, Nduwayo(2019) conducted an investigation examining the effect of social capital in delivering social amenities across rural Tanzania. The study leveraged on descriptive survey methodology integrating interviews and questionnaire feedback in gathering data for the study. Leading stakeholders in the development of social amenities including community projects such as water pans and storage tanks participated in the study. The results showed that social capital including structural and relative wielded an impact on the performance of social amenities projects. The study postulated that investment and development of social amenities in rural areas was critical in uplifting economic standards. Further, the study found that critical social capital was vital in delivering valuable community social amenities projects.

2.2.4 Public Utilities Infrastructure Investments and Economic Growth

A study by Nadiri, Nandi and Akoz(2018) examined the effect of telecommunication utility infrastructure on the productivity levels across different industries in the United States. The study deployed comparative and cross-sectional causal methods. Data on communication infrastructure

across different sector was leveraged in the analysis of impact assessment. The results show that increased deployment of communication infrastructure such as high-speed internet and digital systems infrastructure wielded a significant boost on the productivity levels of many industries across the US. Further, modern high-tech communication utilities contributed in lowering labor demands hence contributing in cost cutting for businesses. On the flip-side, communication infrastructure was found to increase the demand for private capital (Twesigye, 2022).

Laitinen et al.(2020) examined the effect of vital national utility sector, notably water and sanitation in regard to its transformation to aligning with green sustainable economic growth model in Finland. The study employed participatory survey methodology. Critical stakeholders in the utility sector centering on water services and sanitation were interviewed and their insights gathered for purposes of sustainable policy development. The results found that, policy changes in regard to the management of water and sanitation resources needed to be activated immediately. Main areas of utility management include; boosting environmental and ecological knowledge on sustainable water management systems (Oluoch, Lal, Susaeta, & Wolde, 2021). Further, the study highlighted the need for development of new water and sanitation infrastructure that facilitated re-usability and recycling of water and sanitation outputs to enable realization of green and circular economy for Finland.

Majanga (2015) conducted a study examining the feasibility of liberalizing power utility services and its effect on the economic development of Malawi. The study utilized primary data collection which leveraged on descriptive survey design. Questionnaires were constructed to cover key areas of power utility infrastructure across Malawi and how it influenced economic development dynamics. The findings revealed that limited power distribution network infrastructure and monopoly of electricity utility distribution had a net effect of significantly increasing the cost of electricity. High cost of power utility negatively impacted economic growth

of Malawi, as more of local natural resources and raw materials were exported to countries with lower utility cost for processing and value addition. This model was non beneficial to the country.

Mizutani et al. (2020) conducted a study that analyzed the approach to structural reforms for utility industry in electricity provision towards boosting economic growth. The study utilized quantitative research design. Panel data drawn from 35 OECD countries, extending a period of 22 years (1991-2013). Data analysis was based on Barro-type GDP growth rate regression model. The analysis revealed that for utility liberalization and third market accessibility wielded a positive effect on the economic growth through positive GDP progression. Further, the results found marginal effect on the GDP growth drawn by wholesale distribution of electricity through vertical separation. This result indicates that market differentiation through wholesale distribution system didn't have any effect in spurring GDP changes. Whereas cost factor is silent in regard to third-party access and wholesale distribution, the findings shows that cost of electricity utility doesn't influence volume of demand. This study slightly contradicts findings by Majanga(2015) who determined that cost of electricity distribution, even in wholesale model or third-party was detrimental to driving industrial productivity. In the study by Mizutani et al. (2020), exclusive third-party power utility access significantly boosted industrial productivity.

Locally, Guma (2019) carried out a study on the utilization of telecommunication platforms towards shaping distribution of utility services in water and electricity within urbanized settings. Cross-sectional survey design was adopted for the study. Data on the deployment of ICT platforms across urban suburbs of Nairobi and their adoption as channels for utility access facilitation was utilized. The results showed that existence of fragmented society in Nairobi region, with enclaves of wealthy suburbs and low-income regions. This has created spatial differentiation in delivery of ICT infrastructure that facilitates smart access to utility services including water provision, electricity and other telecommunication services. This has made service providers

employ market-driven techniques in providing such access to such solutions. This has caused imbalance with premium access extended to wealth suburbs while poor neighborhoods access poor quality utility services access. This results in fragmented economic progress.

2.3 Summary of the Literature and Gaps

Numerous past studies have been examined focusing on the influence of infrastructure investments notably; roads, energy, social amenities and public utilities infrastructure investments and their effect on the economic growth of a country. Numerous gaps from past literature were found. The study by Ng et. al. (2019) was broad with emphasis on development overview for roads infrastructure, urbanization, export, education and physical capital stock. The study however failed to demonstrate development ratios per investments in regard to roads infrastructure investments and national GDP and per capita income. Maparu and Mazumder (2017) study showed causal effect on economic development attributed to transport infrastructure but failed to demonstrate quantitative trends on economic growth as the directional casual effect was limited to element of urbanization.

The study by Nguea (2020) showed that transport infrastructure doesn't drive FDI inflows, however, the study revealed that in overall, infrastructure investment enhanced business climate. The study failed to determine whether a link existed between infrastructure development and economic growth in a country. The study by Muvawala et al. (2021) did establish a significant association between transport infrastructure and economic growth, however the examination was limited on urban transport infrastructure which fails to compile cross-country status of transport infrastructure investments and spurring economic activities and growth at the same time. The study by Lelei (2020) fails to determine attributes of negative impact of energy investments and GDP growth, with its critical moderating role of driving manufacturing sector. The study by Njiru et al.

(2020) determined that only public infrastructure investments had a positive effect on the economic growth in comparison to social infrastructure development and labor force development. The study failed to reconcile between productive economy (human capital development), per-capita income and the GDP aspects as key attributes for driving public infrastructure development.

The study by Ahmad and Zhao(2018) offers insights on energy role in boosting economic growth in China but fails to demonstrate quantitative factors of association between public expenditure on energy projects and short-term outcomes on economic performance. The study by Al-Darraji and Bakir(2020) does show that, investments in clean energy positively tracked GDP growth, which also returned an inelastic association. The results were limited in scope and were also inconclusive in regard to per-capita growth and household economy hence need for more scrutiny. The study by Zakari and Khan(2022), was limited on the aspect of energy consumption and economic growth, thus failed to indicate the effect of energy investments in driving economic indicators such as GDP, per-capita income and HDI. The study by Nyasha et al.(2018) found existence of unidirectional causality between energy consumption and economic growth in Ethiopia. The study however failed to determine if overall investments in energy sector wielded any impact in driving economic growth. The study by Gakuo (2015) highlighted the positive impact of energy investments on economic growth, but failed to highlight the effect on household income and long-term trends. Equally, the study failed to show how the public investments in energy sources impacts on short-term economic trends in context of government expenditures.

The study by Yu et al.(2019) focused on the aspect of migration between cities in China triggered by amenities and economic prospects. The study failed to determine whether investments in amenities wielded any impact on the economic growth of a country. Hakim et al. (2022) study showed that good amenities track enhanced economic potential of an area, with people following rewarding jobs and access to good tertiary institutions. However, the study by Hakim et al. (2022)

failed to show whether committing public resources towards the development of social amenities impact on economic growth. The study by Turok and McGranahan (2019) focused on urbanization and economic growth, where public amenities are well developed hence attracting urban migration. However, the study failed to determine whether investments in public amenities yield a linear relationship with economic growth in a country. The study by Nduwayo (2019) focused on social capital and its influence on the development of social amenities and failed to show how public investments on amenities could be directed towards accruing rapid economic development.

The findings by Nadiri et al. (2018), established that communication infrastructure as utility contributed towards boosting industrial productivity. The study fails to determine whether such industrial productivity can be extrapolated to effect overall national economic performance. The study by Laitinen et al.(2020) focused on aligning current utility infrastructure to green and sustainable water and sanitation systems in Finland. The study failed to show how the green practices can be optimized to realize national economic growth through introducing sustainable water and sanitation infrastructure. Majanga (2015) highlighted the importance of lower power utility costs in driving manufacturing sector in turn boosting growth, but failed to demonstrate the utility investment strategy that can be pursued nationally to moderate power costs. Mizutani et al. (2020) study failed to propose a method of power utility harmonization through public investments in power utility infrastructure (generation, transmission and distribution) and its outcome in driving economic growth of a country. Guma (2019) highlighted the value of ICT platforms in extending access to utilities including; water services, electricity and telecommunication. The study however failed to show how government investments in utilities infrastructure can be moderated for benefit of entire citizenry to spur uniform economic growth.

2.4 Conceptual Framework

The current study sought to examine the effect of infrastructure investments on the economic growth of Kenya. The conceptual framework highlights the diagrammatic representation of the relationship between indicators of independent study variable which is infrastructure investments versus dependent variable economic growth of Kenya. The indicators for independent infrastructure investments selected for the study included; roads infrastructure investments, energy investments, public amenities investments and public utilities investments.

Independent Variables

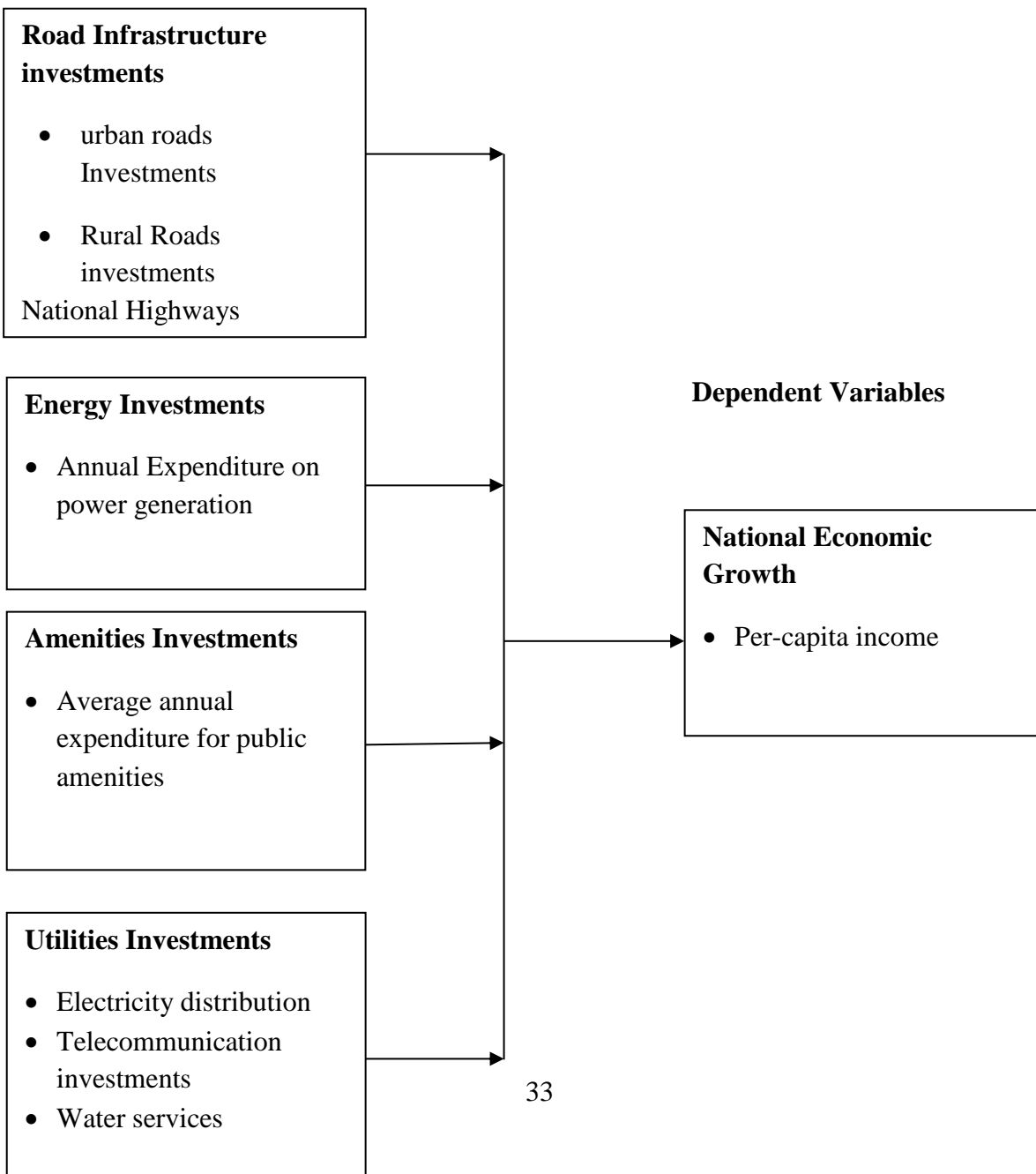


Figure 2.1 Conceptual Framework

2.5 Operational Definition of Variables

The tabulation in Appendix II highlights the operational definition of variables

Jha (2018) posits that there has been an increase in development beyond economic growth which has been highlighted by the overwhelming adoption of the Sustainable Development Goals (SDGs) and also the advocacies of the Paris Agreement on climate change. Thus, various composite indices have been adopted in a bid to measure and quantify economic growth. This study however adopted economic growth as the response/dependent variable which was measured using the per capita income as the variable indicator.

Road infrastructure investments used as an independent variable with the indicators being the annual budgetary allocations to roads for both development and the maintenance of the road networks in Kenya. A study conducted by Ombara (2019) stated that an assessment of Kenya transport infrastructural developments was a good metric to identify opportunities, familiarize with challenges while also making future plans on financing of similar development endeavors by the Kenyan Government. The study used these indicators as they will help in creating evidence-based investment frameworks for the government.

Energy production investments is the other independent variable adopted by this study. Budgetary allocations for the generation and the distribution of power will be the indicator as this metric will serve as a good measure of how much the government allocates in the generation and distribution of power for use in various sectors including households. Kenya has consistently made significant efforts in the provision of reliable and affordable electricity (Pueyo, 2018). This has seen significant investments and budgetary allocations by the government in areas such renewable energy. Insufficiency of power generation can be a big contributor in unreliability of electricity

and this has grave cost consequences especially to the economy. Therefore, the study adopted budgetary allocations to this sector as an indicator in a bid to find whether there actually exists a relationship between investments in power generation and distribution to economic growth (Noronha, Zanini, & Souza, 2019).

Investments in public utilities is also another independent variable for this study, indicator being the expenditure of the government in investing in the public utilities. Measurement of this variable will be the annual budgetary allocations of the treasury in the development of public utilities. Broughel et. al (2019) in his study demonstrated how important technological innovations are significant drivers of economic growth in a bid to address technological critics and also shed light on policy discussions.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This section of the study presented a breakdown of procedures and process that were used and executed in gathering the data needed to determine whether national infrastructure investments influence economic growth of Kenya. Areas covered include; research design, target population, sampling, and data collection procedure and data analysis.

3.2 Research Design

The current study opted utilized descriptive survey design. According to Pandey and Pandey (2021) descriptive design is a statistical survey approach where factors influencing phenomena are described in regard to underlying causes and effects. Descriptive survey enabled probing of facts about a topic which is being studied by injecting attributes of inquisition notably; why, when, how and which. This way; all characteristics of a study variables were examined and their effect/impacts measured and effectively presented using both descriptive statistics. It is designed to gather data about present existing situations. Further, descriptive design provided a systematic description that is factual and accurate concerning the nature and status of the subject under study (Sekaran & Bougie, 2019).

Underlying attribute that is shared in descriptive study designs is that there is only one single sample that defines a dataset without any comparison group (Lune & Berg, 2017). Usually, a descriptive research model is concerned with assessing the rate of occurrence or the association between variables. The model is suitable as it helped to define, analyze existing relationships, and contrast variables in a specific study. The current study sought to examine whether Infrastructure

Investments impacts on economic growth of the country. Descriptive design thus enabled us build a rapport of association between factors for Infrastructure Investments notably; roads infrastructure investments, energy production investments, public amenities investments and public utilities investments and their relationship with economic growth of Kenya measured by per-capita growth.

3.3 Target Population and Sampling

The target population refers to a collection of individuals or object, which are the focus of a scientific query (Greener & Martelli, 2018). Sampling on the other hand refers to selection of precise items/unit in a population which shall be examined in the study or directly participate in the study as representation of the entire target population. Bougie and Sekaran (2019) defines research population as a well-defined collection of individuals or objects known to have similar characteristics. The study focused on the national financial indicators for the Kenyan budgetary allocation alongside other development financing from grants, commercial and concessional loans that the national government allocates for infrastructure development programs. Further, the study utilized economic data on the changes recorded in the national rates on house hold level personal income, which is the dependent indicator (per-capita income) which showed economic progression in regard to personal income for the defined period of infrastructure investments.

3.4 Research Procedure

The current study also integrated secondary data in analyzing effects of infrastructure investments on economic growth of Kenya. Specifically, the study sought to find and to determine whether; roads investments, energy investments, social amenities investments and public utilities investments yields effect on economic growth of Kenya. Unlike primary study, where the researcher will require to develop a tool for collecting firsthand information, in this study, an economic data table was effectively used to tabulate time series economic data for a period of 30 years. Four indicators on infrastructure investments notably; roads investments, energy

investments, social amenities investments and public utilities investments were all tabulated for the period of time. For the dependent indicator; economic growth, the study opted to utilize per-capita figure. This therefore offered more effective assessment on the relationship between investments on infrastructure and its impacts on household wealth measured by per-capita income.

3.5 Data Analysis

The current study sought to utilize past data published by government agencies and development institutions in Kenya including KNBS, CBK, media and ministerial reports. As detailed in the data collection procedure section, past data thus was tabulated for easier export to statistical soft-wares for further processing and validation. The data was then processed and sufficiently tabulated, which eventually was followed by analysis which includes descriptive analysis and inferential analysis.

3.5.1 Descriptive analysis

Descriptive statistics shall cover the computation and presentation of descriptive for independent variables notably; Road infrastructure investments, energy production investments, social amenities infrastructure and public utilities infrastructure investments, which include; mean, standard deviation Kurtosis and Skewness.

3.5.2 Exploratory Data Analysis

The Exploratory data analysis (EDA) focused on datasets analysis then grouping in accordance characteristics determined. The current study sought to explore on impact of infrastructure investments on economic growth of Kenya. Independent variables include; Roads infrastructure investments, energy infrastructure investments, public amenities infrastructure investments and

public utilities infrastructure investments. The EDA technique enables grouping of each variables data and enable development of a model to predict their independent effect on the predicted variable which is the economic growth, examined using changes in per-capita income.

3.5.3 Pre-Estimation Diagnostics

3.5.3.1 Unit Root Testing

The unit root test was used to determine whether stationary moments exist for periodic data in a time series dataset (Lee & Tieslau, 2019). Unit root test examined time-series data for stationary and non-stationary characteristics. The test sought to investigate and determine the level of consistency in regard to distribution of time-series data in regard to drift and existence of unit root. Augmented Dickey-Fuller (ADF) scale hence was adopted in testing for the existence of unit root. A unit root thus indicated that the data is potentially unpredictable hence unreliable.

3.5.3.2 Optimal Lag Order

The study will utilize Auto-Regression Distributed lags (ARDL) model for the regression analysis. In a time series analysis, data is estimated for a period of time, where both predictor variables (independent) and residual variables (dependent output, Y), change with time which is referenced as lags. The lag order are based on period of reference for the data. The current study thus utilized 2 lag length, since the study intended to use 30 observations covering annual data.

3.5.3.3 Testing for Cointegration

Cointegration test verifies for the existence of serial correlation a time series data (Mugableh, 2018). Determination for existence of cointegration state means that two or more non-stationary variables in a time series set are integrated together over time and cannot be changed from equilibrium point (Saleem & Shabbir, 2020). The study therefore leveraged on Johansen trace test to asses for the existence of cointegration. s

3.5.4 Model Fitting

The study adopted the ARDL bound test for the model to determine whether a relationship exists between Infrastructure investments against economic developments.

$$ECONG_t = f(\text{ROADS}_t, \text{ENGY}_t, \text{AMENT}_t, \text{UTL}_t) \quad (1)$$

Where; $t = 1, 2, 3, 4 \dots n$ (time for 30 year, from 1991 – 2021)

Therefore

$$\text{Ln}(ECONG)_t = \alpha_0 + \beta_1 \text{Ln}(\text{ROADS})_t + \beta_2 \text{Ln}(\text{ENGY})_t + \beta_3 \text{Ln}(\text{AMENT})_t + \beta_4 \text{Ln}(\text{UTL})_t + \hat{\epsilon}_t$$

(2)

Where; $\hat{\epsilon}_t$ = error term , $\beta_{1,2,3,4}$ = beta-coefficient for independent variables

3.6 Post Estimation Procedures

Once the model was established, the study consequently undertook to perform a series of post-estimation tests, which were intended to determine whether the ARDL model was sufficiently robust to stand fitness test. The test determined whether, Infrastructure investments wielded any influence on the economic development in Kenya.

3.6.1 Testing for Granger Causality

To investigate the direction of causality, the study ultimately employed Granger causality test in two ways. First, for the long-run, it employed the general Granger causality. Second, for short-run, it employed Granger causality under Block Exogeneity test.

Granger causality test: Correlation does not necessarily imply causation in any substantive sense of the term. The tests, will assist to determine whether Roads Infrastructure Investments, Energy Infrastructure Investments, Amenities Roads Infrastructure Investments and Utilities Infrastructure.

3.6.2 Testing for Residual Autocorrelation

The study sought to test for the existence of autocorrelation for the predictor variable. The study will execute Vector Error Correction model test (VECM). Existence of residual autocorrelation means that, internal correlation exists between independent variable, hence the model will fail the fitness test. The test therefore evaluated the null hypothesis of no serial correlation against the alternative of auto-correlated residuals. If the p-value was more than 5% significant level, the null hypothesis wouldn't be rejected hence confirmed there is no serial correlation of the error term. If autocorrelation was present, ARDL model is estimated using the robust standard errors to account for the presence of autocorrelation.

3.6.3 Impulse Response Analysis

The impulse response functions is useful as it reveals the effect of a standard deviation shock on the dependent variable (economic growth in Kenya estimated using per capita income). IRF are formed through the moving average (MA) of the vector autoregressive (VAR) equation. Additionally, the study will deploy Variance Decomposition (VDC) to determine which of the independent variables, accounts for more variability/influential in per-capita income change (Δ ECONG).

3.6.3 Post-estimation Model Test for Diagnostics

3.6.3.1 Diagnostic Tests

To validate the certified study model, diagnostic tests were hence performed to ensure that the data used in the study can effectively predict the effect of Infrastructure investments on the economic growth of Kenya. The diagnostics tests will offer certification as to whether data relating to indicators of Infrastructure Investments notably; Road network infrastructure, energy production infrastructure, public amenities infrastructure and public utilities infrastructure versus Economic growth measured in GDP per Capita. Diagnostics tests performed in the study include; Unit Root Test, Hausman Tests, Cointegration Test, Collinearity Test, Heteroskedasticity test.

3.6.3.2 Collinearity

Co-linearity test attempts to examine the existence of internal correlation between two or more independent variable (Senaviratna & Cooray, 2019). The existence of linear correlation for test independent variables will then means collinearity exists, which makes the model unfit. The predictors for the study regression model are; Road network infrastructure (X_1), energy production infrastructure (X_2), public amenities infrastructure (X_3) and public utilities infrastructure (X_4) versus Economic growth (Y) measured in per-capita income. The scales to be used for examining

multicollinearity will be tolerance and Variance Inflation Factor (VIF). Using estimate cutoff parameter, the regression tests for each of the independent variable (X_1 , X_2 , X_3 , & X_4) against, the dependent variable (per-capita income). The cutoff points for tolerance will aid in determining the existence of multi-collinearity.

CHAPTER FOUR

DATA ANALYSIS, FINDINGS AND DISCUSSION

4.1 Introduction

The chapter covers data analysis and discussion of the results. The study was mainly aimed to determine the influence of national infrastructure investments on the economic growth of Kenya. The focus of the study was on Road Infrastructure Investment Energy Production investment, Public Amenities investments and Public Utilities Investment and how they affect the economic growth income per capita in Kenya. In addition, it gives the summary descriptive statistics of Road Infrastructure expenditure Energy Production expenditure, Public Amenities Expenditure and Public Utilities Expenditure and growth income per capita in Kenya. The chapter covers the correlational matrix that gives the relationship among the variables, the unit root test results to determine the order of integration for variables, test for cointegration, collinearity test, impulse response analysis, testing for granger causality test for heteroscedasticity and lastly the regression ARDL bound test for the model estimation.

4.2 Descriptive statistics

The descriptive statistics for the variables are presented in table 4.1. This comprises of the mean values, minimum and maximum values, and variance and standard deviation values of the variables.

(Creswell, 2009) stated that mean of defines standard deviation as a statistic that measures the dispersion of a dataset in relation to its mean and is computed as the square root of the variance. Mean as the sum of all valid observations inside a variable divided by the number of valid

observations. (Tebbs, 2006) stated that maximum and minimum are the lowest and highest valid observation respectively. The means, maximum and minimum were recorded in KES millions.

Table 4.1 showed the descriptive summary for road investment with a mean KES 7.94e+08 million with a standard deviation of 6.31e+08 a minimum and max of KES 2.4e+07 and KES 1.67e+09 million. The Energy investment had a mean of KES 2.96e+07 million with a standard deviation of 3.22e+07 and a minimum of KES 765000 million and a maximum of 9.4e+07.

Amenities investment recorded a mean of KES 5.53e+09 million and a standard deviation of 2.87e+09 and a minimum of KES 6.04e+08 million and a maximum of KES 1.1e+10 million, lastly the Utilities investment indicated a mean of KES 3.18e+08 million a standard deviation of 5.89e+08 a minimum of KES 373000 million and a maximum of KES 1.60e+09 million.

Table 4.1 Descriptive statistics predictors

Variable	Obs.	Mean	Std. Dev.	Min	Max
Road Investment	31	7.94e+08	6.31e+08	2.43e+07	1.67e+09
Energy Investment	31	2.96e+07	3.22e+07	765000	9.4e+07
Amenities Investment	31	5.53e+09	2.87e+09	6.04e+08	1.1e+10
Utilities Investment	31	3.18e+08	5.89e+08	373000	1.60e+09

(Source: Research 2022)

Descriptive summary from the independent variable economic growth measured through per capita income was presented in KES.

Table 4.2 indicated the summary for per capita income with a mean of KES 84373.22 a standard deviation of 63153.85 a minimum of KES 20800 a maximum of KES 227420.8.

Table 4.2 Descriptive summary Economic growth

Variable	Obs.	Mean	Std. Dev.	Min	Max
Economic Growth	31	84373.22	63153.85	20800	227420.8

(Source: Research 2022)

4.3 Exploratory Data Analysis

Figure 4.1 indicated the consistent growth movement of per capita income through the 31 years with a peak in 2021. Indications show that there was a sharp growth from mid-2000.

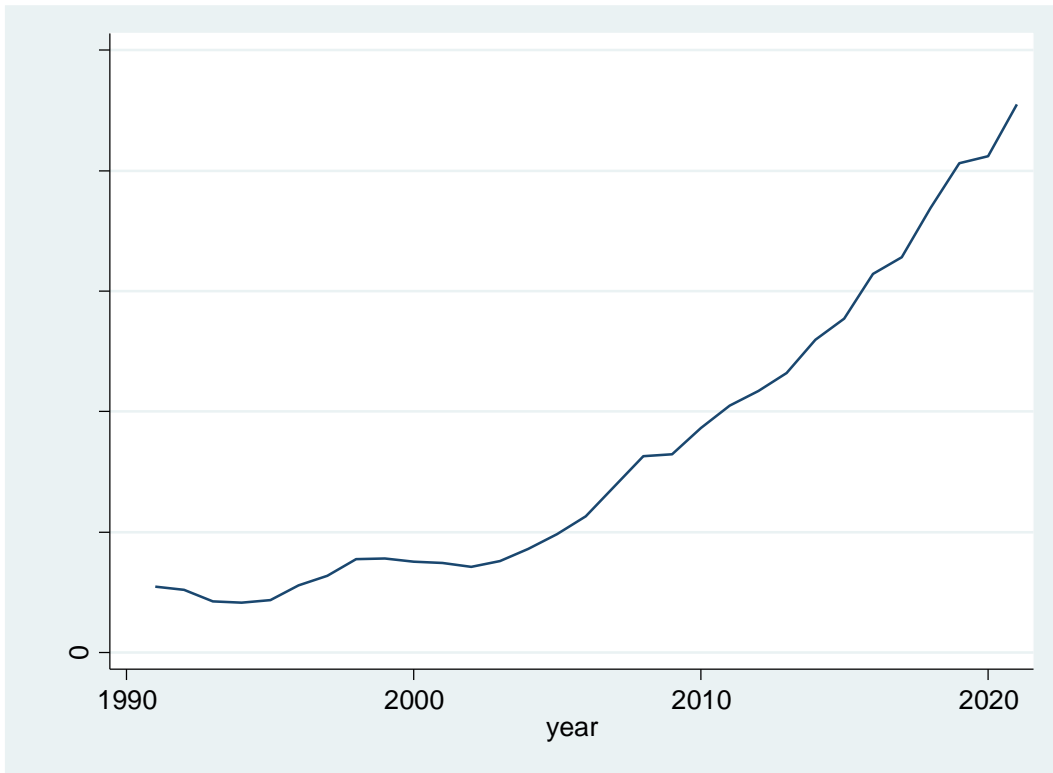


Figure 4.1 Per Capita Income trend plot

Figure 4.2, indicated the trend for road investments and how the investments were made year on year. The Structure from the plot indicated there was a steady growth in investments through the years slowing down in 2008. There was a strong rally in 2009 and steady finish through to 2021.

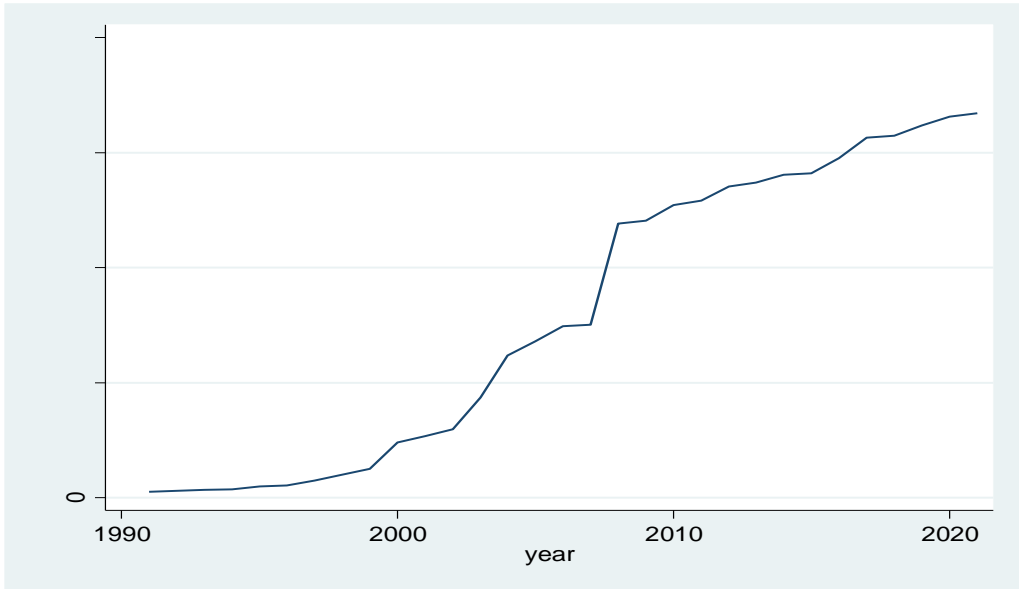


Figure 4.2 Road Investments trend plot

Graphical indicators from figure 4.3 indicated that there was a little investment in energy between 1991 to beyond early 2000s. The Investments increased between 2010 and rallied upwards all the way to 2013 with a depressed investment down between 2013 and 2017. The investments in Energy reached its peaks in 2014 and 2021.

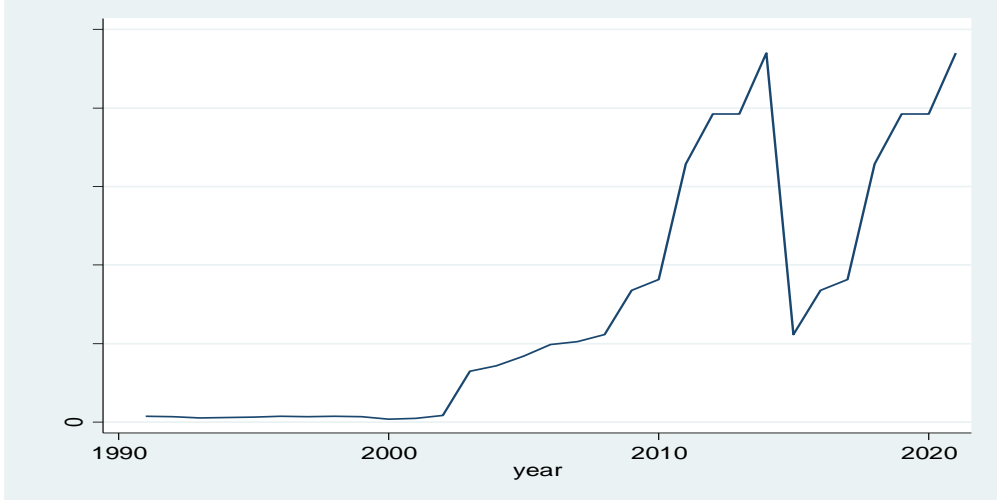


Figure 4.3 Energy Investments trend plot

Investments in amenities were steady with a growth trend through the subsequent years from 1991 to 2021. The trend was shown in figure 4.4.



Figure 4.4 Amenities Investments trend plot

Investments in Utilities indicated steady growth between 1991 and 2021 shown in figure 4.5.

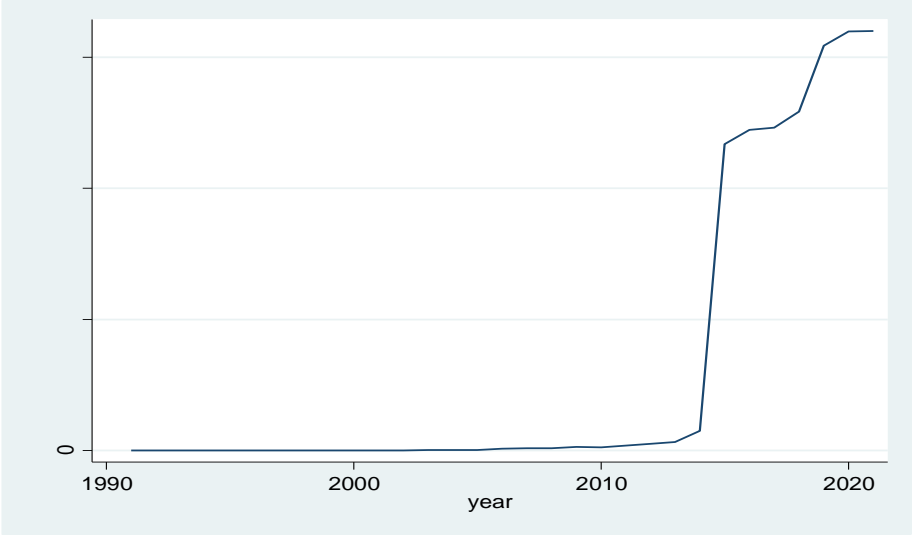


Figure 4.5 Utilities investment trend plot

4.4 Unit Root testing

(Shaari, 2013) stated that unit root test was critical in determining the order of integration of the variables prior to empirical model estimations. This is due to the fact that estimating the empirical model without prior knowledge of the order of variable integration would result in a spurious regression problem.

The Dickey - Fuller test was used to determine whether or not there was a unit root among the variables.

The test for stationarity tested according to (Herranz, 2017) using critical values, the null hypothesis is there is a unit root. Table 4.3 indicated that at level, all variables were nonstationary because the t - statistics were greater than the critical values at all 1%, 5%, and 10% significance levels.

We find that after differencing and testing for the unit root, all of the variables are now stationary, implying that there is no unit root. As a result, the variables have one unit root, implying that they are integrated of order one.

According to (Pesaran et al., 2001) the results from the unit root test indicated that our research adopted the Autoregressive Distributed Lag (ARDL) Estimation model.

As a result, the ARDL cointegration technique is preferable when dealing with variables of different order, $I(0)$, $I(1)$, or a combination of the two, and robust when there is a single long run relationship between the underlying variables in a small sample size.

(Nkoro & Uko, 2016) states that the F-statistic detects the underlying variables' long-run relationship (Wald test). When the F- statistic exceeds the critical value band, the long run relationship of the series is said to be established in this approach.

Table 4.3 Unit Root Test

At level		At First Difference						Order of	
t- statistics		Critical values			t- statistics			Critical values	
		1%	5%	10%					
		1%	5%	10%	1%	5%	10%		
Per Capita Income	-1.733	-5.148	-3.499	-2.168	-5.449	-4.150	-3.500	-3.144	I(1)
Road Inv	7.840	-4.148	-3.499	-3.179	-3.848	-4.222	-3.222	-3.180	I(1)
Energy	3.033	-4.333	-3.903	-3.179	-5.786	-4.101	-3.500	-3.180	I(1)
Agriculture	-2.018	-4.093	-3.89	-3.179	-8.497	-4.101	-3.500	-3.180	I(1)
Amenities	-2.016	-4.148	-3.499	-3.179	-5.397	-4.150	-3.500	-3.180	I(1)
Utilities	7.696	-4.148	-3.499	-3.179	-4.361	-4.150	-3.500	-3.180	I(1)

(Source: Research 2022)

4.5 Cointegration test

According to (Nkoro & Uko, 2016) cointegration techniques have become the solution for determining the long run relationship between non-stationary series and reparametrizing them to the Error Correction Model (ECM).

Test for cointegration indicated by testing t-statistical significance at critical values at 1%, 5% and 10%. With the values null hypothesis showing no presence of cointegration, and the linear combination of integrated variables are non-stationary.

Table 4.4 indicated results from the cointegration test indicating that there

That test statistic at 5% critical values indicated that the variables were cointegrated

Table 4.4 Engle- Granger Test for cointegration

	Test statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-3.453	-3.958	-3.023	-3.356

N (1st step) = 31

N (test) = 30

(Source: Research 2022)

4.5.1 Error Correction Model

Cointegration analysis is not applicable in cases of variables that are integrated of different orders (i.e., series-A is I(1) and series-B is I(0)) under the conventional cointegration procedures, but it is applicable in ARDL cointegration procedures.

Testing for cointegration is an important step in determining if a model empirically demonstrates relevant long run connections. If it is unable to achieve cointegration among underlying variables, it is necessary to continue working with variables in differences instead. However, information will be lacking in the long run. The error correction model results using the equation (Barunik, 2011) indicated an equation for Error correction Model. $\Delta C_t = \alpha_0 + \beta \Delta Y_t + \rho_{t-1} + \epsilon_t$

The results from Long run model also the OLS model indicated that all variables were statistically significant at 5% level. Table 4.5 indicated Long run model all independent variables had positive and statistically significant effect on the economic growth.

Table 4.5 Long Run Model				
Per capita income	Coefficients	Standard		P-value
		Error	t Stat	
Intercept	18260.45	3564.417	5.122985	0.000000
Road	2.49E-05	4.57E-06	5.443454	0.000000
Energy	0.000564	6.25E-05	9.033695	0.000000
Amenities	2.51E-06	1.18E-06	2.12357	0.043383
Utilities	4.96E-05	3.24E-06	15.29884	0.000000

(Source: Research 2022)

The short run Model was indicated in table 4.6 with significant differencing and lags added results indicated that Lagged Energy investments and Utilities had a statistically significant and positive effect on economic growth in the short run model.

Table 4.6 Short Run Model

D. per capita income	Coefficients	Standard Error	t Stat	P-value
----------------------	--------------	----------------	--------	---------

Intercept	2260.038	1510.865	1.50	0.148
Road D1.	.0000142	.0000122	1.16	0.258
Energy D1.	.0004587	.0001061	4.32	0.000
Amenities D1.	1.49e-06	1.46e-06	1.03	0.316
Utilities D1.	.0000357	8.47e-06	4.21	0.000
Error	-3.79e-06	6.43e-06	-0.59	0.561
L1.				

(Source: Research 2022)

Table 4.6.1 indicated that the ECT is not statistically significant therefore the error correction model is not sufficient

Table 4.6.1 Long Run and short Run Estimated Models

Variable	Model			
	Long Run	p-value	Short Run	p-value
C	18260.45	0.0000	2260.038	0.148
Road	2.49E-05	0.0000	.0000142	0.258
Energy	0.000564	0.0000	.0004587	0.000
Amenities	2.51E-06	0.043383	1.49e-06	0.316
Utilities	4.96E-05	0.0000	.0000357	0.000
ECT			-3.79e-06	0.561

(Source: Research 2022)

4.6 Autocorrelation Test

(Unibo, n.d.) stated that the Durbin-Watson statistic is commonly used to test: $H_0: = 0$ vs. $H_1: > 0$, since in business and economic applications, when error terms are associated, the correlation tends to be positive

This is accomplished by calculating the correlation between mistake words and their immediate predecessors:

The statistic D ranges in value from zero to four. When the error terms are independent, we expect D to be close to 2. small values of D suggest that error terms tend to cluster positive autocorrelation. Large values of D suggest that error terms tend to alternate, indicating negative autocorrelation. Results from table 4.7 of the autocorrelation test indicated no presence of serial correlation.

Table 4.7 Autocorrelation Test

Durbin-Watson d-statistic (5, 31)	=1.093721
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(Source: Research 2022)

4.7 Impulse Response Analysis

The link between linear vector autoregressive (VAR) models and linear local projection (LP) models has piqued the curiosity of many researchers. Jordà (2005, 2009) suggested and Ramey popularized linear LP estimators of impulse responses (2016).

According to (Gonçalves et al., 2021) In recent years, such models have been critical in capturing asymmetries, thresholds, and other nonlinearities in the reactions of macroeconomic variables to exogenous shocks. Results from figure 4.6 show that for one Standard deviation shock to road investments, energy investments, amenities and utilities increases per capita income, these positive responses gradually decline between periods.

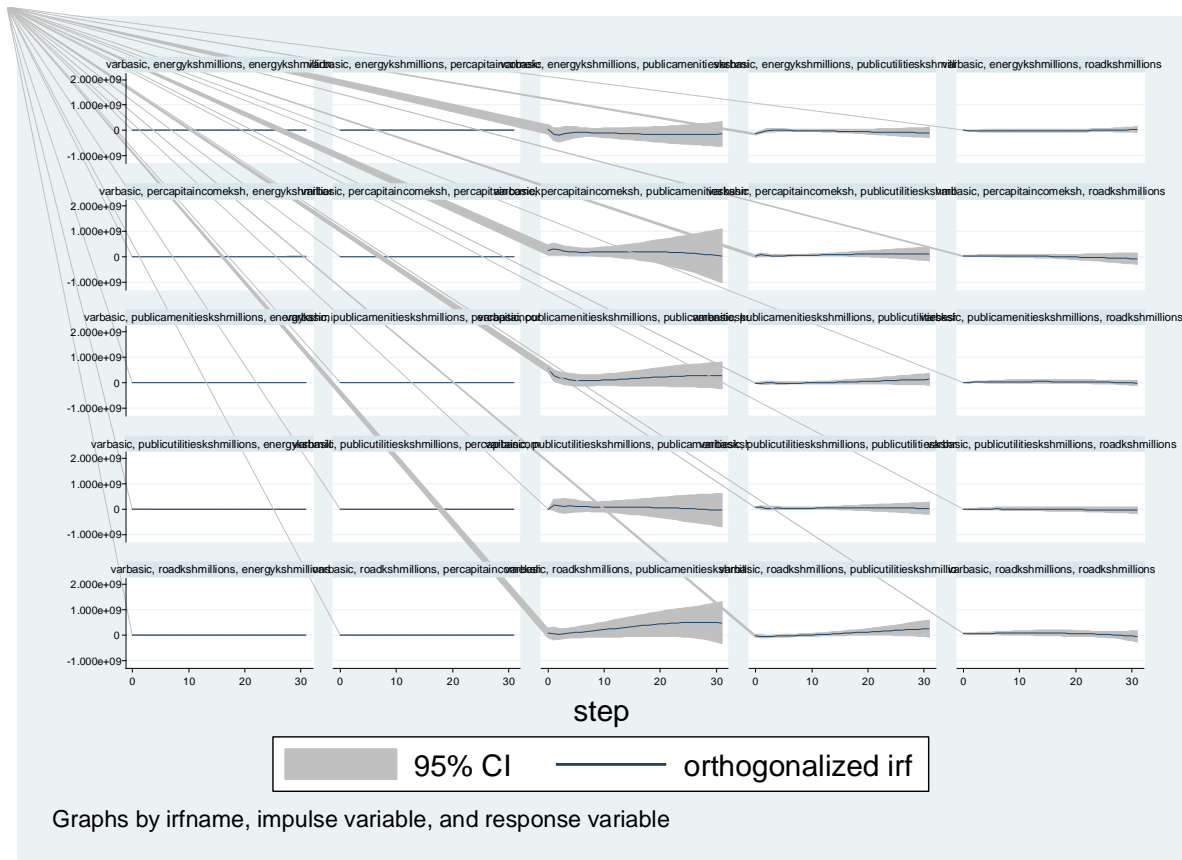


Figure 4.6 VAR Impulse Response

4.8 Diagnostic Tests for regression Assumptions

This section will go over the assumptions of the regression model and how they were checked to determine if any of them were broken. The findings may be biased if the regression model assumptions are violated.

4.8.1 Multicollinearity test

The study used a multicollinearity test using tolerance and the variance inflation factor (VIF) as reference scales to evaluate the occurrence of correlation levels between the independent variables.

(Murray et al., 2012) stated that in order to construct a model appropriate for the investigation, the tolerance margins should not exceed 0.1 (> 0.1), and the VIF should not exceed 10. Tolerance levels less than 0.1 and VIF values more than 10 are considered unacceptable by the model.

The mean VIF when all other factors are constant and consistent should not exceed 10.

Results from the test on table 4.8 showed the VIF values for the variables indicated that the assumption of no multicollinearity was not violated since the mean VIF was 7.16 which is below 10.

Table 4.8 Multicollinearity test

Variable	VIF	Tolerance (1/VIF)
Road investment	8.86	0.11
Energy Investment	4.23	0.24
Amenities	11.94	0.08
Utilities	3.81	0.26
	Mean VIF	
	7.16	

(Source: Research 2022)

4.8.2 Test for Normality

Statistical approaches are founded on a number of fundamental assumptions. One widely held belief is that a random variable is regularly distributed. According to (Paper, 2016) many statistical studies readily presume normalcy without any actual data or test.

The normality test is the most successful in most instances. It is the proportion. The numerator is the square of the best linear estimate of the standard deviation. (Fiorentini et al., 2004). Systems for testing normal distribution can be graphical or numerical.

The graphical methods will be the Q-Q plots and the normal distribution histogram. The numerical methods will be the Jarque-Bera test and the Shapiro wilks tests.

4.8.2.1 Graphical normality tests

Figure 4.6 indicated the normal probability plots showing that the per capita income is normally distributed for testing normal distribution

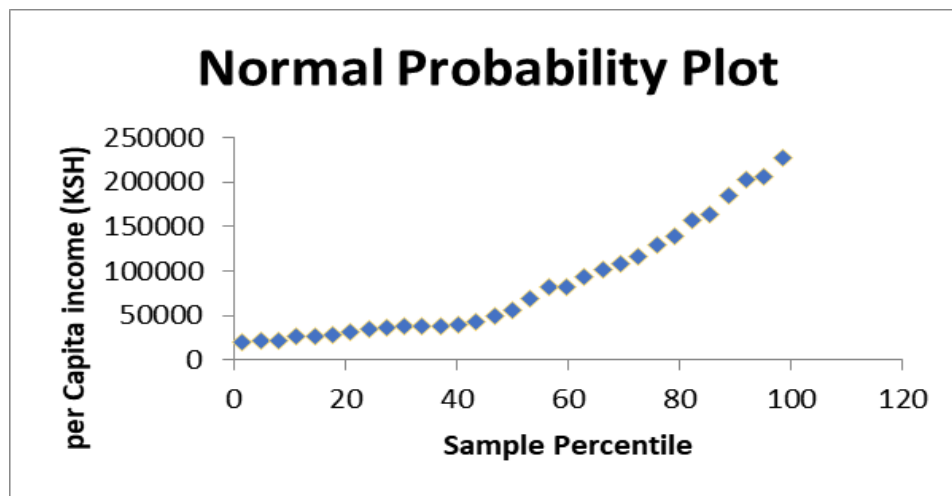


Figure 4.7 Normal Probability plot per capita income

Figure 4.7 shows a Q- Q plot for the residuals Q-Q plots display the observed values against normally distributed data represented by the line. The Q-Q graph is taken into account in the study. The probability-probability plot (P-P plot or percent plot) compares a variable's empirical cumulative distribution function to a certain theoretical cumulative distribution function (e.g., the standard normal distribution function).

Detrended normal P-P and Q-Q plots depict the actual deviations of data points from the straight horizontal line at zero

The structure should show the level which the residuals are distributed along a normal distribution line.

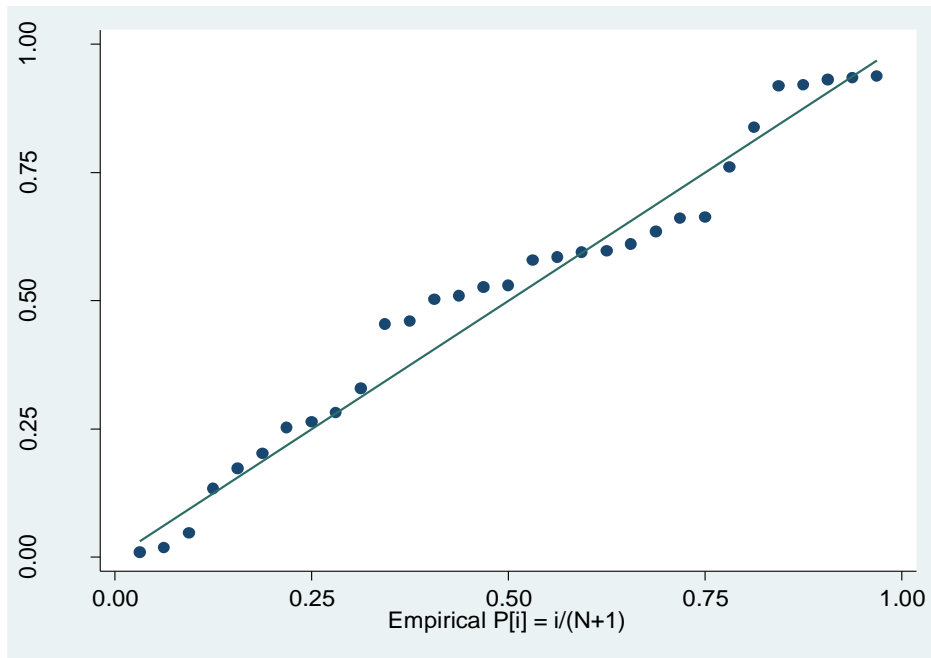


Figure 4.8 Q-Q plot residuals

The histogram on table 4.8 showed that the data was statistically close to a normal distribution.

The histogram was plotted from the residuals against densities.

Predicted residuals are visually within the normal distributed curve.

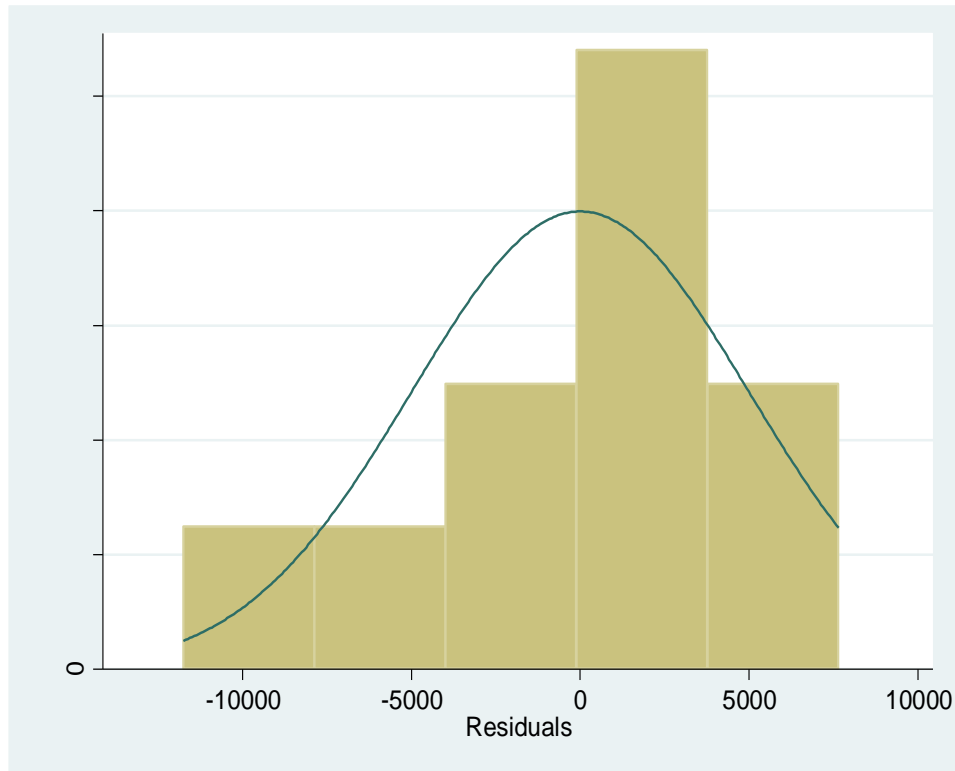


Figure 4.9 Normal Distribution Histogram

4.8.2.2 Numerical Normality tests

According to (Nelson, 1983) Jarque-Bera test was used to test for normal distribution. The Jarque-Bera test, originally devised for constant conditional variance models with no functional dependence between conditional mean and variance parameters, can be safely applied to a broad class of GARCH-M models. The test uses a chi and p-value with a null hypothesis stating that the data is not normally distributed. P value at 0.05 when the $p \leq 0.05$ then the null is not rejected and we conclude that the data is not normally distributed. Hence if the p value is > 0.05 we reject the null hypothesis and distribution of data is normally distributed.

Table 4.9 shows the Jarque-Bera test results showed that Chi (2) 0.529 $p > 0.05$ we conclude that the data is normally distributed.

Table 4.9 Jarque-Bera test

Jarque-Bera normality test:	1.045 Chi (2) .5929
-----------------------------	---------------------

Jarque-Bera test for Ho: normality:	
-------------------------------------	--

(Source: Research 2022)

Shapiro-Wilk Test was also used to test for normality for the variables.

The Shapiro-Wilk test is a statistical test that determines if a continuous variable has a normal distribution. The null hypothesis asserts that the variable is normally distributed, while the alternative hypothesis asserts that it is not normally distributed. So, after completing this test: If p 0.05, the null hypothesis is rejected if p is greater than 0.05, the null hypothesis cannot be rejected.

The results from table 4.10 indicated that the p values for road investments p 0.00061, energy investments 0.00017, amenities 0.16560 for utilities were 0.0000. We conclude that only amenities data is normally distributed.

Table 4.10 Shapiro-Wilk Normality Test

Variable	Obs	W	V	Z	Prob>z
Road	31	0.85361	4.768	3.236	0.00061
Energy	31	0.82658	5.649	3.587	0.00017
Amenities	31	0.95093	1.598	0.972	0.16560
Utilities	31	0.56380	14.208	5.499	0.00000

(Source: Research 2022)

4.9 Correlation Analysis

A correlation analysis was performed to obtain the correlation coefficient in order to understand the correlation among the model's variables.

(*Statistics*, 2008) correlation coefficients range between -1.0 to positive 1.0 indicating percentages -100 to positive 100%. The correlations may be expressed in percentage form. All the variables were numerically placed in a matrix. (Fisher, 2016) explains that significance levels are measured on the 1% and 5% levels. The results from table 4.11 indicate that the Road investments had a positive and statistically significant correlation to economic growth $r=0.9196$ $p=0.000$. The results further showed that there was a positive correlation between energy investments $r=0.8514$ and correlation was statistically significant at $p=0.0000$. Amenities showed a positive $r =0.9576$ correlation that was statistically significant $p=0.0000$. The utilities indicated that there was positive $r=0.8879$ correlation and the correlation was statistically significant $p=0.0000$

Table 4.11 Correlation Matrix

	perCapita	Road	Energy	Amenities	Utilities
perCapita	1.0000				
Road	0.9196*	1.0000			
Energy	0.8514*	0.8658*	1.0000		
Amenities	0.9576*	0.9125*	0.8052*	1.0000	
Utilities	0.8879*	0.6867*	0.5544*	0.8319*	1.0000

(Source: Research 2022)

4.10 Autoregressive Distributed Lag (ARDL) Model

Theoretically, states (Nkoro & Uko, 2016) economic analysis suggests that there is a long run relationship between the variables under consideration. This indicates that the long run relationship properties are preserved. In other words, the means and variances are constant and not depending on time. However, most empirical researches have shown that the constancy of the means and variances are not satisfied in analyzing time series variables. ARDL model is used to correct this problem. The study sought to find out the effect of national infrastructure investments on the economic growth of Kenya.

The equation

$$ECONG_t = f(ROADS_t, ENGY_t, AMENT_t, UTL_t) \quad (1)$$

Where; $t = 1, 2, 3, 4 \dots n$ (time for 31 years, from 1991 – 2021)

Therefore

$$\ln(\text{ECONG})_t = \alpha_0 + \beta_1 \ln(\text{ROADS})_t + \beta_2 \ln(\text{ENGY})_t + \beta_3 \ln(\text{AMENT})_t + \beta_4 \ln(\text{UTL})_t + \hat{\epsilon}_t$$

(2)

The lag estimation was conducted and the results indicated lag of 1 was sufficient for all the variables in the model.

Table 4.12 indicated the lag structure that was used to generate the ardl model

Table 4.12 Lag structure

	percapitaincome	Road	energy	amenities	utilities
r1	1	0	0	0	0

(Source: Research 2022)

The ARDL model was adopted with 1 maximum lag

The results from the model were indicated from table 4.13 the resulting model indicates that per capita income at L1 unit had a .5813656 increase at a statistically significant level $0.001 p < 0.05$.

The model summary indicated a R-square value of 0.9962 indicating that 99.62% of variation on the economic growth was caused by the effect of national infrastructure investments.

The resulting equation from the model

$$(0.5813656)_t = 6229.333 + .0000122 (\text{ROADS})_t + 0.0002446 (\text{ENGY})_t + 1.68e-06 (\text{AMENT})_t + .0000208 (\text{UTL})_t + \hat{\epsilon}_t$$

All the coefficients indicated statistically significant and positive effect of the variables except for amenities which was positive but not statistically significant $p=0.099$ $p>0.05$.

Table 4.13 ARDL model

ARDL(1,0,0,0,0) regression

Sample: 1992 - 2021

Number of obs = 30
 F(5, 24) = 1247.98
 Prob > F = 0.0000
 R-squared = 0.9962
 Adj R-squared = 0.9954
 Root MSE = 4308.6499

Log likelihood = -290.2724

percapitaincomeksh	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
percapitaincomeksh L1.	.5813656	.1448013	4.01	0.001	.2825103	.8802209
roadkshmillions	.0000122	4.88e-06	2.51	0.019	2.16e-06	.0000223
energykshmillions	.0002446	.0000938	2.61	0.015	.0000511	.0004382
publicamenitieskshmillions	1.68e-06	9.77e-07	1.71	0.099	-3.42e-07	3.69e-06
publicutilitieskshmillions	.0000208	7.60e-06	2.73	0.012	5.09e-06	.0000365
_cons	6229.333	4148.01	1.50	0.146	-2331.738	14790.41

(Source: Research 2022)

4.11 ARDL Bounds test for Cointegration

To experimentally investigate the long-run linkages and short-run dynamic interactions between the variables of interest bounds test was conducted

(Arfaoui et al., 2016) stats that the ARDL limits test assumes that the variables are I(0) or I(1) (1).

So, before running this test, we use the unit root tests to identify the order of integration of all

Table 4.15 Error Correction Model

> (1 0 0 0 0) ec bttest

ARDL(1,0,0,0,0) regression

Sample: 1992 - 2021

Number of obs = 30

R-squared = 0.6831

Adj R-squared = 0.6171

Log likelihood = -290.2724

Root MSE = 4308.6499

	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
ADJ						
percapitaincomeksh						
L1.	-.4186344	.1448013	-2.89	0.008	-.7174897	-.1197791
LR						
roadkshmillions	.0000292	9.16e-06	3.19	0.004	.0000103	.0000481
energykshmillions	.0005843	.0001211	4.82	0.000	.0003343	.0008343
publicamenitieskshmillions	4.00e-06	2.58e-06	1.55	0.134	-1.33e-06	9.33e-06
publicutilitieskshmillions	.0000496	6.27e-06	7.92	0.000	.0000367	.0000626
SR						
_cons	6229.333	4148.01	1.50	0.146	-2331.738	14790.41

The cusum plot for model stability on figure 4.10 indicated that the model was stable.

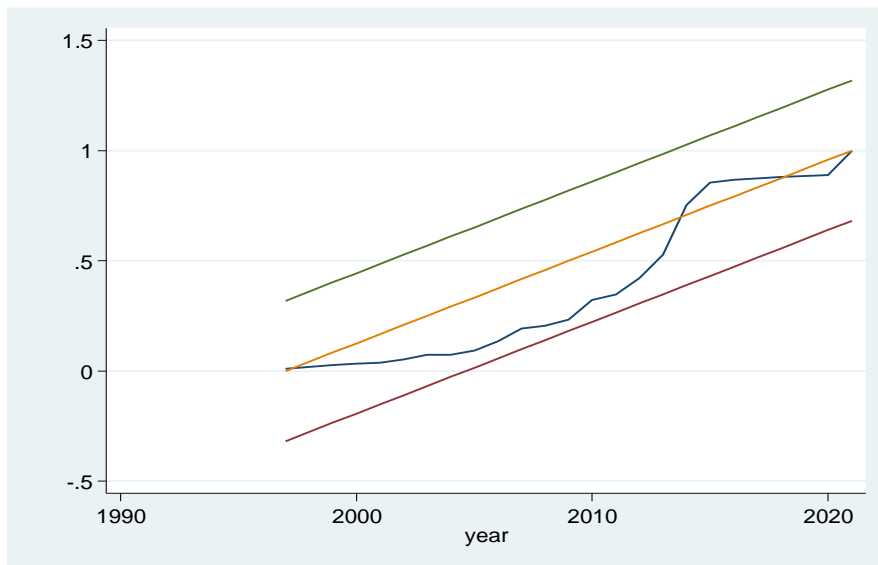


Figure 4.10 Cusum plot

4.12 Hypotheses testing

According to (Paiva, 2010) A hypothesis is an assertion regarding a population's characteristics. A hypothesis test allows us to put a claim about the population to the test and determine how probable it is to be true.

The hypotheses were tested to measure significance of the effect of the predictor variables on the dependent variable, and results collated after the ARDL model was generated.

The hypothesis being tested were;

Ho₁: Infrastructure investments on the development of road networks have no statistically significant effect on economic growth of Kenya.

The study indicated that effect infrastructure investments on development of road networks on economic growth of Kenya was statistically significant $p = 0.004$ $p < 0.05$ therefore we rejected the null hypothesis.

Ho₂: Infrastructure investments on the energy production systems have no statistically significant effect on economic growth of Kenya.

The study found that the effect of infrastructure investments on energy production systems on economic growth of Kenya was statistically significant $p = 0.000$ $p < 0.05$ we therefore reject the null hypothesis.

Ho₃: Infrastructure investments on construction of social amenities have no statistically significant effect on economic growth of Kenya.

The study found that the effect of infrastructure investments on social amenities on economic growth of Kenya was not statistically significant $p=0.134$ $p>0.05$ we therefore fail reject the null hypothesis.

Ho₄: Infrastructure investments on installation of public utilities have no statistically significant effect on economic growth of Kenya.

The study found that the effect of Infrastructure investments on installation of public utilities economic growth of Kenya was statistically significant $p=0.000$ $p<0.05$ we therefore reject the null hypothesis.

4.13 Discussion of Findings

This study analyzed the effect of infrastructure investments on the economic growth of Kenya. In doing so, the study reviewed the 1991 -2021 period using annual data.

The study showed that there was a positive effect of infrastructure investments on development of road networks on economic growth of Kenya $2.92e-5$ and was statistically significant at 5% and 10% levels. This agrees with (Mureithi, 2015) whose research stated that public expenditure was positive 1909.1677 and was statistically significant 0.0006. $p<0.006$. The study however did not concur with (Kutasi & Marton, 2020) whose research indicated a contrast indicating excessive investments in Road networks may not have had significant effect on economic growth.

The study found that the infrastructure investments on the energy production systems had a positive $5.843e-4$ and statistically significant, $p = 0.000$ effect on economic growth of Kenya. This concurred with research from (Liu, 2010) whose research stated that changing fuel prices may have a positive impact on economic growth at 0.72555 . even though it disagreed on the

significance a 10% level with a $p = 0.096$. It however was a departure from (Ombongi & Long, 2018) whose results indicated a negative and statistically significant impact that investments in energy sector especially fossil fuel and petroleum.

Further the research concluded that Infrastructure investments on installation of public utilities have no statistically significant effect on economic growth of Kenya. Though positive the p value fell short at 5% level and 10% levels $p=0.134$. This concurred with research from (Kutasi & Marton, 2020) which stated that health culture and education had negative and statistically insignificant effects on economic growth. The research disagreed with (Mureithi, 2015) whose figures for amenities indicated statistically significant impact on economic success $p = 0.021$.

Lastly the study indicated that that the effect of Infrastructure investments on installation of public utilities economic growth of Kenya was statistically significant and positive $4.96e-5$, $p=0.000$ $p<0.05$ we therefore reject the null hypothesis. The findings concurred with (*Jacob Ambrose Aboge - Research 06-10-2021*, n.d.) Whose research indicated investments were positively impacting economic growth at p value of 0.011. The research however did not agree with (Jeevan et al., 2015) who stated that the expenditure on amenities was non impactful to economic growth figures.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

Based on the previously stated premise, this chapter discusses the thesis summary. It then goes on to present key study findings, conclusions, and recommendations.

5.2 Summary of Findings

The study sought to determine the impact of infrastructure spending on Kenya's economic growth. The importance of infrastructure investments, particularly in emerging countries such as Kenya, was explored.

The overall objective of this study was to establish determine the influence of infrastructure investments on the economic growth of Kenya.

The first specific objective to determine the influence of road network investments on economic growth of Kenya. Findings of the correlation matrix indicated that there was a positive and statistically significant, coupled with a ARDL correction model result that showed investments in road networks impacted positively in a statistically significant way $p=0.004<0.05$.

Evaluating the effect of energy production investments on economic growth of Kenya. The study showed that there was a positive and statistically significant effect at $p=0.000<0.05$.

The third specific objective was to assess the influence of social amenities investments on growth of Kenya. The study indicated a positive correlation of social amenities investments growth of

Kenya. The regression further established that there was a positive but not statistically significant effect of social amenities investments on economic growth of Kenya. $p = 0.134 > 0.05$.

The fourth and final specific objective was to examine the effect of public utilities investments on economic growth of Kenya. The results from the correlation analysis indicated a positive correlation between public utilities investments and economic growth of Kenya. The regression analysis indicated that there was a positive and statistically significant effect of public utilities investments on economic growth of Kenya $p = 0.000 < 0.05$.

5.3 Conclusions

The research incisively indicated that increases in road network investments causes a improvement on economic growth of Kenya. The impact of road network investments on economic growth of Kenya was statistically significant.

The study further indicated that shocks in energy production investments caused benefits on economic growth of Kenya. The impact of the energy production investments were statistically significant towards the economic growth of Kenya.

In combination with more investments in social amenities improved economic growth of Kenya. The impact of investments in social amenities on economic growth of Kenya was statistically significant.

The study also indicated that further investments in public utilities improved economic growth of Kenya. The study also established that there was a statistically significant impact of public utilities improved economic growth of Kenya.

5.4 Recommendations

5.4.1 Road Network Investments

The study would recommend further investments in road networks so as to improve economic growth of Kenya. Findings therefore confirm the current ambitious plan by the government to build more physical economic infrastructure especially road infrastructure by increasing total number of tarmacked roads is founded on the belief that increased road connectivity has a positive multiplier on the overall economic growth.

Several important policy suggestions may be derived from the model's results. The first is the significance of including the private sector in the funding of Kenya's road infrastructure. This might be accomplished through increased awareness of the PPP program, which now has a legal structure thanks to the passage of the PPP Act in 2012.

5.4.2 Energy production investments

The research indicated that an improvement in energy production investments indicated positive economic growth improvements. Recommendations are in ensuring that efficient supply of subsidies on the energy production for example house hold gas and petroleum production in Kenya.

5.4.3 Social amenities investments

Improvements in social amenities had no significant impact on economic growth. The investments were crucial in assuring better the conclusions and the current results are consistent in connection to the positive impact of spending on public facilities – but only when there were no delays of expenditure determinants. The impact could be improved by ensuring the government tries to devolve functionality and ensure that systems in the grass root improve the social amenities.

5.4.4 Public Utilities investments

The study indicated that the investments in public amenities cause positive economic growth indicators. Further investments in public utilities including better support systems and maintenance could improve the productivity due to investments.

5.5 Limitations of study

The study is only concerned with the to determine the influence of national infrastructure investments on the economic growth of Kenya.

Investments and government expenditure, on the other hand, can be evaluated on different grounds in order to better appreciate their impact to other impacts of economic indicators.

This confined the analysis to relying solely on available data on investments from economic journals and reports. Furthermore, the difficulty in validating real government expenditure since data is difficult to come by.

5.6 Suggestions for Further Research

The sole focus of this study was establishing the effect of road network investments, energy production investments, social amenities investments and public utilities investments economic growth of Kenya. Therefore, further research needs to be done on other government investments that may be used to measure economic growth. There needs to be a study on impact of investments form government expenditure on economic growth across different trade regions like east African block, west African blocks and the southern block.

REFERENCES

- Broughel, J., & Thierer, A. (2019). *Technological Innovation and Economic Growth: A Brief Report on the Evidence*. George Mason University. Virginia: SSRN.
doi:10.2139/ssrn.3346495
- Chen, X., Locatelli, G., Zhang, X., Gong, Y., & He, Q. (2021). Firm and project innovation outcome measures in infrastructure megaprojects: An interpretive structural modelling approach. *Technovation*. doi:10.1016/j.technovation.2021.102349
- Jha, S. (2018). *Measuring, Monitoring, and Operationalizing Quality of Growth - Implications for the People's Republic of China*. Manila: Asian Development Bank.
doi:http://dx.doi.org/10.22617/BRF189573-2
- Makhathini, M., Mlambo, V., & Mpanza, S. (2020). Infrastructure Provision as a Catalyst for Local Economic Development in South Africa. *Strategic Review of Southern Africa*, 42(1), June. Retrieved October 01, 2022
- Matara, J. M., Odada, J. E., & Obere, A. (2021). Influence of Infrastructure Expenditure on Gross Domestic Growth Product in Kenya. *International Journal of Social Sciences and Information Technology*, 7(7), 1-13. Retrieved October 01, 2022
- Mbataru, P. (2018). An analysis of the influence of road infrastructure implementation on local development : the case of Thika Superhighway in Kenya. *African Management Development Institutes' Network (AMDIN)*, 1(1), 82-89. Retrieved September 01, 2022, from <https://hdl.handle.net/10520/EJC-1724ba7ca3>

- Mose, N. G. (2021, January). Determinants of regional economic growth in Kenya. *African Journal of Business Management*, 15(1), 1-12. doi:10.5897/AJBM2020.9118
- Noronha, M., Zanini, R. R., & Souza, A. M. (2019). The impact of electric generation capacity by renewable and non-renewable energy in Brazilian economic growth. *Environmental Science and Pollution Research*, 26, 33236 - 33259. doi:https://doi.org/10.1007/s11356-019-06241-4
- Oluoch, S., Lal, P., Susaeta, A., & Wolde, B. (2021). Public preferences for renewable energy options: A choice experiment in Kenya. *Energy Economics*, 98, 105256. doi:10.1016/j.eneco.2021.105256
- Ombara Isaac. (2019). Transport Infrastructure Development in Kenya: How connectivity Impacts East Africa Regional Integration. *Insight on Africa*, 11(2), 200-218. doi:10.1177/0975087819845205
- Pueyo, A. (2018, April). What constrains renewable energy investments in Sub-Saharan Africa ? A comparison of Kenya and Ghana. *World Development*, 109, 85-100. doi:10.1016/j.worlddev.2018.04.008
- Twesigye, P. (2022). Structural, governance, & regulatory incentives for improved utility performance: A comparative analysis of electric utilities in Tanzania, Kenya, and Uganda,. *Utilities Policy*, 79, 101419. doi:https://doi.org/10.1016/j.jup.2022.101419.
- Zou, L., Shen, H. J., Zhang, J., & Lee, C.-C. (2021, March). What is the Rationale Behind China's Infrastructure Investment under the Belt and Road Initiative. *Journal of Economic Surveys*, 1-29. doi:10.1111/joes.12427

- Ahmad, M., & Zhao, Z. Y. (2018). Causal linkages between energy investment and economic growth: a panel data modelling analysis of China. *Energy Sources, Part B: Economics, Planning, and Policy*, 13(8), 363-374.
- Astivia, O. L. O., & Zumbo, B. D. (2019). Heteroskedasticity in Multiple Regression Analysis: What it is, How to Detect it and How to Solve it with Applications in R and SPSS. *Practical Assessment, Research, and Evaluation*, 24(1), 1.
- Auma, J. H. (2018). *Determinants of strategies implementation adopted by infrastructure development projects in Kenya: a case of the Lamu Port-south Sudan-Ethiopia-transport Project (LAPSSET)*. (Master's Thesis, University of Nairobi).
- Bodrožić, Z., & Adler, P. S. (2018). The evolution of management models: A neo-Schumpeterian theory. *Administrative Science Quarterly*, 63(1), 85-129.
- Bonfatti, R., & Poelhekke, S. (2017). From mine to coast: Transport infrastructure and the direction of trade in developing countries. *Journal of Development Economics*, 127, 91-108.
- Brooks, L. & Liscow, Z. (2019). *Infrastructure Costs*. (Working Paper No. 54 for the Hutching Center, Brookings Institution. Extracted from: https://www.brookings.edu/wp-content/uploads/2019/08/WP54_Brooks-Liscow_updated.pdf (Accessed on 14th February 2022)).
- Calia, M. (2018). Trump pushes infrastructure plan, but says it will likely have to wait until after the midterms. CNBC. Retrieved from <https://www.cnbc.com/2018/03/29/trump> .

- Campbell, J. M., & Kubickova, M. (2020). Agritourism microbusinesses within a developing country economy: A resource-based view. *Journal of Destination Marketing & Management, 17*, 100460.
- Chen, X. (2020). *Why Social Infrastructure Projects Experience Cost Overrun*. (Master's Thesis, Université d'Ottawa/University of Ottawa).
- Cigu, E., Agheorghiesei, D. T., & Toader, E. (2019). Transport infrastructure development, public performance and long-run economic growth: a case study for the Eu-28 countries. *Sustainability, 11*(1), 67.
- Chahal, H., Gupta, M., Bhan, N., & Cheng, T. C. E. (2020). Operations management research grounded in the resource-based view: A meta-analysis. *International Journal of Production Economics, 230*, 107805.
- Chen, H., Hongo, D. O., Ssali, M. W., Nyaranga, M. S., & Nderitu, C. W. (2020). The asymmetric influence of financial development on economic growth in Kenya: evidence from NARDL. *SAGE Open, 10*(1), 2158244019894071. (Available online: <https://journals.sagepub.com/doi/full/10.1177/2158244019894071> Accessed on 14th February 2022).
- Collins, C. J. (2021). Expanding the resource based view model of strategic human resource management. *The International Journal of Human Resource Management, 32*(2), 331-358.
- Curry, B. (2019). City of Ottawa increases transit funding by \$7.5-million in face of public anger over problems with new LRT system. *The Globe and Mail*. Retrieved from

<https://www.theglobeandmail.com/canada/article-city-of-ottawaincreases-transit-funding-by-75-million-in-face-of/> (Accessed on 15th Feb 2022).

- Danau, D., & Vinella, A. (2021). Under/Over-Investment and Early Renegotiation in Public-Private Partnerships. *The Journal of Industrial Economics*, 69(4), 923-966.
- de Jesus, C. S., Araujo, R. A., & Drumond, C. E. (2018). An empirical test of the Post-Keynesian growth model applied to functional income distribution and the growth regime in Brazil. *International review of applied economics*, 32(4), 428-449.
- Dutt, A. K. (2017). Heterodox theories of economic growth and income distribution: a partial survey. *Journal of Economic Surveys*, 31(5), 1240-1271.
- Fazekas, M., & Tóth, B. (2018). The extent and cost of corruption in transport infrastructure. New evidence from Europe. *Transportation research part A: policy and practice*, 113, 35-54.
- Gakuo, E. W. (2015). *The Relationship between Government Investment in Energy Infrastructure and Economic Growth in Kenya* (Doctoral dissertation, University of Nairobi).
- Greener, S., & Martelli, J. (2018). *An introduction to business research methods*.
- Gukat, B. T., & Ogboru, I. (2017). An empirical analysis of government expenditure and economic growth in Nigeria.
- Guma, P. K. (2019). Smart urbanism? ICTs for water and electricity supply in Nairobi. *Urban studies*, 56(11), 2333-2352.
- Güriş, B. (2019). A new nonlinear unit root test with Fourier function. *Communications in Statistics-Simulation and Computation*, 48(10), 3056-3062.

- Gutman, J. , Amadou ,S. & Chattopadhyya, S. (2015). *Financing African Infrastructure: Can the World Deliver?*, Washington: The Brookings Institution.
- Hakim, A. R., Nachrowi, N. D., Handayani, D., & Wisana, I. D. G. K. (2022). Do Amenities and Economic Factors Affect Migration? Empirical Evidence from Indonesian Cities. *Environment and Urbanization ASIA*, 09754253221083169.
- Holtz,L. & Heitzig, C.(2021). *Figures of the week: Africa’s infrastructure paradox*. (Brookings Institution). Available Online: <https://www.brookings.edu/blog/africa-in-focus/2021/02/24/figures-of-the-week-africas-infrastructure-paradox/> (Accessed on 17th Feb 2022).
- Hussain, Z.(2014).Can political stability hurt economic growth. *World Bank Press journals*. Available online: <https://blogs.worldbank.org/endpovertyinsouthasia/can-political-stability-hurt-economic-growth> (Accessed on 17th February 2022)
- Jedwab, R., & Storeygard, A. (2019). Economic and political factors in infrastructure investment: evidence from railroads and roads in Africa 1960–2015. *Economic History of Developing Regions*, 34(2), 156-208.
- Kabukuru, W. (2016). A Mega-project rises in East Africa: United Nations Podcast on Africa Renewal. Available Online: <https://www.un.org/africarenewal/magazine/august-2016/megaproject-rises-east-africa> (Accessed on 17th February 2022).
- Khan, S. A. R., Zhang, Y., Kumar, A., Zavadskas, E., & Streimikiene, D. (2020). Measuring the impact of renewable energy, public health expenditure, logistics, and environmental performance on sustainable economic growth. *Sustainable development*, 28(4), 833-843.

- Kruse, C. (2014). The Hoover Dam and its Importance. Available Online: <https://sites.psu.edu/charlottekruse/2014/04/28/the-hoover-dam-and-its-importance/#:~:text=The%20fact%20that%20the%20dam,social%20growth%20of%20that%20region>. (Accessed on 15th February 2022).
- Laitinen, J., Antikainen, R., Hukka, J. J., & Katko, T. S. (2020). Water supply and sanitation in a green economy society: the case of Finland. *Public Works Management & Policy*, 25(1), 33-50.
- Lawanson, O. I., & Evans, O. (2019). Human Capital, structural change and economic growth developing countries: the case of Nigeria. University of Lagos Press and Bookshop.
- Leduc, S., & Wilson, D. (2013). Roads to prosperity or bridges to nowhere? Theory and evidence on the impact of public infrastructure investment. *NBER Macroeconomics Annual*, 27(1), 89-142.
- Lee, J., & Tieslau, M. (2019). Panel LM unit root tests with level and trend shifts. *Economic Modelling*, 80, 1-10.
- Lelei, L. K. (2020). *Effect of Government Infrastructure Development Expenditure on Performance of Manufacturing in Kenya*. (Masters Dissertation, Kenyatta University).
- Leshore, L., & Minja, D. (2019). Factors affecting implementation of Vision 2030 flagship projects in Kenya: A case of the Galana-Kulalu irrigation scheme. *International Academic Journal of Law and Society*, 1(2), 395-410.
- Lune, H., & Berg, B. L. (2017). *Qualitative research methods for the social sciences* (9th, Global Edition). Essex: Pearson Education Ltd.

- Macharia, J. (2019). Sustainable Development in Kenya. *Horizons: Journal of International Relations and Sustainable Development*, (13), 172-183.
- Magnier, M. (2015). Benefits of Infrastructure Spending Not So Clear-Cut, Economists Say: Long-Term Dividends of Infrastructure Projects Often Muddled Due to Real-World Factors Like Bloat, Corruption and Politics. Available Online: <https://www.wsj.com/articles/benefits-of-infrastructure-spending-not-so-clear-cut-economists-say-1422819575> (Accessed on 14th Feb 2022).
- Majanga, B. (2015). Liberalization of Utility Services in the Developing Countries: A Panacea to Economic Development? An Analysis on Malawi Power Sector. *Applied Economics and Finance*, 2(3).
- Maparu, T. S., & Mazumder, T. N. (2017). Transport infrastructure, economic development and urbanization in India (1990–2011): Is there any causal relationship?. *Transportation research part A: policy and practice*, 100, 319-336.
- Mehmood, T., Alzoubi, H. M., & Ahmed, G. (2019). Schumpeterian entrepreneurship theory: evolution and relevance. *Academy of Entrepreneurship Journal*, 25(4).
- Michiels, C. (2018). *The Effect of Infrastructure on Foreign Direct Investment in Africa*. (Master's Thesis, Erasmus University Rotterdam)
- Mitra, A., O'Regan, N., & Sarpong, D. (2018). Cloud resource adaptation: A resource based perspective on value creation for corporate growth. *Technological Forecasting and Social Change*, 130, 28-38.
- Mizutani, F., Tanaka, T., Nakayama, N., & Uranishi, S. (2020). Structural reform of the electricity industry and economic growth. *Journal of Economic Policy Reform*, 23(2), 184-208.

- Mkutu, K., Müller-Koné, M., & Owino, E. A. (2021). Future visions, present conflicts: the ethnicized politics of anticipation surrounding an infrastructure corridor in northern Kenya. *Journal of Eastern African Studies*, 15(4), 707-727.
- Montes, G. C., & Nogueira, F. D. S. L. (2021). Effects of economic policy uncertainty and political uncertainty on business confidence and investment. *Journal of Economic Studies*.
- Mugableh, M. I. (2018). A homoscedastic co-integration analysis of Malaysian financial market. *American Journal of Finance and Accounting*, 5(4), 360-370.
- Munim, Z. H., & Schramm, H. J. (2018). The impacts of port infrastructure and logistics performance on economic growth: the mediating role of seaborne trade. *Journal of Shipping and Trade*, 3(1), 1-19.
- Murakami, H. (2018). A two-sector Keynesian model of business cycles. *Metroeconomica*, 69(2), 444-472.
- Muvawala, J., Sebukeera, H., & Ssebulime, K. (2021). Socio-economic impacts of transport infrastructure investment in Uganda: Insight from frontloading expenditure on Uganda's urban roads and highways. *Research in Transportation Economics*, 88, 100971.
- Mwenzwa, E. M., & Misati, J. A. (2014). Kenya's Social Development Proposals and Challenges: Review of Kenya Vision 2030 First Medium-Term Plan, 2008-2012.
- Nason, R. S., & Wiklund, J. (2018). An assessment of resource-based theorizing on firm growth and suggestions for the future. *Journal of management*, 44(1), 32-60.
- Ndaiga, H. (2021, July 9th). Status of Kenya's Sh300bn road construction projects: The government is building 4,120km of roads countrywide. Available at:

<https://www.constructionkenya.com/2790/road-construction-kenya/#:~:text=Through%20the%20R2000%20programme%2C%20the,4%20billion>

(Accessed on 21st February 2022).

Nduwayo, A. F. (2019). *Influence of Social Capital on Performance of Social Amenities Projects in Rural Areas of Tanzania: a Case of Water Projects in Puge Division, Tabora*. (Master's Thesis, University of Nairobi).

Ng, C. P., Law, T. H., Jakarni, F. M., & Kulanthayan, S. (2019, April). Road infrastructure development and economic growth. In *IOP Conference Series: Materials Science and Engineering*, 512 (1), 012045.

Nguea, S. M. (2020). The Impact of Infrastructure development on Foreign Direct Investment in Cameroon.

Njiru, E. W., Simiyu, J. M., & Bunde, A. O. (2020). Effect of government infrastructure investment on economic growth in Kenya. *Journal of Economics and Sustainable Development*, 11(4), 77-86.

Nyambane, M. (2020). *Modeling Interest Rate on Economic growth of Kenya between 1970 and 2018* (Doctoral dissertation, University of Nairobi).

Nyasha, S., Gwenthure, Y., & Odhiambo, N. M. (2018). Energy consumption and economic growth in Ethiopia: A dynamic causal linkage. *Energy & Environment*, 29(8), 1393–1412.

Pandey, P., & Pandey, M. M. (2021). *Research methodology tools and techniques*. Bridge Center.

Prasetyo, P. E. (2019). The reliability of entrepreneurial productivity as driver of economic growth and employment. *International Journal of Entrepreneurship*, 23(4), 1-15.

- Prasetyo, P. E. (2020). The role of government expenditure and investment for MSME growth: Empirical study in Indonesia. *The Journal of Asian Finance, Economics, and Business*, 7(10), 471-480.
- Radjenović, T., & Krstić, B. (2017). Intellectual capital as the source of competitive advantage: the resource-based view. *Facta Universitatis, Series: Economics and Organization*, 127-137.
- Rambe, P., & Khaola, P. (2021). The impact of innovation on agribusiness competitiveness: the mediating role of technology transfer and productivity. *European Journal of Innovation Management*.
- Saleem, H., & Shabbir, M. S. (2020). The short-run and long-run dynamics among FDI, trade openness and economic growth: using a bootstrap ARDL test for co-integration in selected South Asian countries. *South Asian Journal of Business Studies*, 9(2), 279-295.
- Sekaran, U., & Bougie, R. (2019). *Research methods for business: A skill building approach*. John Wiley & Sons.
- Senaviratna, N. A. M. R., & Cooray, T. M. J. A. (2019). Diagnosing multicollinearity of logistic regression model. *Asian Journal of Probability and Statistics*, 5(2), 1-9.
- Statista (2020). Share of internet users in Africa as of December 2020, by country. Available online: <https://www.statista.com/statistics/1124283/internet-penetration-in-africa-by-country/#:~:text=As%20of%20December%202020%2C%20Kenya,payment%20system%20encourages%20internet%20access>. (Accessed on 21st Feb 2022).

- Statista (2021). Extreme poverty rate in Kenya from 2017 to 2021. Available Online: <https://www.statista.com/statistics/1227076/extreme-poverty-rate-in-kenya/> (Accessed on 17th February 2022).
- Stupak, J. M. (2017). Economic impact of infrastructure investment. *Congressional Research Service*. Available Online: <https://sgp.fas.org/crs/misc/R44896.pdf> (Accessed on 14th Feb 2022).
- Thuita, P. (2022, Feb 3rd). List of Top Construction Projects in Kenya: Overview of the country's biggest construction ventures. Available online: <https://www.constructionkenya.com/999/major-construction-projects/> (Accessed on 21st Feb 2022).
- Turok, I., & McGranahan, G. (2019). Urbanisation and Economic Growth: The Arguments and Evidence for Africa and Asia. *Urbanisation*, 4(2), 109-125.
- Twinoburyo, E. N., & Odhiambo, N. M. (2018). Monetary policy and economic growth: A review of international literature. *Journal of Central Banking Theory and Practice*, 7(2), 123-137.
- UNCTAD (2020). Economic Development in Africa Report 2021: Reaping the potential benefits of the African Continental Free Trade Area for inclusive growth. Available online : <https://unctad.org/press-material/facts-and-figures-7#:~:text=Poverty%20levels%20declined%20in%20most,from%2083%25%20to%2080%25>. (Accessed on 17th Feb 2022)
- UNDP (2021). Human Development Index (HDI). Available online: <https://hdr.undp.org/en/content/human-development-index-hdi> (Accessed on 21st

Feb 2022).

Wekesa, C. T., Wawire, N. H., & Kosimbei, G. (2016). Effects of infrastructure development on foreign direct investment in Kenya. *Journal of Infrastructure Development*, 8(2), 93-110.

World Bank (2020). Annual Rate of GDP Performance of Kenya. (Available Online: <https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=KE> Accessed on 16th February 2022).

World Bank(2020b). World Bank GDP Kenya: World Bank national accounts data, and OECD National Accounts data files. Available Online: <https://data.worldbank.org/indicator/NY.GDP.MKTP.KD?end=2020&locations=KE&start=1960&view=chart> (Accessed on 16th February 2022).

Yee, A. (2018). Geothermal Energy Grows in Kenya. Available at: <https://www.nytimes.com/2018/02/23/business/geothermal-energy-grows-in-kenya.html> (Accessed on 16th February 2022).

Yu, Z., Zhang, H., Tao, Z., & Liang, J. (2019). Amenities, economic opportunities and patterns of migration at the city level in China. *Asian and Pacific Migration Journal*, 28(1), 3-27.

Yusliza, M. Y., Yong, J. Y., Tanveer, M. I., Ramayah, T., Faezah, J. N., & Muhammad, Z. (2020). A structural model of the impact of green intellectual capital on sustainable performance. *Journal of Cleaner Production*, 249, 119334.

Zakari, A., & Khan, I. (2022). Boosting economic growth through energy in Africa: the role of Chinese investment and institutional quality. *Journal of Chinese Economic and Business Studies*, 20(1), 1-21.

- Arfaoui, L., Ziadi, A., & Manai, S. (2016). The Relationship between Democracy and Economic Growth in Tunisia: An Application of Autoregressive Distributed Lag Model. *International Journal of Social Science Research*, 4(1), 137. <https://doi.org/10.5296/ijssr.v4i1.8870>
- Barunik, J. (2011). Lecture : Introduction to Cointegration. *Introduction to Cointegration-Applied Econometrics, Summer Sem.*
- Creswell, J. W. (2009). John W. Creswell's Research Design 3rd Ed. In *Research Design 3rd Ed.* <https://www.worldcat.org/title/research-design-qualitative-quantitative-and-mixed-methods-approaches/oclc/269313109>
- Fiorentini, G., Sentana, E., & Calzolari, G. (2004). On the validity of the Jarque-Bera normality test in conditionally heteroskedastic dynamic regression models. *Economics Letters*, 83(3), 307–312. <https://doi.org/10.1016/j.econlet.2003.10.023>
- Fisher. (2016). *Chapter 1 Longitudinal Data Analysis*. 1–63. <papers3://publication/uuid/E5149E20-DC18-4AA5-B7DD-42BB393AA88C>
- Gonçalves, S., Herrera, A. M., Kilian, L., & Pesavento, E. (2021). Impulse response analysis for structural dynamic models with nonlinear regressors. *Journal of Econometrics*, 225(1), 107–130. <https://doi.org/10.1016/j.jeconom.2021.06.009>
- Herranz, E. (2017). Unit root tests. *Wiley Interdisciplinary Reviews: Computational Statistics*, 9(3), 111–139. <https://doi.org/10.1002/wics.1396>
- Jacob Ambrose Aboge - Research 06-10-2021*. (n.d.).
- Jeevan, J., Ghaderi, H., Bandara, Y. M., Saharuddin, A. H., & Othman, M. R. (2015). The Implications of the Growth of Port Throughput on the Port Capacity: the Case of Malaysian

- Major Container Seaports. *International Journal of E-Navigation and Maritime Economy*, 3, 84–98. <https://doi.org/10.1016/j.enavi.2015.12.008>
- Kutasi, G., & Marton, Á. (2020). The long-term impact of public expenditures on GDP-growth. *Society and Economy*, 42(4), 403–419. <https://doi.org/10.1556/204.2020.00018>
- Liu, Q. (2010). *Efficiency Analysis of Container Ports and Terminals*. 206. <http://eprints.ucl.ac.uk/19215/>
- Mureithi, P. L. P. (2015). *the Nexus Between Road Infrastructure and Economic Growth in Kenya By Supervisor*.
- Murray, L., Nguyen, H., Lee, Y.-F., Remmenga, M. D., & Smith, D. W. (2012). Variance Inflation Factors in Regression Models With Dummy Variables. *Conference on Applied Statistics in Agriculture*. <https://doi.org/10.4148/2475-7772.1034>
- Nelson, B. B. (1983). Testing for Normality. *Journal of Quality Technology*, 15(3), 141–143. <https://doi.org/10.1080/00224065.1983.11978861>
- Nkoro, E., & Uko, A. K. (2016). Autoregressive Distributed Lag (ARDL) Cointegration Technique: Application and Interpretation. *Journal of Statistical and Econometric Methods*, 5(4), 63–91.
- Ombongi, P. N., & Long, W. (2018). Factors Affecting Financial Performance of Small and Medium Enterprises (SMEs): A Case of Manufacturing SMEs in Kenya. *Online International Journal of Research in Business Studies and Management*, 5(1), 37–45.
- Paiva, A. (2010). *Hypothesis Testing ECE 3530-Spring 2010*.
- Paper, W. (2016). Univariate Analysis and Normality Test Using SAS, STATA, and SPSS.

Measurement, January, 1–67.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics, 16*(3), 289–326.

<https://doi.org/10.1002/jae.616>

Shaari, A. H. (2013). *Stationarity and Unit Root Testing Why do we need to test for Non-Stationarity ? Two types of Non-Stationarity.* 1–21.

Statistics. (2008). *1994*, 1379–1389. <https://doi.org/10.18356/a1a57f4f-en>

Tebbs, J. M. (2006). *INTRODUCTION TO.*

Unibo. (n.d.). Durbin-Watson Significance Tables. *Universita Di Bologna*, 1–11.

http://www.dm.unibo.it/~simoncin/Durbin_Watson_tables.pdf

Appendix I: Data Tabulation Sheet

Year	per Capita income (KSH)	Road (KSH Millions)	ENERGY (KSH Millions)	PUBLIC AMENITIES (KSH Millions)	PUBLIC UTILITIES (KSH Millions)
1991	27300.00	24335795.00	1444400.00	2338948737.00	462000.00
1992	25905.00	30445095.00	1397000.00	1864203677.00	489000.00
1993	21330.00	34648430	1023000.00	1520479153.00	373000.00
1994	20800.00	36259495.00	1188000.00	604101686.00	416500.00
1995	21870.00	48617395.00	1234000.00	1825741711.00	402995.00
1996	27880.00	52681295.00	1474000.00	2919840038.00	625745.00
1997	31980.00	73723895.00	1363000.00	3012243482.00	697495.00
1998	38700.00	98736890.00	1527000.00	4847541522.00	651495.00
1999	39087.00	125679995.00	1367000.00	3786446857.78	456995.00
2000	37641.69	239950256	765000.00	4683958269.42	636060.00
2001	37090.84	268559699	934000.00	3786446857.78	635545.00
2002	35588.66	297979995.00	1736000.00	3060911088.89	633405.00
2003	37836.36	436189458	12937000.00	4728316245.00	1065168.00
2004	42991.57	618445521	14282000.00	5150328817.09	2409120.00
2005	49211.01	679044282	16735000.00	5161050418.98	1065170.00
2006	56525.12	745635811	19726000.00	5171772020.87	6068945.00
2007	68902.17	751162246	20539000.00	5182493622.76	7596270.00
2008	81521.11	1191056242	22335000.00	5193215224.65	9049870.00
2009	82336.32	1203231115	33527100.00	5794209160.66	13155320.00

2010	93301.11	1272763981	36356200.00	6062926894.00	12139345.00
2011	102428.40	1292186609	65700000.00	5794209160.66	18415970.00
2012	108625.31	1352366131.00	78500000.00	6672884240.00	24669219.00
2013	115980.80	1370846051.00	78500000.00	6930651728.00	31404995.00
2014	129804.46	1402870624	94000000.00	7110081008.00	74479995.00
2015	138563.62	1409906347.00	22335000.00	7167625727.30	1168914009.00
2016	157173.78	1475791329.00	33527100.00	8866586818.34	1224056772.00
2017	164182.01	1564547046.00	36356200.00	9713399489.00	1232482850.00
2018	184492.73	1573278408	65700000.00	9882993324.00	1293591777.00
2019	202974.95	1617433468.00	78500000.00	10665853550.00	1544475866.00
2020	206124.95	1656291167	78500000.00	10859453789.00	1598963394.00
2021	227420.79	1671946099.00	94000000.00	10968257104.68	1600215221.00

Appendix II: Operationalization of Research Variables

Variable	Type	Operationalization Indicator	Measurement	Hypothetical direction
Economic growth	Dependent	<ul style="list-style-type: none"> Per-capita income 	Per-capita national average (KSH.)	No significant positive relationship
Road infrastructure investments	Independent	<ul style="list-style-type: none"> Road construction budgetary allocation 	Roads budget per year (KSH.)	No positive relationship

Energy production investments	Independent	<ul style="list-style-type: none"> Total energy generation and distribution budgetary allocation 	Annual power generation budget (KSH.)	No positive relationship
Public amenities investments	Independent	<ul style="list-style-type: none"> Expenditure on public amenities 	Annual budgetary allocations for utilities construction (KSH.)	No positive relationship
Public utilities investments	Independent	<ul style="list-style-type: none"> Expenditure on installation of public utilities 	Annual budget for public utilities	No positive relationship