THE NEXUS BETWEEN ROAD INFRASTRUCTURE AND ECONOMIC GROWTH IN KENYA

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DECLARATION

Declaration by Student

This research paper is my original work and has not been presented to any other examination body or institution for any award. No part of this research should be reproduced without my consent or that of the University of Nairobi.

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This research paper has been submitted with my approval as the University Supervisor.

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DEDICATION

This project is dedicated to my family for their support during this time of research study.

LIST OF ABBREVIATIONS

ADB	African Development Bank
DFIs	Development Financial Institutions
ECM	Error Correction Model
GDP	Gross Domestic Product
GoK	Government of Kenya
KeNHA	Kenya National Highways Authority
KERRA	Kenya Rural Roads Authority
KRB	Kenya Roads Board
KSh	Kenya Shillings
KURA	Kenya Urban Roads Authority
LAPSSET	Lamu Port South Sudan Ethiopia Transport project
OLS	Ordinary Least Square
OMO	Open Market Operations
PPP	Public Private Partnership
SVAR	Structural Vector Autoregressive model

ABSTRACT

This paper addressed the questions on the impacts of road infrastructure network on the overall economic growth rate in Kenya and if there exists a sectoral bias in the public expenditure between road infrastructure and provision of other social services in Kenya using for 1963 to 2014 period. Ordinary Least Squares method was used to regress a simple linear regression model.

The study found that for every one shilling spent on road infrastructure by the government GDP per capita increases by Kshs. 572.753 holding other factors constant. This therefore empathises on the importance of road infrastructure as pointed out in the country's economic development blue print vision 2030 on physical infrastructure. These 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. In addition, it is noteworthy that these efforts are not only geared towards construction of international trunk roads but also national, urban and the rural roads in efforts of increasing connectivity. However, the GDP per capita is not very responsive to the private sector investment in the road infrastructure as it is for the public road expenditure.

On the sectoral bias expenditure on health and energy are strongly positively correlated. Similarly expenditure on health and energy expenditure are strongly positively correlated with education and agricultural expenditure thus ruling out the possibilities of sectoral bias for such public expenditures.The study therefore recommends for more adoption and sensitization of the PPP programme that has now a legal framework following the enactment of PPP act 2012. In addition, the annuity financing aspect in road infrastructure needs to be fast truck by the government in order to realize the dream of 10,000 km now tarmac roads by the government.

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CHAPTER ONE
1.0 INTRODUCTION

1.1 Background information

Economic growth is one of the core issues of economics that has existed ever since the inception of Economics as a discipline. More specifically, economic growth has received much attention in the area of economic development. A lot of economic literature exists as to what leads to economic growth in an economy. In macroeconomics, desegregation of economic growth may be viewed as caused by the growth in various components of the Gross Domestic Product (GDP).

Focusing on the sectorial decomposition of GDP, it is evident that a well-functioning and integrated road transport network is a catalyst for growth in national output as well as poverty reduction especially in the rural areas. It is evidently clear that the quality of physical infrastructure especially road networks enters the determination of the production costs, ease to market access, attraction of investments and ultimately job creation. A review of transport network in Africa reveals that road transport is the most widely used transport mode across the continent. This is underpinned on the mere fact of geographical disadvantage, which limits the feasibility of inland waterways given the land lockedness in majority of the African countries. In addition, the rugged terrain among majority of the African countries limits the coverage under railway transport that is normally gravity conscious. This has therefore led into an unprecedented emphasis on the road networks as the only alternative transport network towards enhancing connectivity across the continent.

A review of literature on economic development reveals that many economists are of agreement that physical economic infrastructures are core for accelerating economic growth in any economy. Of these infrastructures, road infrastructure is crucial in increasing connectivity, reducing cost of production through reduced transport costs among others. Boopen (2006) asserts that provision of vital linkages between spatially separated facilities enables social contact and interaction possible as well as providing access to employment, health, education, and other services that brings about civilization.

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. In addition, it is noteworthy that these efforts are not only geared towards construction of international trunk roads but also national, urban and the rural roads in efforts of increasing connectivity.

A review of the current efforts in infrastructure development reveals that the government has focused on different financing models in attempts to diversify financing source at its disposal. These include the loans from development banks such as the African Development Bank, international loans from World Bank, issuance of the sovereign bonds as well as the infrastructural bonds through the securities exchange. Further, in order to realise the targets towards development of the physical infrastructure, the government is currently in the process of introducing the new financing model referred to as the annuity finance mainly targeting the road infrastructure. All these efforts are clear indication of the role the road infrastructure plays in enhancing economic growth in an economy. However, the fact remains the demand for road transport in Kenya outstrips supply given the transport sector is entirely dependent on roads transport networks.

Given the above mentioned concerted efforts by the government towards development of road transport network, studies on the nexus between road infrastructure and economic growth in Kenya with an aim of informing policy implications is core. On the other hand, investment in the road infrastructure comes with a challenge given that the government is the provider of other core social infrastructure such as education, health among others. All these services require huge financial resources given that they are public goods hence the free rider problem that deters the private sector from venturing in them. With education being a major consumer of the overall budgetary allocation, it would then be of great importance to evaluate whether the financing gap in the road infrastructural financing would be partly attributed to the expenditure for provision of other major social amenities and if so is the effect statistically significant. Looking at the annual expenditure on education we find that in the financial year 2010 / 2011, the total expenditure was KSh. 179,000 million that rose to KSh. 260,122 million in the financial year 2012 / 2013. In financial year, 2014 / 2015 the budget

was expected to rise to KSh. 339,079 million (GoK budget estimates, 2014). Given this scenario, it would be essential in understanding the recent introduction of Public-Private-Partnership (PPP) by the government in financing physical infrastructure; roads being one of them. The study, therefore, seeked to analyze the sectorial bias in reference to the government expenditure.

1.2 The state of road transport network in Kenya.

In Kenya, road transport network is core as seen in the government development manifesto as well as the country's development blue print Vision 2030. Currently, road transport is the predominant transport mode carrying about 93 per cent of all the total cargo and passenger traffic in the country (Kenya Roads Board). Looking at road classification, it's evident that there are currently 61, 936 kilometres of classified roads based on five main classifications namely: Class A roads-those linking centres of international importance such as ports and cross borders terminal, Class B roads-those linking national centres within a country, Class C roads-those linking provincially important centres, Class D roads-mainly secondary roads and Class E roads-which represent minor roads (Kenya Roads Board) with 98,950 kilometres being unclassified.

Turning to the institutional framework with regard to the construction and maintenance of various roads classifications:-the Kenya National Highways Authority mandate is to construct and maintain the international trunk and national roads. Kenya Urban Roads Authority deals with roads in Cities and Municipalities while the Kenya Rural Roads Authority mandate is to construct and maintain class C, D and E roads. The demand for roads transport in Kenya outweighs the supply given that the network supports about 93% (per cent) of the cargo and passenger traffic; hence the ever experienced heavy road traffic.

1.3 Problem statement

An overview of the road infrastructure in Kenya suggests that road transport is core and dominates the entire transport sector; accounting for approximately 93 per cent of total cargo and passenger traffic (Kenya Roads Board). It is therefore of no doubt that, an efficient road transport network is core in supporting the entire transport sector at large. Further, the overview of the state and progress in road infrastructure network reveals that there has been unprecedented efforts by the various government regimes to expand the existing road

network, a move that has seen road infrastructure receiving a substantial budgetary allocation of the entire development expenditure budget.

In sessional paper number 10 of 2010 on Kenya Vision 2030, economic physical infrastructure emphasized a foundation for socio-economic transformation of the Kenyan economy. Among the key milestones as far as road transport network in Kenya is concerned are the constructions of Trans African corridor from Mombasa to Dakar Senegal. In addition, the northern corridor from Cape Town in South Africa passing through Kenya to the Northern Africa city of Cairo in Egypt is yet another milestone in the development of the road infrastructure in Kenya. On the latest developments is the commissioning of the Lamu Port South Sudan Ethiopia Transport (LAPSSET) project, construction of the 51 kilometre Thika Road superhighway with various by-passes (Northern, Eastern, Southern) among other urban and rural roads have transformed the state of road infrastructure in Kenya.

Looking at the financing of all these road projects, it is evident that the financing has been partly by Development Financial Institutions (DFIs) such as the African Development Bank, World Bank, European Development Bank, among others and partly by the Government of Kenya. The commercial banks have also been involved indirectly in road financing through purchasing of the government infrastructural bonds floated in the Nairobi Securities Exchange.

The current development in the financing of road infrastructure that seeks Public-Private-Partnership (PPP) is a move by the government to solve the financing constraints. This could be attempts to undertake gap financing especially when the project is economically viable but not financially viable thus discouraging the private sector from participating in road infrastructure financing. However, this could be easy if the economic multiplier of the road infrastructure on the economic growth is positive and certain. It is for this reason that this study seeks to investigate the nexus between road infrastructure and economic growth in Kenya in attempts to find out how road infrastructure affects economic growth in Kenya. This is because, if the multiplier effect of road infrastructure on the economy could be certain, gap-financing problem will be solved with ease. This is therefore the research gap that this study seeks to fill.

1.4 Research questions

- What are the impacts of road infrastructure network on the overall economic growth rate in Kenya?
- Does there exist a sectoral bias in the public expenditure between road infrastructure and provision of other social services in Kenya?

1.5 Objectives of the study

The study seeked to find out the road infrastructure-economic growth nexus in Kenya.
Specifically, the study seeked:

- To find out the impact of road infrastructure network on the overall economic growth rate in Kenya.
- To determine the public expenditure sectoral bias between road infrastructure and provision of other social services.
- To draw policy implication arising from the review of literature and the empirical analysis of data.

1.6 Significance of the study

From the reviewed literature, road transport network is core in increasing connectivity, which in turn promotes regional trade, efficient resource allocation by increasing the mobility of factors of production from the surplus areas to the deficit areas as well as the reduced cost of production. In addition, efficient road network is core in reducing rural poverty by increasing market access by the rural farmers. With this insight, this study will be of importance in three folds: First, is to the policy makers. The study can be helpful in informing policy formulation and implementation with regard to investing in road infrastructure. This is because; it could be easier to justify the economic viability of investment in road infrastructure if the impacts of the road infrastructure on economic growth are certain. The mega projects in terms of construction of new roads, bypasses as well as maintenance of the existing ones can be economically viable if their impacts are certain. Policies and decisions to do with gap financing where the project is economically viable, but fall short of financial viability thereby leading to private sector shying away from financing them, could only be made if the economic contribution of road infrastructure projects are known in certainty, a gap that this study seeks to fill.

Secondly, the significance to the existing body of literature and knowledge. The study will give a platform for areas of further research as well as providing reference to future studies on the same areas. Lastly, to the financiers of the road infrastructure. The study could be helpful in evaluation of the projects before financing it. Sometimes a difference in the financial viability and economic viability is crucial when it comes to the financing of mega infrastructural projects mainly by the development banks. Therefore, the study could shed some lights on the economic viability of road infrastructure in Kenya by giving an insight into the multiplier effects of investing in road infrastructure.

1.7 Scope of the study

The study covered road infrastructure investments in Kenya in attempts to find out the relationship between road infrastructure development and the overall economic growth rate over time. Therefore, the study did not capture investment in other economic infrastructures that are core in economic growth. The period under review was 1963 – 2015 thus enhancing the ability of the study to capture all the road infrastructure investment by different government regimes that have existed in the past.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

This chapter covers both theoretical and empirical literature on the nexus between road infrastructure development and economic growth in Kenya. More specifically, it covers the theoretical literature, empirical literature and finally concludes with an overview of the literature highlighting the research gap that the study seeked to fill.

2.2 Theoretical literature

Within the development economic literature, there exist robust literature on impacts of economic infrastructure at large on economic growth and development in both the developed and emerging economies. The role of public physical infrastructure in the process of economic growth has received a wide attention ever since the contributions of seminal works by Aschauer (1989) and the theoretical model of Barro (1990) on public capital that generates spill over effects for the private sector.

Yaya (2011) posits that the development practitioners tend to emphasize the importance of reliable and affordable infrastructure for reducing poverty and its contribution in the achievement of Millennium Development Goals. Good transport linkages reduce transport costs, road congestion and promote industrial development throughout the country. This implies that the better the infrastructure the more successful the economic development policies will be (Ashipala & Haimbodi, 2003). Poor infrastructure facilities, especially in transport, communications and information technologies, are one of the major impediments for investment and growth in many African countries (World Bank, 1994).

However, despite the argument by various researchers that physical infrastructure contributes to economic growth a puzzle remains as to whether transport infrastructure contributes to economic growth and vice versa. It is notable that while the endogenous economic growth models assert that transport network contribute to economic growth, Wagner's law regards that the increase in GDP is a main driver for public investment thus the possibility of two way – causal effect between road infrastructure and economic growth.

Barro (1990) conducted the seminal work that has greatly influenced the theoretical literature on infrastructure and economic growth. The work found that the positive effects of infrastructure in economic growth can be wiped out completely by the taxes levied by the government to finance them. This was affirmed by the latter studies (Helms, 1995; and Mendoza et al., 1997) who concluded that the negative effect of government spending on economic growth simply arises from the distortions and the disincentives effects arising from taxation as a source of finance infrastructural projects. From the public economics, these disincentives arise from the government's domestic borrowing to finance infrastructure through the open market operations (OMO) which raise the cost of funds in the domestic market thus crowding out private sector borrowing, which plays a major role in economic growth and development.

2.3 Empirical literature

The review of the empirical studies on the nexus between road infrastructure and economic growth in Kenya reveals a rich pool of empirical works in different geographical settings. Empirical study by Aschauer (1989) found out a strong significant positive relationship between public investments in infrastructure and economic growth for the United States for the period 1949 –1985. The study results explain the decline in the United States' economic growth between 1970s and 1990s, which attributed to the cut down in public investment. The findings were in tandem with the World Bank development report (1994) whose empirical results confirm the importance of infrastructure in economic growth in different countries. A later study by Aschauer (2000) found that the stock of public infrastructure capital is a significant determinant of aggregate total factor of productivity and that investments in public sector not only improve quality of life but also increase economic growth and returns for private investments. This conquers with Demetriades and Mamuneas (2000) who indicated that public infrastructure capital has significant positive long-run effects on both output supply and input demands.

Boopen (2006) using both the crossectional and panel data analysed the contribution of transport capital to growth for a sample of 38 Sub- Saharan African countries. His findings in both samples cases revealed that transport capital has been a contributor to the economic

progress of the 38 countries sampled. The findings conquered to the later study by Seethepalli et al. (2008) which found infrastructure as core in promoting growth in East Asia. Montolio and Solé-Ollé (2009) replicateed similar results in the Spanish economy and point out that productive public investment in road infrastructure positively affected relative provincial productivity performance in Spain. This confirms results of an earlier study by Fernald (1999) which provided evidence that increasing the roading stock induces faster productivity growth in those industries that use roading more intensively, implying that the causation is more likely to be from infrastructure investment to output growth, rather than the other way around in Spain. However, Tatom (1991; 1993); Holtz-Eakin (1994); Holtz-Eakin and Schwartz (1995); and Garcia-Mila et al. (1996) report contrary findings that there is little evidence of an effect from infrastructure to income growth in United States using panel data.

Turning into the theoretical literature on the causal relationship between transport infrastructure and economic growth, a lot of research efforts and interests from economists is available. To start with, Gramlich (1994) put it that it remains essentially unclear whether the direction of causation is from transport infrastructure to economic growth or vice-versa or both. Kessides (1996) notes that one of the main shortcomings of research on the economic impact of transportation infrastructure is that it has so far not adequately accounted for simultaneity of effects economic growth can lead to development of the transport system as well as result from it.

On the causal relationship between transport infrastructure and economic growth, De la Fuente (2000) also concludes that causality flows from infrastructure investment to economic growth. Based on the modelling, Mittnik and Neumann (2001) establish that public investment has positive influence on GDP albeit no significant causal link running from GDP to public investment. Similarly, Canning and Pedroni (2008) investigate the consequence of various types of infrastructure provision in a panel of countries. They show that while infrastructure does tend to cause long-run economic growth, there is substantial variation across countries. Nurudeen and Usman (2010) using cointegration and error correction methods analysed the relationship between government expenditure and economic growth in Nigeria. Thereby revealing that government total capital expenditure total recurrent expenditures, and government expenditure on education have negative effect on economic

growth. On the contrary, rising government expenditure on transport and communication results to an increase in economic growth. Finally, Pradhan (2010) explores the nexus between transport infrastructure (road and rail), energy consumption and economic growth in India over the period 1970 - 2007. He finds evidence of unidirectional causality from transport infrastructure.

Ashipala and Haimbodi (2003) looked at the relationship between public investment and economic growth in South Africa, Botswana and Namibia using the VECM methodology. They found out that the effect of public investment on growth is not significant; however, it has the correct sign. On the other hand, private investment has a long run growth impact in South Africa and Namibia. However, they find evidence indicating a reverse causality from GDP growth to public investment. The causality is negative in the case of Botswana suggesting that as the economy grows investment in public goods declines, which contradicts both the Keynesian theory and Wagner's law.

Turning to the infrastructure – economic growth – poverty reduction nexus, Jerome and Ariyo (2004) explored the impact of infrastructural reforms on poverty reduction. The study noted that infrastructure reforms and privatization in Africa have been carried out without considering the needs of the poor and without meeting the policy preconditions that are indispensable for their effectiveness hence no effect on poverty reduction. A later study by Ogun (2010) investigated the impact of infrastructural development on poverty reduction in Nigeria. The study specialised in the relative effects of physical and social infrastructure on living standards or poverty indicators, aiming to provide empirical evidence on the implications of increased urban infrastructure for the urban poor. Using structural vector autoregressive (SVAR) model, the study unequivocally finds that infrastructural development leads to poverty reduction, which leads to increase in economic growth.

Pravakar, Ranjau & Geethanjali (2010) using Generalized Methods of Moment and Autoregressive distributed lag model investigated the role of infrastructure in promoting economic growth in china for the period 1975 to 2007 found that infrastructure and investment have played an important role in economic growth in the Chinese economy. Boopen (2006) analyzed the contribution of transport capital to growth for a sample of Sub

Saharan African and a sample of Small Island Developing States, using both cross sectional and panel data analysis. The study concludes that transport capital has been a major contributor to the economic progress of the Sub Saharan African countries. Calderon (2009) using an econometric technique suitable for dynamic panel models, assessed the impacts of infrastructure development on growth in African countries based on econometric estimates for a sample of 136 countries for the period 1960 - 2005. He evaluated the impact on per capita growth of faster accumulation of infrastructure stocks and enhancement in the quality of infrastructure services for 39 Africa countries covering three key infrastructure sectors namely telecommunications, electricity, and road transportation he finds that infrastructure stocks and services quality boost economic growth.

2.4 Overview of literature review

From the reviewed literature, it is evident that different empirical studies report mixed results on the relationship between transport infrastructure investment and economic growth. Some of the studies report a positive relationship while others report a negative relationship between transport infrastructure investment and economic growth. With regard to the causality, the reviewed literature presents mixed results as well. For instance, Pradhan (2010) report a unidirectional relationship while Ashipala & Haimbodi (2003), report a two – way causal relationship.

Therefore, there is need to analyse the Kenyan scenario to provide concrete information on the quantitative effect of road infrastructure network on economic growth. Apart from doing so, the study accounts for the structural and institutional changes thus adding value to the analysis. This is because different political regimes have had different priorities accorded to road infrastructure development, as an engine for growth through the respective government manifestos. By analysing the effect of road infrastructure network on economic growth the results of the study will be core in informing the issues concerned with the transport economics and resource allocations thus urging for the case of investing in road infrastructure.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Introduction

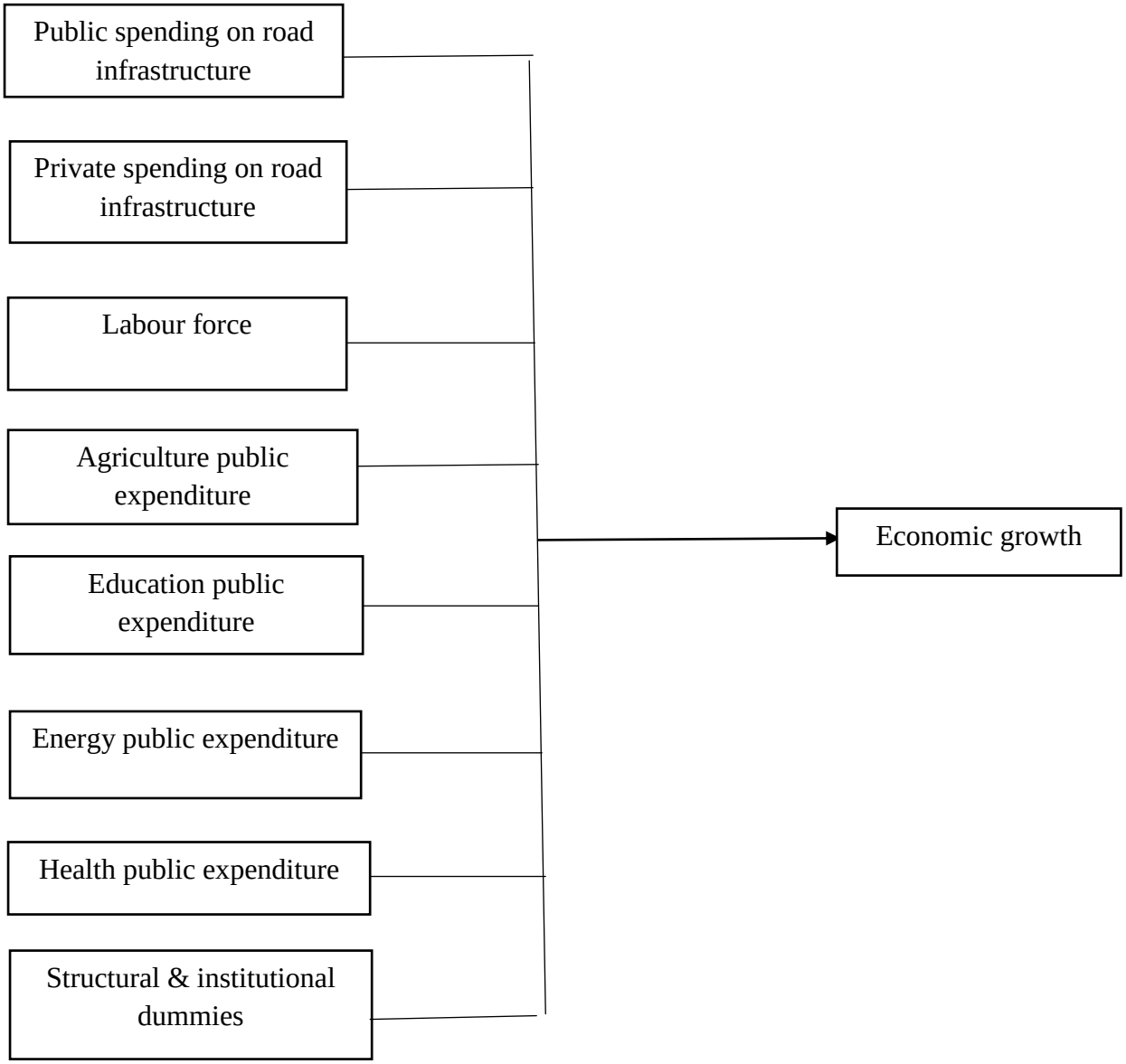
This chapter discusses the research methodology used in the study. It encompasses theoretical framework, empirical model, definition and measurement of variables, sources of data and the econometric approach adopted by the study.

3.2 Theoretical framework

The basis of the study was the Solow's neoclassical growth model of economic growth. The model presents a relationship between the total output of a country and the country's aggregate inputs of the factors of production. The model is based on the assumptions of Constant capital-output ratio, no government intervention, full employment at all times, constant labour force growth rate and constant technology.

The Solow's model assumes the physical capital as the ideal measure of capital in the economy. From the economic definition point of view, road network is a capital good because it is used in the production of other goods and services by necessitating mobility of goods and services within any economy. Therefore, given this scenario, the amount of capital stock within the economy will affect the economic growth rate implying that the road infrastructure network being part of the physical capital affects the economic growth. This is therefore the link between the road infrastructure and economic growth as portrayed by the Solow's model of economic growth.

From our theoretical framework and empirical literature reviewed, we outline the conceptual framework as follows:



Source: Author (2015)

3.3 Empirical model specification

To the Solow's model, we endogenize some variables that the model assumes to be exogenous. In this case, we not only use the physical capital; but also we endogenize the human capital development, which is core in skills enhancement, which feeds into increased productivity. From the theoretical framework, we specify our empirical model as follows:

$$GDP = \beta_0 + \beta_1 \text{Pr}ivateInfrSpending + \beta_2 PublicInfrSpending + \beta_3 Labour + \beta_4 AGR_{PS} + \beta_5 OSS_{PS} + \beta_6 InstitutionalDummy + \propto_t \quad .....(1)$$

Where:

GDP-is the Gross Domestic Product

$\text{Pr}ivateInfrSpending$ -This is the private sector's spending on the road infrastructure.

$PublicInfrSpending$ -This is the government's spending on road infrastructure.

$Labour$ -This is the economy's labour force.

AGR_{PS} -This is the public sector expenditure on the agricultural sector.

OSS_{PS} -This is the public sector expenditure on the provision of other major social services.

$InstitutionalDummy$ -Dummies capturing structural and institutional changes.

$\propto_t$ - is the error term of the model

To further understand the effect of the expenditure on provision of other social services, we decompose the social services into the main services namely education, energy and health sector expenditure. We further note that the expenditure figures used are the annual capital expenditures and not the recurrent expenditures. We therefore, have the extended version of model 1 that contains the decomposed social services and the structural and institutional dummies and presented in model 2.

$$GDP = \beta_0 + \beta_1 \text{Pr}ivateInfrSpending + \beta_2 PublicInfrSpending + \beta_3 Labour + \beta_4 AGR_{PS} + \beta_5 EDUCEXP + \beta_6 ENERGYEXP + \beta_7 HEALTHEXP + \beta_8 D_{1963\text{-}1978} + \beta_9 D_{1979\text{-}2002} + \beta_{10} D_{2003\text{-}2012} + \beta_{11} D_{2013\text{-}2015} + \varepsilon_t .....(2)$$

Where:

EDUCEXP-This is the public sector expenditure on the education sector

ENERGYEXP-This is the public sector expenditure on the energy sector

HEALTHEXP-This is the public sector expenditure on the health sector

$D_{1963-1978}$ -Dummy capturing structural and institutional changes for period 1963-1978

$D_{1979-2002}$ -Dummy capturing structural and institutional changes for period 1979-2002

$D_{2003-2012}$ -Dummy capturing structural and institutional changes for period 2003-2012

$D_{2013-2015}$ -Dummy capturing structural and institutional changes for period 2013-2015

ε_t -is the error term of the model.

3.4 Definition and measurement of variables

From our empirical model, we define and measure the following variables as:

- *GDP*-This is that total market value of all goods and services produced in an economy for a period of one year.
- $PrivateInfrSpending$ -This is the private spending on the road infrastructure. The variable is chosen from the understanding that private capital is core in infrastructural budget gap financing. In addition, in the wake of the public- private-partnership (PPP), it is evident that the government realises the importance of the private sector in financing infrastructure in Kenya hence the inclusion of the variable into the model.
- $PublicInfrSpending$ -This is the government's spending on road infrastructure. It is mainly the annual budgetary allocation by the government, which goes into provision of road infrastructure.
- *Labour* (L)-this is the economy's labour force. We measure this by the working-age population, which will be a proxy of the labour force/input.
- AGR_{PS} -This is the public sector expenditure on the agricultural sector, which is consider the largest component of Kenyan economy. Thus, any investment in this sector will significantly affect economic growth.
- OSS_{PS} -This is the public sector expenditure on the provision of other major social services. The study will mainly concentrate on the public expenditure on the education, health and energy sectors, which are the largest social service sectors.

3.5 Sources of data

The period chosen for economic analysis for this study is 1963-2015 using annual data. This is on consideration of data availability and in an effort to retrieve how variables under study have evolved over time as well as capture the development of the major physical infrastructure since independence. The data used is from secondary sources, specifically: Kenya National Bureau of Statistics, Central Bank of Kenya, and Kenya's Economic Surveys and Statistical Abstract. On the expenditures, the study used the capital expenditures only. Therefore, all the recurrent expenditures were netted out. In addition, the study used data on the actual capital expenditures and not the budgeted expenditure. This therefore, took into account the changes on the prices.

3.6 Data analysis

3.6.1 Pre estimation tests

3.6.1.1 Test for integration

Due to the nature of the time-series data of the variables under consideration, the variables were tested for unit root in order to see whether they are stationary or non-stationary. The unit root test is carried out to determine the level at which each variable is stationary or simply to determine the order of integration. The Augmented Dickey Fuller test was used to test for the existence or absence of a unit root. Co-integration analysis test was conducted in case of non-stationary of the series to derive long run relationships. The test for unit root and differencing was done to avoid the problem of spurious and inconsistence regression results.

3.6.1.2 Test for collinearity

Correlation among the independent variables is undesired if the BLUE estimates are to be obtained upon the data regression. Therefore, there is need to ensure that the regressors are independent of each other to avoid the econometric problems of multicollinearity which is evidenced by a very high coefficient of determination (R^2) upon estimating the model. Therefore, prior to estimation of the empirical model, we conducted a correlation matrix among all the variables of the model. A high correlation coefficient between any two variables was enough to conclude that the two variables are highly correlated thus justifying the elimination of one of the two variables out of the model.

3.6.2 Estimation technique

The estimation technique used in this study is the Ordinary Least Squares (OLS); this was done with the help of STATA packages. This was applied on the time-series or annual data to estimate the regression line. The study used both the error correction model (ECM) and co-integration to determine the long run and short run equilibrium relationship. Causality test was conducted, among other tests such as Ramsey Reset, heteroskedasticity and normality tests that catered for proper model specification and reliability of the results.

To achieve objective one, the empirical model was regressed and the respective coefficients discussed. After this, the hypotheses on the significance of the specific objectives were tested to find out whether the respective independent variables are significant in determining growth or not. In addition, the joint test for all the variables was carried out to determine whether all the variables jointly influence economic growth or not.

To achieve objective two, correlation matrix was constructed for all the variables of the model. In addition, the correlation coefficient among these variables was conducted to determine their correlation.

CHAPTER FOUR

4.0 DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

The chapter covers data analysis and discussion of the results. It gives the summary descriptive statistics of investments, remittances, foreign direct investments and pension fund. In addition, 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 heteroskedasticity and lastly the regression results for the model.

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, variance and standard deviation values, skewness and kurtosis values of the variables.

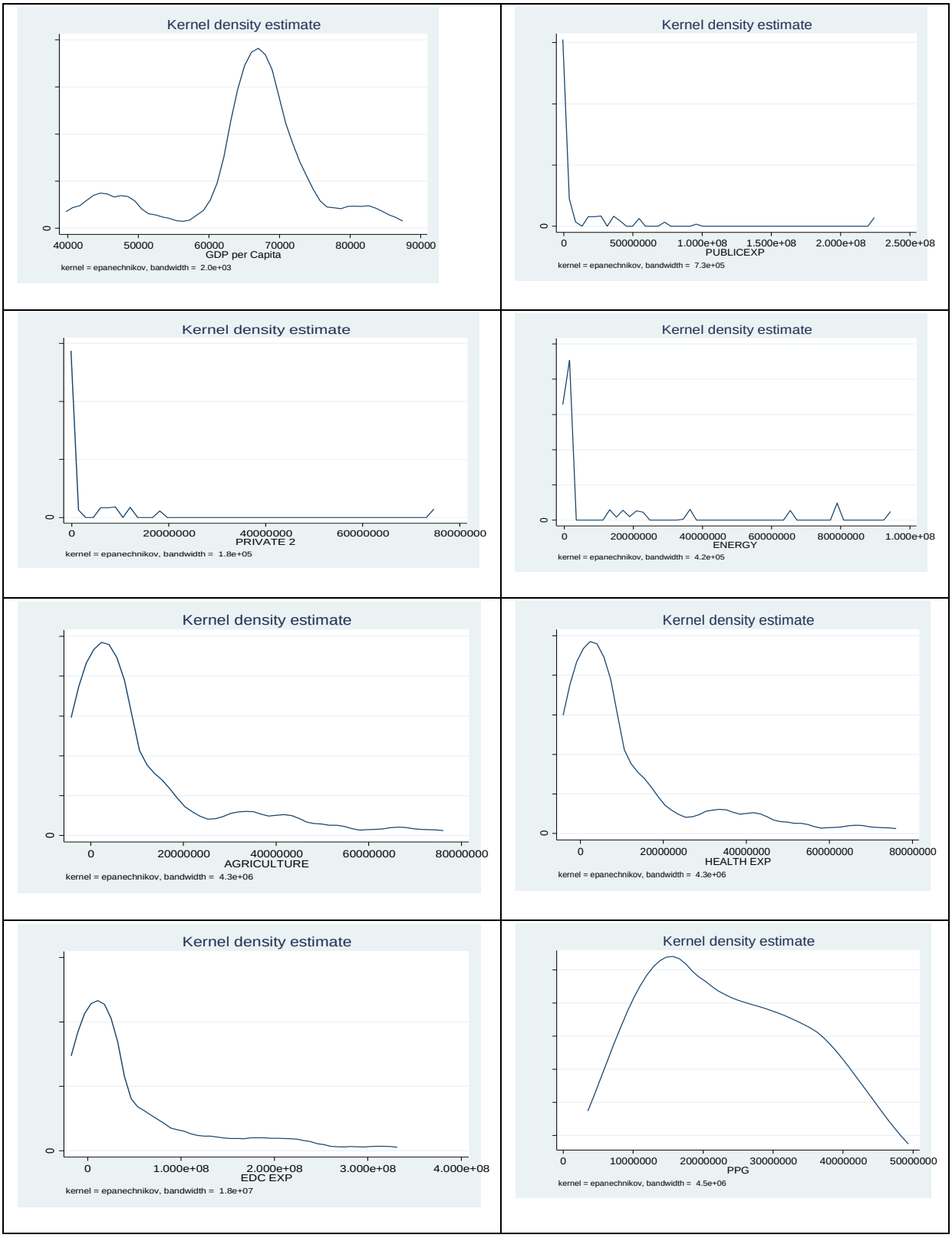
Table 4.1: Descriptive statistics

	GDP per capita	Public expenditure	Private expenditure	Energy	Agriculture	Health	Education	Population growth
Mean	65091.68	1.23E+07	4067090	1.00E+07	1.15E+07	1.35E+07	4.90E+07	2.35E+07
Std. Dev.	10019.01	3.55E+07	1.18E+07	2.20E+07	1.70E+07	1.70E+07	7.47E+07	1.09E+07
Minimum	41750.43	92565	29854.5	15480	35400	102728	328689	7985526
Maximum	85456.3	2.24E+08	7.45E+07	9.40E+07	7.19E+07	7.19E+07	3.13E+08	4.49E+07
Variance	1.00E+08	1.26E+15	1.40E+14	4.84E+14	2.90E+14	2.90E+14	5.57E+15	1.20E+14
Skewness	0.7513608	4.555128	4.555618	2.619914	1.87542	1.876552	1.862932	0.3053437
Kurtosis	3.500952	25.96003	25.96088	8.907162	5.873597	5.87732	5.741968	1.890073
Obs	52	52	52	52	52	52	52	52

From the descriptive statistics of the model, we deduce that expenditure on education has the highest mean value of Kshs. 4.9 billion followed by annual population growth rate of 2.35 million people. Public expenditure on health comes third followed by roads, agriculture and energy respectively. On the measures of dispersion as evidenced by standard deviation, expenditure on education has the largest dispersion from their mean value, Public expenditure is second GDP per capita having the least deviation from their mean value. Looking at the distribution parameters, we find that all the variables are positively skewed meaning that they are skewed to the right. On kurtosis values, we conclude that all variables have non – normal

distribution with only the GDP per capita having a near normal distribution given that its kurtosis values as close to 3.0. The graphical evidence on the distribution of variables are presented in figure 1 below.

Figure 1.0 Normality distribution of variables



4.3 Correlational analysis

In order to understand the correlation among the variables of the model, a correlation analysis was carried out to compute the correlation coefficient. The results for the correlation matrix are presented in table 4.2 below.

Table 4.2: Correlational matrix

	GDP per capita	Public expenditure	Private expenditure	Energy	Agriculture	Health	Education	Population growth
GDP per capita	1.0000							
Public expenditure	0.5279	1.0000						
Private expenditure	0.5272	0.4729	1.0000					
Energy	0.6087	0.5990	0.8991	1.0000				
Agriculture	0.6447	0.6994	0.6989	0.8955	1.0000			
Health	0.6440	0.6995	0.6990	0.8955	1.0000	1.0000		
Education	0.6616	0.5494	0.6488	0.9488	0.5429	0.9429	1.0000	
Population growth	0.7974	0.5795	0.5778	0.7136	0.5520	0.8517	0.5617	1.0000

From the results, all variables have moderate positive correlation. However, expenditure on health and energy are strongly correlated. In addition, expenditure on health and energy are strongly correlated with education and agricultural expenditure and population growth. As such, this warrant dropping of expenditure on health and energy out of the regression equation since their strong correlation with other variables would lead to multicollinearity problem upon regression of the empirical model.

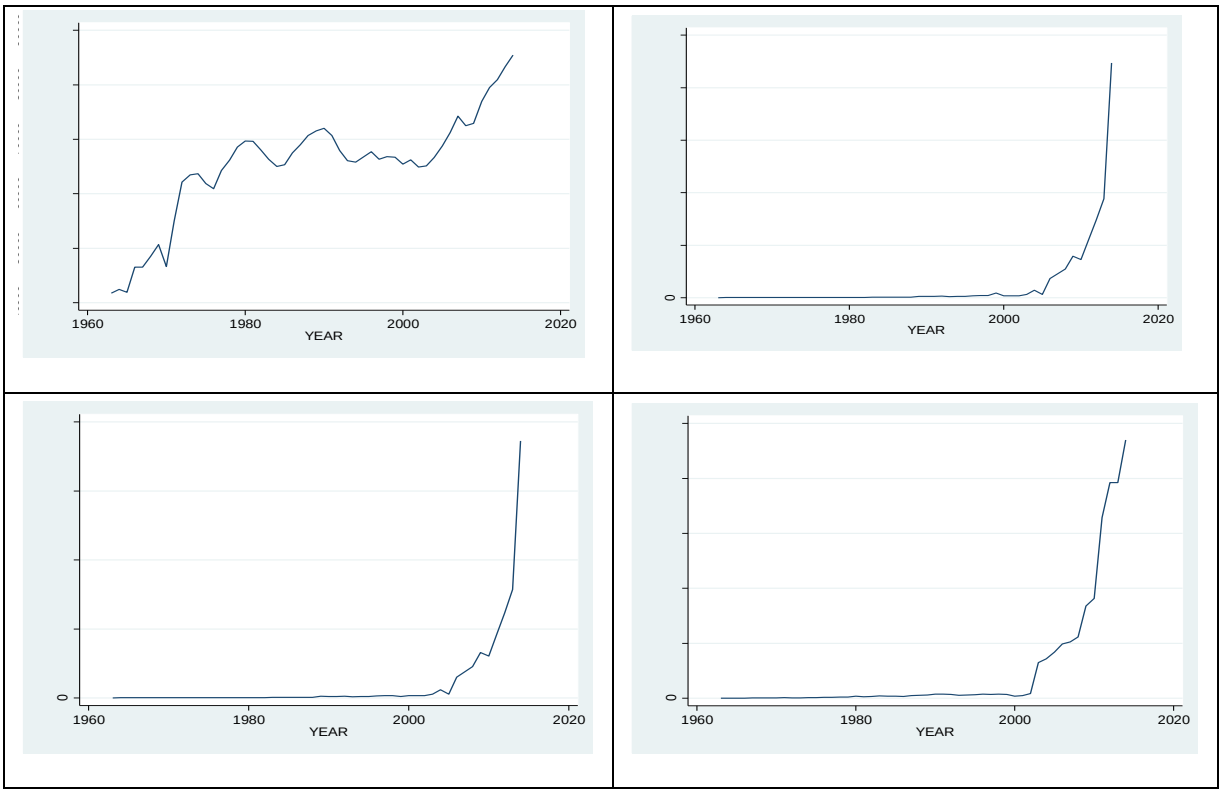
From the correlation coefficients, we conclude that there is no sectoral bias among different government public expenditures. This is because the correlation coefficients across all the expenditures are positive. This implies that the expenditures are mutually exhaustive rather than mutually exclusive.

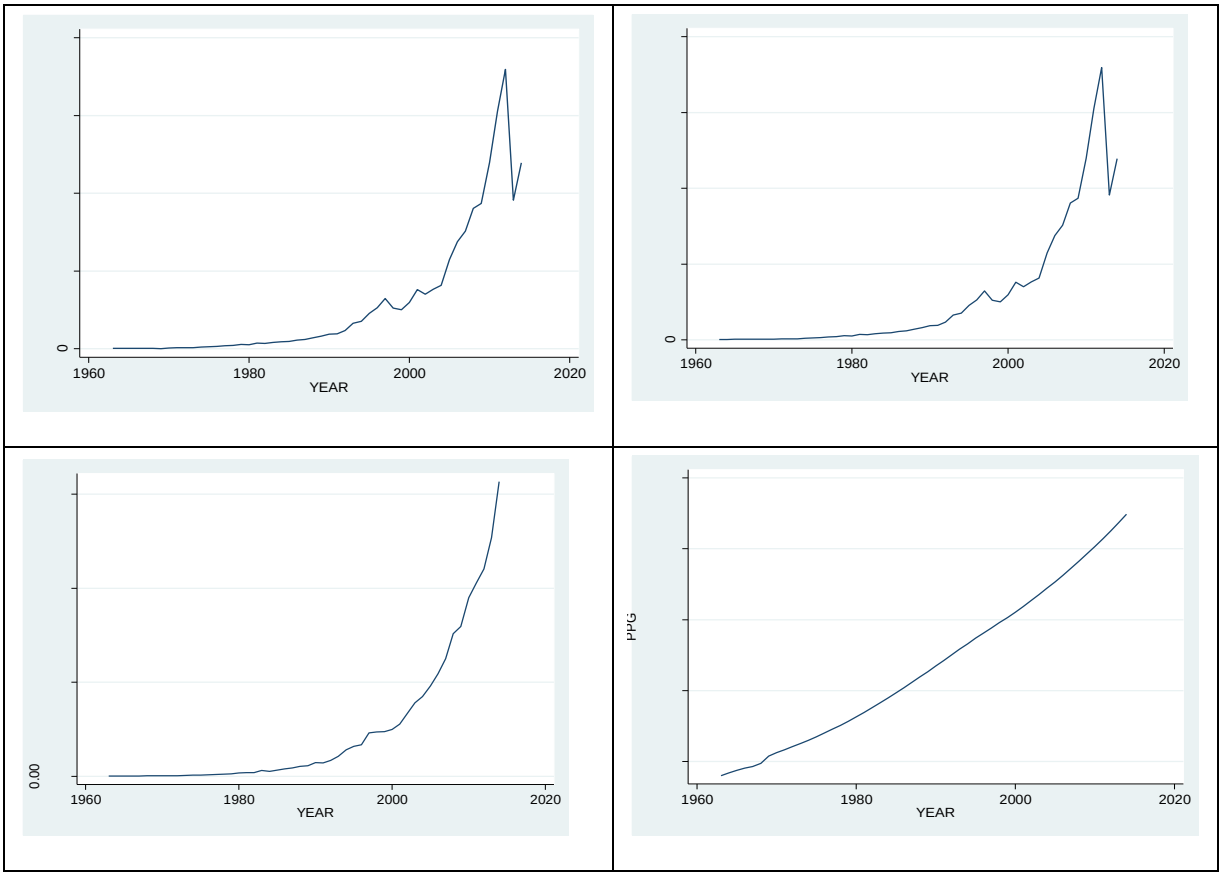
4.4 Pre- estimation tests

4.4.1 Unit root tests

Unit root test was essential in determining the order of integration of the variables prior to the empirical model estimations. This is because estimation of the empirical model without prior knowledge in the order of integration of the variables would lead to spurious regression problem. In this case, the Dickey – Fuller test was applied in testing the presence or the absence of unit root among the variables. Prior to testing for the unit roots, we plot the variables. The plot graphs indicate that all the variables are non – stationary and have a trend. This therefore implies that when testing for the unit root, we apply the test taking into account the deterministic trend. The plot graph is given in Figure 2 below.

Figure 2.0 Plot graphs for all variables





The results for stationarity / unit root tests with a deterministic trend in the variables are presented in table 4.3 below.

Table 4.3 Unit root test results

	At level				At First Difference				Order of Integration
	t- statistics	Critical values			t- statistics	Critical values			
		1%	5%	10%		1%	5%	10%	
GDP per capita	-1.733	-4.148	-3.499	-3.179	-5.449	-4.150	-3.500	-3.180	I(1)
Public expenditure	7.840	-4.148	-3.499	-3.179	-3.848	-4.150	-3.500	-3.180	I(1)
Private expenditure	4.240	-4.148	-3.499	-3.179	-4.768	-4.150	-3.500	-3.180	I(1)
Energy	3.033	-4.148	-3.499	-3.179	-5.786	-4.150	-3.500	-3.180	I(1)
Agriculture	-2.018	-4.148	-3.499	-3.179	-8.497	-4.150	-3.500	-3.180	I(1)
Health	-2.016	-4.148	-3.499	-3.179	-5.397	-4.150	-3.500	-3.180	I(1)
Education	7.696	-4.148	-3.499	-3.179	-4.361	-4.150	-3.500	-3.180	I(1)
Population growth	0.759	-4.148	-3.499	-3.179	-8.826	-4.150	-3.500	-3.180	I(1)

From the results, we find that at level t-statistics all the variables are non – stationary implying that they have unit roots. This is because, the t – statistics is higher than the critical values at all one percent, five percent and ten percent significance levels. Therefore, this called for the differencing of the variables. Upon differencing and thereafter testing for the unit root, we find that all the variables are now stationary implying that there is no unit root. This leads to the conclusion that the variables have one unit root meaning that they are integrated of order one.

4.4.2 Regression analysis and hypothesis testing

Upon testing for the unit root among the variables, we find that all the variables have the same order of integration. This means that whether we estimate the model using variables at their level point or after first difference yields unbiased estimators and no spurious regression since all the variables are integrated of the same order. Upon estimating the empirical model, the results of the estimated model are reported in table 4.3.

Table 4.4: Regression results

	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]
Public expenditure	572.75	1909.1667	0.30	0.006	43738.52 32283.23
Private expenditure	211.65	556.9737	0.38	0.069	92601.25 134931.24
Agriculture	781.74	329.8481	2.37	0.022	1174.5786 14446.25
Education	327.46	136.4417	2.40	0.021	6022.24 525.5786
Population growth	795.56	335.6793	2.37	0.018	1453.478 14458.148
DUMMY1	42359.39	17392.09	2.44	0.019	77433.89 7284.898
DUMMY2	35813.41	17594.66	2.04	0.048	71296.43 330.3838
DUMMY3	30460.94	14559.97	2.09	0.042	59823.91 1097.963
Constant	87281.5	17104.09	5.10	0.000	52787.81 121775.2

Number of obs = 56
F(8, 43) = 17.16
Prob> F = 0.0000

R-squared = 0.7615
Adj R-squared = 0.7172
Root MSE = 5328.4

The total sample size was 56 meaning that we are dealing with the z – statistics. From the empirical model specified in the methodology, we regress investment on remittances, pension fund and the foreign direct investments. From the results looking at the p –values of all the variables we find that all variables are significant in determining the economic growth and development in the economy at 10 percent significance level. This is because their respective p – values are less the 10 percent significance level. More specifically, we find that government expenditure on road infrastructure, agriculture, education, population growth and the three dummy variables are significant at 5 percent since their respective p – values are less than 5 percent. However, we conclude that private sector expenditure on road infrastructure is significant in determining economic growth at 10 percent since its p – value is 6.9 percent, which is higher than 1 percent and 5 percent but lower that 10 percent.

Turning into the interpretations, we find that a one shilling expenditure on road infrastructure by the government increases GDP per capita by Kshs. 572.753 holding other factors constant. Therefore public investment in road infrastructure shocks economic growth positively. For the private investment in the road infrastructure, we find that a one shilling expenditure on road infrastructure increases GDP per capita by Kshs. 211.65 ceteris paribus. However, on the expenditure on the other social public services we find that on education, one shilling expenditure on education increases GDP per capita by Kshs. 327.46 ceteris paribus. On agricultural expenditure, one shilling expenditure increases GDP per capita by Kshs. 781.74 ceteris paribus.

Looking at the institutional dummies, we find that all are significant in explaining economic growth. As such, we conclude economic growth agenda has been at the centrepiece of all the government regimes ever since independence. However, dummy1 seems to be more significant than other dummies given that its p –value is less. This is justified in the sense that just after independence there was a lot of commitment in growing then economy. In addition, at the regime, the economy was performing very well compared to all other regimes.

Looking at the joint test statistics, we find that the F – statistics is equal to 17.16 with a p – value of 0.000. This means that all the factors are jointly significant in explaining investment. The coefficient of determination is equal to 76.15 percent implying that 76.15 percent of total

changes in economic growth are accounted for by changes in all the explanatory variables of the model with only 23.85 percent of total changes in economic growth being determined by the factors outside the model. Upon accounting for the degrees of freedom, the adjusted coefficient of determination is 71.72 percent implying that 71.72percent of total changes in economic growth are accounted for by changes in all the explanatory variables of the model with only 28.28 percent of total changes in economic growth being determined by the factors outside the model.

4.4.3 Heteroskedasticity test

Upon running the regression, we test for the presence of the serial correlation in the residuals of the model. This is core in determining whether the estimated model best fits the data. In this study, the Breusch-Pagan test for serial correlation was used. The results of the heteroskedasticity are presented below:

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance

Variables: fitted values of GDP per capita

chi2(1) = 8.36

Prob>chi2 = 0.6038

The test was applied using all the explanatory variables. It is a chi – square test with a value of 8.36. To decide on whether to accept or reject the null hypothesis, we check on the p – value of the Chi – square. Since the p values is greater than 0.05 we accept the null hypothesis. Thus, there is no heteroskedasticity implying that there is homoscedasticity. This implies that the variance of the model residues is constant across residuals.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This study analysed the nexus between road infrastructure and economic growth in Kenya. In doing so, the study reviewed the 1963 -2015 period using annual data. The study was motivated by the acceptance that road infrastructure is vital for economic growth and poverty reduction since it plays a key role in enhancing competitiveness, facilitating trade and integrating countries to the rest of the world. Road infrastructure opens up unconnected regions to trade and investment and improves access to goods, services and employment opportunities. This leads to sustainable growth and development of the economy, which arises due to the multiplier effects of government spending on infrastructure in the economy.

The study tried to address and answer the questions on the impacts of road infrastructure network on the overall economic growth rate in Kenya and if there exists a sectoral bias in the public expenditure between road infrastructure and provision of other social services in Kenya. Up to now, there exists robust literature on roads infrastructure but not so much on the nexus between it and economic growth in general. The significance of the research problem is to scrutinize the deep underlying issues about the nexus between road infrastructure and economic growth in Kenya.

5.2 Summary of findings

From the data analysis, the study found out that a one shilling expenditure on road infrastructure by the government increases GDP per capita by Kshs. 572.753 holding other factors constant. Therefore public investment in road infrastructure shocks economic growth positively. For the private investment in the road infrastructure, we find that a one shilling expenditure on road infrastructure increases GDP per capita by Kshs. 211.65 ceteris paribus. However, on the expenditure on the other social public services we find that on education, one shilling expenditure on education increases GDP per capita by Kshs. 327.46 ceteris paribus. On agricultural expenditure, one shilling expenditure increases GDP per capita by Kshs. 781.74 ceteris paribus.

Looking at the joint test statistics, we find that the F – statistics is equal to 17.16 with a p – value of 0.000. This means that all the factors are jointly significant in explaining investment. The coefficient of determination is equal to 76.15 percent implying that 76.15percent of total changes in economic growth are accounted for by changes in all the explanatory variables of the model with only 23.85 percent of total changes in economic growth being determined by the factors outside the model. Upon accounting for the degrees of freedom, the adjusted coefficient of determination is 71.72 percent implying that 71.72 percent of total changes in economic growth are accounted for by changes in all the explanatory variables of the model with only 28.28 percent of total changes in economic growth being determined by the factors outside the model.

5.3 Conclusion

From the data analysis, it is evident that economic growth in Kenya is highly responsive to the government expenditure on the road infrastructure. This is evidenced by the fact that a one shilling expenditure on road infrastructure by the government increases GDP per capita by Kshs. 572.753 holding other factors constant. This therefore empathises on the importance of road infrastructure as pointed out in the country's economic development blue print vision 2030 on physical infrastructure. These 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. In addition, it is noteworthy that these efforts are not only geared towards construction of international trunk roads but also national, urban and the rural roads in efforts of increasing connectivity.

However, the GDP per capita is not very responsive to the private sector investment in the road infrastructure as it is for the public road expenditure. However, the effect is positive thus calling for the need for more inclusion of the private sector through Public – Private – Partnership.

5.4 Policy recommendation

From the results of the model, several crucial policy recommendations can be drawn. First is the importance to loop in the private sector financing the road infrastructure in Kenya. This could be through a more sensitization of the PPP programme that has now a legal framework following the enactment of PPP act 2012. In addition, the annuity financing aspect in road infrastructure needs to be fast truck by the government in order to realize the dream of 10,000 km now tarmac roads by the government.

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APPENDICES

YEAR	GDP per Capita (Kshs)	PUBLIC EXP (KSH, MILL)	PRIVATE EXP (Ksh Mill)	ENERGY EXP (KSH, MILL)	AGRICULTURE EXP (KSH, MILL)	HEALTH EXP (KSH, MILL)	EDUCATION EXP (KSH, MILL)	POPULATION GROWTH	D 1	D 2	D 3	D 4
1963	41,750.43	92,565	29,855	15,480	68,440	102,728	328,689	7,985,526	1	0	0	0
1964	42,433.51	133,710	43,570	16,880	70,120	112,639	368,975	8,392,453	1	0	0	0
1965	41,899.09	150,390	49,130	27,780	62,080	134,019	397,282	8,734,529	1	0	0	0
1966	46,514.94	162,615	53,205	35,880	81,400	146,347	428,950	9,062,735	1	0	0	0
1967	46,506.57	187,208	61,402	58,080	102,620	154,978	457,810	9,272,895	1	0	0	0
1968	48,556.14	199,823	65,607	67,220	118,260	168,426	489,524	9,725,280	1	0	0	0
1969	50,657.99	206,423	67,807	63,580	35,400	176,298	527,626	10,752,893	1	0	0	0
1970	46,648.15	213,870	70,290	92,480	196,360	196,360	568,080	11,252,466	1	0	0	0
1971	55,011.81	223,058	73,352	176,000	210,640	210,640	670,220	11,657,479	1	0	0	0
1972	62,140.05	235,440	77,480	144,800	244,440	244,440	673,580	12,083,165	1	0	0	0
1973	63,458.49	260,858	85,952	116,400	282,860	282,860	922,480	12,529,810	1	0	0	0
1974	63,662.46	295,170	97,390	189,000	414,600	414,600	1,376,000	12,997,447	1	0	0	0
1975	61,896.36	276,687	91,229	212,200	486,000	486,000	1,444,800	13,486,241	1	0	0	0
1976	60,926.77	261,015	86,005	270,800	591,200	591,200	1,616,400	13,995,974	1	0	0	0
1977	64,248.14	295,185	97,395	319,400	738,000	738,000	1,890,000	14,527,187	1	0	0	0
1978	66,164.22	300,675	99,225	393,400	862,400	862,400	2,182,200	15,081,598	1	0	0	0

1979	68,566.71	316,575	104,525	412,600	1,070,400	1,070,400	2,740,800	15,661,414	0	1	0	0
1980	69,701.73	321,690	105,730	698,800	1,037,200	1,037,200	3,619,400	16,267,906	0	1	0	0
1981	69,621.73	328,710	108,070	530,320	1,422,600	1,422,600	3,953,400	16,901,181	0	1	0	0
1982	68,019.99	359,100	118,200	653,800	1,393,600	1,393,600	4,128,600	17,559,778	0	1	0	0
1983	66,335.70	388,703	128,068	790,000	1,599,700	1,599,700	6,398,800	18,241,331	0	1	0	0
1984	65,001.14	396,675	130,725	696,000	1,762,600	1,762,600	5,360,320	18,942,599	0	1	0	0
1985	65,320.26	426,915	140,805	787,000	1,854,200	1,854,200	6,593,800	19,660,713	0	1	0	0
1986	67,492.34	492,150	162,550	615,000	2,205,400	2,205,400	7,930,000	20,393,724	0	1	0	0
1987	68,974.27	607,500	201,000	903,000	2,358,600	2,358,600	9,120,600	21,140,344	0	1	0	0
1988	70,715.12	624,000	206,500	1,033,000	2,770,180	2,770,180	10,661,600	21,899,004	0	1	0	0
1989	71,519.68	1,437,000	477,500	1,185,800	3,260,240	3,260,240	11,285,800	22,668,238	0	1	0	0
1990	72,045.18	1,374,000	456,500	1,450,000	3,741,600	3,741,600	14,450,000	23,446,229	0	1	0	0
1991	70,705.53	1,390,500	462,000	1,444,400	3,800,260	3,800,260	14,444,400	24,234,087	0	1	0	0
1992	67,910.57	1,471,500	489,000	1,397,000	4,645,000	4,645,000	17,095,600	25,029,754	0	1	0	0
1993	66,052.50	1,123,500	373,000	1,023,000	6,541,180	6,541,180	21,393,000	25,824,736	0	1	0	0
1994	65,795.71	1,254,000	416,500	1,188,000	7,015,600	7,015,600	28,275,600	26,608,089	0	1	0	0
1995	66,775.12	1,269,000	402,995	1,234,000	9,114,600	9,114,600	31,813,460	27,373,035	0	1	0	0
1996	67,706.41	1,937,250	625,745	1,474,000	10,567,980	10,567,980	33,483,020	28,116,027	0	1	0	0
1997	66,315.07	2,152,500	697,495	1,363,000	12,883,900	12,883,900	46,226,300	28,842,245	0	1	0	0

1998	66,823.36	2,014,500	651,495	1,527,000	10,449,880	10,449,880	47,225,080	29,564,614	0	1	0	0
1999	66,701.96	4,431,000	456,995	1,367,000	10,054,200	10,054,200	47,493,200	30,301,240	0	1	0	0
2000	65,450.48	1,968,195	636,060	765,000	11,868,210	11,868,210	49,868,210	31,065,820	0	1	0	0
2001	66,224.47	1,966,650	635,545	934,000	15,188,460	15,188,460	55,596,460	31,863,280	0	1	0	0
2002	64,898.74	1,960,230	633,405	1,736,000	13,988,620	13,988,620	66,806,090	32,691,980	0	1	0	0
2003	65,091.37	3,255,518	1,065,168	12,937,000	15,304,380	15,304,380	78,138,640	33,551,079	0	0	1	0
2004	66,652.93	7,287,375	2,409,120	14,282,000	16,308,890	16,308,890	84,726,310	34,437,460	0	0	1	0
2005	68,769.53	3,255,525	1,065,170	16,735,000	22,963,790	22,963,790	96,027,430	35,349,040	0	0	1	0
2006	71,234.89	18,266,850	6,068,945	19,726,000	27,515,680	27,515,680	109,238,900	36,286,015	0	0	1	0
2007	74,243.08	22,848,825	7,596,270	20,539,000	30,282,540	30,282,540	124,908,590	37,250,540	0	0	1	0
2008	72,481.62	27,209,625	9,049,870	22,335,000	36,121,900	36,121,900	151,676,860	38,244,442	0	0	1	0
2009	72,923.07	39,525,975	13,155,320	33,527,100	37,353,420	37,353,420	159,339,920	39,269,988	0	0	1	0
2010	76,975.77	36,478,050	12,139,345	36,356,200	47,910,580	47,910,580	189,845,780	40,328,313	0	0	1	0
2011	79,527.51	55,307,925	18,415,970	65,700,000	61,103,110	61,103,110	205,510,450	41,419,954	0	0	1	0
2012	80,954.98	74,067,671	24,669,219	78,500,000	71,851,540	71,851,540	220,337,860	42,542,978	0	0	1	0
2013	83,307.35	94,275,000	31,404,995	78,500,000	38,197,290	38,197,290	253,632,210	43,692,881	0	0	0	1
2014	85,456.30	223,500,000	74,479,995	94,000,000	47,834,510	47,834,510	313,168,100	44,863,583	0	0	0	1