TRANSPORT INFRASTRUCTURE INVESTMENT ON ECONOMIC GROWTH IN KENYA

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DECLARATION

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

…… **……**

Signature **Date**

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Declaration by Supervisor

I confirm that the work in this research proposal has been done by the candidate under my supervision.

…… **……**

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DEDICATION

I dedicate this study to my family.

ABSTRACT

The study sought to analyze transport infrastructural investment effect on economic growth and investment effect of various modes of transport on economic growth in Kenya using the Autoregressive Distributed Lag and the Vector Autoregressive models. In both models, annual data was used. Data for the parameters that were fitted on the ARDL model ranged from 1984 to 2017 while the data for the parameters on the VAR model ranged from 2001 to 2017. The findings reveal that capital investment in transport and the rate of inflation has significant effect on economic growth while labour wage employment has an insignificant effect. It is also revealed that investments in road, railways and air have significant effect on economic growth with incremental investments in road and railways having positive effects while air had a reverse effect. Investments in marine were found to be insignificant. It is concluded from the study that there is need to increase budgetary allocations to expand the available transport infrastructure. It is recommended that future studies should focus on the effect of external debts on transport infrastructure.

ACRONYMS AND ABBREVIATIONS

AfDB	African Development Bank
ARDL	Autoregressive Distributed Lag
ECM	Error Correction Model
ERSWEC	Economic Recovery Strategy for Wealth and Employment Creation
GDP	Gross Domestic Product
GNP	Gross National Product
KNBS	Kenya National Bureau of Statistics
LDCs	Least Developed Countries
MTPI	Medium Term Plan One of the Kenya Vision 2030
MTPII	Medium Term Plan Two of the Kenya Vision 2030
MTPIII	Medium Term Plan Three of the Kenya Vision 2030
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Squares
PPP	Public-Private Partnership
VAR	Vector Autoregression
VECM	Vector Error Correction Model
WB	World Bank

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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Transport infrastructure in Kenya has experienced remarkable improvement for the last five decades. This has significantly encouraged economic progress performance in the country and promoting the socio-economic welfare of the citizens (World Bank, 2017). Transport infrastructure entails the network of roads, railway lines, airports, and marine transport. These infrastructures provide both social and economic benefits especially by linking different sectors of the economy. Today, more than ever before, the role of transport infrastructure development as a driver for social and economic development has continued to be more relevant; design and development of good transport systems is now important in incentivizing activities that promote growth in a city or country and goes a long way in strengthening societies and ensuring sustainable growth and development (Skorobogatova & Kuzmina-Merlino, 2016).

Sustainable transport systems could offer solution of interlocking transport problems, address the needs of poor and remote communities, therefore, with unreliable transport systems, it would be difficult to connect local producers to international markets and when they fail to take their products to local markets, the GDP of a country would be negatively affected. Suitable transport infrastructures are necessary to enhance local, regional and international markets (Canning & Pedroni, 1999; Bakht, Khandker & Koolwal, 2009). UN Conference (2016) identified sustainable transport as an important component for economic growth as it stimulates cross-border trade and enhances integration and co-operation while at the same time, creating jobs.

The World Bank (2017) indicates that the developing nations use approximately USD 200 billion yearly for new infrastructural projects, which represents 4% of GDP. This is a fifth of the developing countries' investments. Its apparent transport infrastructure development is expensive. Huge amounts of investments are needed to establish highways, railways, roads airports and seaports and thus adequate planning is required. These infrastructures could have a long life-span

if they were regularly maintained. Nevertheless, with no maintenance, the assets deteriorate within few years and this prompt the governments to keep on rebuilding the infrastructure at higher cost than it would take to maintain them.

Ehizuelen (2016) state that lack of modern infrastructure is a critical stumbling block for Sub-Saharan development, since, various countries rely on infrastructure that were developed in colonial times which are old and depleted due to lack of renewal and maintenance for resources are scarce. This situation affects investment climate negatively and hinders both poverty reduction and economic development in Africa.

Bottini, Coelho and Kao (2013) posits that transport infrastructures affect output since they act as an enabler to industrial growth and also, various sectors of the economy benefit leading to increased GDP. Proper transport infrastructure extensively reduces cost of doing businesses and in a huge way elevates total factor productivity (TFP). Consequently, transport infrastructure acts as a catalyst to economic development of a nation (Calderon & Serven, 2008).

The transport infrastructural development level determines the accessibility of export markets (Crafts, 2009). Cockburn, Dissou, Duclos and Tiberti (2013) indicates that improvement in transport infrastructure, telecommunication and storage equipment has enabled trade globalization and market liberalization to take place over the past few decades. This progress ensues proper planning and quick response to demands of all customers which has an effect of lowering cost in inventory and working capital.

Infrastructure development is vital since it elevate economic growth of a nation in the margin of reducing poverty (Canning & Pedroni, 1999). In Kenya, transport systems have variety of uses including enhancing movement of people, goods and services and it significantly enhances connectivity of basic social services (Calderon & Serven, 2008). The benefit of appropriate transport and communication network is connection they provide for supplying goods and services especially in towns and rural areas where 80 percent of people live. The poor population mostly resides in peripheries of towns and costs and convenience of transport is vital in defining their chances of obtaining a job. Infrastructural activities which includes reintegration and building of

roads, railway lines, airports and sea ports creates job opportunities which can directly lead to poverty levels reduction (Canning & Pedroni, 2004).

There is connection between transport infrastructural investment and labor. An infrastructure investment creates numerous direct jobs. In addition, indirect jobs are created due to increased demand for essential inputs needed for investments (in cement, asphalt, steel, rolling stock industries). Moreover, employment benefits are directly linked to economic growth from income individual get inform of salaries and wages from jobs that farmers create when delivering their products, factories employing more workers when they lower their transportation cost among others (World Bank, 2017).

According to deliberations by the UN Conference (2016), sustainable transport systems are key in realizing the 2030 Agenda on Sustainable Development. Reliable transport systems are important in strengthening rural-urban linkages for the creation of opportunities, which have potential to improve the welfare of the world's poorest communities. Nonetheless, in the world's most volatile regions, transport systems can promote peace, security and trade. Notably, improvement of airport capacity is important for the rapidly increasing urban population. Proper planning on how to enable efficiency of the airspace travel by improving on the air-navigation systems so that so that more aircrafts can safely share the available airspace while at the same time accounting for the mitigation of emissions. But more importantly is having a more integrated transport system to strike a balance among the competing mode of transport in the urban cities. Since realizing this can be particularly costly, a multi-agency approach in planning and setting up institutional structures to inform policy and the much needed fund –raising streams while making use of data in decision-making is critical.

1.1.1 Economic Growth

World Bank (2013) defines economic growth as increased ability of an economy to produce goods and services. Economic growth is measured either in nominal or real values with real terms being adjusted for inflation. Economic development is not similar to economic growth as indicated by Coelho and Kao, (2013). Economic development entails other social factors such as improvement

in education and health, environmental protection, effective resources allocation and sustainable growth (Bottini *et al.*, 2013).

Economic growth is often measured through Gross Domestic Product (GDP), which is a proxy for inclusive economic development (Gramlich, 2004). GDP is commonly utilized assessment of growth of an economy and it's commonly measured at the prices in the market (which entails indirect taxes) and comprises imports and exports whereas the GNP entails the GDP net foreign investments. Economic growth is often calculated in real terms, (inflation-adjusted terms that eliminates the distorting inflation effect on price of goods.

As incomes rise, improved transport services are necessary to incentivize business investments, value and volume of export and need to finance transport infrastructure development to support economic growth and development. Advanced economies prioritize in solving problems congestion and complexities in complete transport networks, upscaling, maintaining and repairing of existing transport infrastructure and leveraging on technology to realize set targets. It has been observed that if struggling economies like Kenya can invest in transport infrastructure then transformative interventions in an economy can be realized. Most importantly, for the majority of the struggling economies, improved infrastructure is a necessary component for elevating economies activities and removing potential barriers to fair trade (OECD, 2017).

1.1.2 Infrastructure Investment and Economic Growth through Various channels

The effect of infrastructure on economic development has attracted wide attention in academic arena. Importance of infrastructure on economic growth date back to Rostow's theory of growth where he emphasized on importance of infrastructure such as roads, railway and other capital investment being essential for the takeoff stage (Rostow, 1962). According to Bottini *et al.*, (2013), concern on infrastructure can be associated with two main universal developments; cost-cutting of the public sector due to heightened pressure of fiscal adjustment and consolidation and secondly liberalization of infrastructure trades to private participation.

One channel where infrastructure impacts on growth is through productivity of various Inputs. In a production of output, capital, labour and technology play a very crucial role. Public investment on infrastructure enhances productivity by reducing cost of production and creating accessibility to raw materials. This therefore reduces cost of production per unit. In most developed countries, an effect of productivity is often minimal but in least developed nations, it is enormous. Conversely, increased productivity especially stock in public investment significantly boosts private capital by ensuring that private sector have access to education, health and other socio amenities thus spurring growth.

Another channel where transport infrastructure investment affects performance is by altering private sector investment and consequently creating employment. Better transport generally make a place more attractive for investment and therefore shaping the location decision of the firm. That is, through enhancing private capital formation. Transport infrastructure ensures private sectors have access to cheap skilled labour and it also enhances marginal productivity, thus increasing the rate of return and profit margin in private sector which leads to more investment from private sector. For instance, Albala-Bertrand and Mamatzakis (2004) carried a study in Chile which indicated that public infrastructure investment lead to substantial positive effect on investment in private sector.

Investment in transport Infrastructure can have negative growth through crowding out effect. Huge transport infrastructure projects require huge budget allocation and since resources are scarce government end up borrowing and this lead to crowding out effect of private sector. Generally, crowding-out effects linked to infrastructure investment has different effect on growth such that increases in the stock of public investment increases growth in output in the medium term but such investment attracts more tax revenues and thus governments do not need huge borrowing in future but the same may affect in the long run when it comes to payment of long-term debts.

The World Bank (2015) views transport infrastructure as a catalyst for the much needed development components. It articulates that other than being a vector change, transport

infrastructure can solve problems that accompany social instability, urbanization, climate change and its associated effects. In addition, where and when transport infrastructure is underdeveloped of lacking, countries strain in realizing (global) competitiveness.

Kenya is among economies that are straining that account for about USD 1 trillion infrastructural development gap. Because of this, there are a range of unmet basic needs, which therefore limits the country's potential to contribute in providing solutions to development challenges at the national level and beyond. It is further noted that long commutes by women in urban cities can hinder them from effective participation in the workforce as consequence of time constrains in associated with child-care. Moreover, in an increasingly globalizing world, assembling of parts is today feasible but it is not without implications beyond the products developed and on the number of job opportunities created for the youth (World Bank, 2017; World Bank, 2017).

The seamless connectivity in various modes of transport and complementarities across different infrastructure sectors enhance efficiencies in service delivery and increase production through adoption of innovative technology. Good connectivity among cities and regions via airports, rail, roads and water decrease travel time and cost. Having good transport infrastructure encourages jobs creation in transport sectors and other sectors since commuting becomes easier and people can save on time and cost hence increasing their productivity in various sectors of the economy leading to higher growth rates.

1.1.3 Infrastructure Investment in Kenya

Infrastructure is recognized as a critical enabler of Kenya's development blue print Vision 2030. Kenya targeted GDP rate of growth of about 10% per year beginning 2012. In that blueprint, transport infrastructure was considered as catalyst to the realization of the projected annual 10% GDP growth. Consequently, various medium-term plans were to be designed in a manner that consistently focuses on infrastructural development (Republic of Kenya, 2013).

Among the infrastructural projects being expanded in Kenya is the expansion, rehabilitation and construction of airports, rehabilitation and construction of roads, rehabilitation and expansion of

ports, and construction of new standard gauge railways (GoK, 2007). These were extra-large transport infrastructure projects projected to spur economic transformation of the Country. The total road network in Kenya is 161,451.3 km of which 131,333.7 km are either good condition or fair condition (Kenya Roads Board, 2018) while the standard gauge railways (SGR) network is 924 km of which 472 km of the phase I was complete in 2017 (Republic of Kenya 2018). Kenya has three main international Airport which are Jomo Kenyatta International Airport (JKIA), Moi International Airport (MIA) and Kisumu Airport and one main sea port i.e. Mombasa port which is undergoing expansion but addition Lamu Port and Dongo Kundu free port are under construction. Nonetheless, the demand for these infrastructural developments cannot be adequately met given the current economic situations and thus a huge finance-gap prevails. The government, therefore, opt to introduce various modalities of boasting the infrastructure development such as introducing taxes and levies and encouraging Public-Private Partnership (PPP). The government and development partners are the major sources of finance and they have increased allocation for the infrastructure in each fiscal year as indicated in **Table 1.**

Table 1: Sources of Transport Infrastructure Funding

Year	Sources of Finance	Approved Gross Estimate (Kshs "M)	Total Expenditure (Kshs (M)
	Dev't Partner	27,863	12,430
2011/2012	GOK	39,740	34,145
	Fuel Levy	-	-
	Dev't Partner	37,371	25,527
2012/2013	GOK	36,836	33,700
	Fuel Levy	-	-
	Dev't Partner	39,017	20,686
***2013/2014**	GOK	37,928	37,173
	Fuel Levy	27,173	25,174.47
	Dev't Partner	177,417	147,932
2014/2015	GOK	74,691	56,543
	Grants	7,800	5,030
	Local AIA	0	0
	Fuel Levy	27,174	25,174

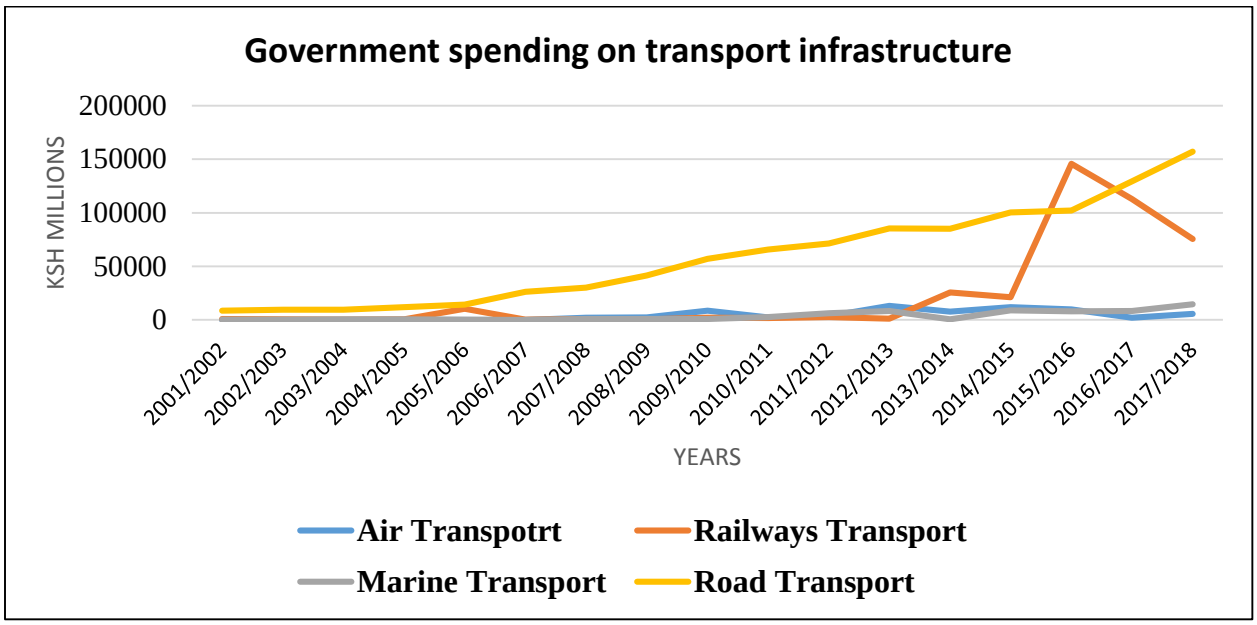
	Dev't Partner	153,177	53,734
2015/2016	GOK	61,748	61,936
	Grants	6,357	4,776
	Local AIA	2,486	2,486
	Fuel Levy	38,500	37,944
	Dev't Partner	166,569	144,996
2016/2017	GOK	109,376	168,214
	Grants	8,700	6,290
	Local AIA	13,031	
	Fuel Levy	56,609	56,469

Source: (Energy, ICT, Infrastructure Sector reports)

An appraisal of the development in transport infrastructure indicates that Kenyan government has focused on narrow financing models and there is need for diversification of the sources. The existing models includes the loans advanced by development banks such as AfDB, international loans from WB and Exim Bank, issuance of sovereign bonds and infrastructural bonds via securities exchange (Gramlich, 2004; Republic of Kenya, 2008). Further, to realize the targets towards development of physical infrastructure, government is currently in the process of introducing new financing model referred to as annuity finance mainly targeting road infrastructure. All these efforts are clear indication transport infrastructure importance in enhancing economic growth in an economy. However, demand for transport infrastructure in Kenya outstrips supply (GoK, 2007; Republic of Kenya, 2013).

To realize a huge increase in economic growth, Kenya has to continue investing in transport infrastructure. The trend indicates a positive growth across the industries. The following table (table 1.2) indicates trend in government expenditure on transport.

Figure 1: Trends in government spending on transport



Source of data: State Department of Transport and infrastructure

Figure 1 indicate that over the last few years, the government has increased funding to road and railway. The sharp peak explains major investment made towards completion of SGR. On the other hand, air transport and marine have been funded minimally.

1.1.4 Infrastructural development and Labor growth

The transport industry is huge and is an integral sector in market for labor. The transport infrastructure development boosts entire value chain thus creating both direct and indirect jobs. Literatures indicate that infrastructural developments create both short term and long term jobs in a country (Wenming, Hee-Seok & Kevin, 2016). It is possible to evaluate the short term jobs emanating from infrastructural development in two stages. The first one is that the direct job can be assessed using information available on the kind of spending on infrastructure and diverse type of direct employment. The second one is indirect employment which is as a result of multiplier effect.

1.2 Statement of the Problem

Deficit in supply of transport infrastructure service has over the time been viewed as the reason the Sub-Saharan Africa region ranks at the bottom in terms of performance and scholars points to deficit in transport infrastructure (Calderon, 2008). The gap in provision of quality transport infrastructure can undermine a country's competitiveness, equality and long-term economic growth (OECD, 2017). In order for Africa to achieve Agenda 2063, countries are required to build integrated high speed train network and marine transport so as to connect African region to commercial centers so as to enhance trade, reduce transport cost and relieve congestion (Agenda 2063, 2015). Over the years, governments in the region use huge proportions of their budgetary allocation on transport infrastructures. Investment in infrastructure can increase access to education, job and services for low income countries. Since 2007, Kenya has been increasing budget allocation in development of transport infrastructure so as to achieve 10% growth as indicated in Kenya Vision 2030. But due to inadequate funds required in construction of huge transport projects, the debate about the importance of private partners in infrastructure projects has been central to the infrastructure policy agenda especially since countries started adapting public-private partnerships (PPPs). Presently, as numerous developing and emerging nations struggle to manage their finances, swelling debts, and concessional funds borrowed from multilateral and bilateral agencies is inadequate, thinking of how to attract private investment to infrastructure projects become imperative (Bakht *et al.,* 2009). Scholars have observed that transport infrastructure investment is an important agenda of government and therefore it is important to understand whether it substantially contribute to economic growth.

Many empirical studies recognize the need to analyze the gap in financing of transport infrastructure. There are other researches that have concentrated on elaborating infrastructure investment implication on economic growth (Fedderke, Perkins & Luiz, 2006; Crafts, 2009; Sanchez-Robles, 1998). Only limited studies have looked at transport infrastructure in general, since majority have focused single mode of transport i.e. roads and they have ignored immense contribution of other transport avenues such as rail, air and marine in economic growth. In addition, the studies do not consider connection between capital investment especially on transport infrastructure and job creation as part of the aspect of increasing national output as well as long-

run and short run influence on growth. This research will analyze effect of the entire transport infrastructure investment on economic growth in Kenya since although each part of modes of transport network contribute to economic the benefit of transport infrastructure system as a whole is greater than the sum of their modes.

1.3 Research Questions

The study seeks to respond to the following set questions:

a. What is the influence of transport infrastructure investment on economic growth in Kenya?

b. How does the various modes of transport investments impact on economic growth in Kenya?

c. What is the link between employment in transport infrastructure and economic growth?

1.4 Research Objectives

The sole aim of this study was to analyze transport infrastructural investments effects on economic growth in Kenya. The specific objectives are to:

a. Determine the influence of transport infrastructure investment on economic growth in Kenya;

b. Determine the how the various modes of transport investments impact on economic growth in Kenya;

c. To investigate how employment in transport infrastructure relates with economic growth

1.5 Significance of the Study

This study will be significant to policy-making arms within government, donors and development partners. It will provide policy injections on the contribution of infrastructural investment on economic growth of a country. Through this study, agencies concerned will see the need of rationalizing budgetary allocation on the transport infrastructure sector and pay special attention to infrastructure investment. The study will be imperative in identifying organizations practices, policies and strategies that can be put in place to boost transport infrastructure development.

Development partners will benefit enormously from this study. The study's finding will highlight implication of transport infrastructure in enhancing economic growth of a country. Therefore, development partners will be in a position to assess their contribution to country's economic growth achievement.

Researchers will benefit greatly from the study findings. It will provide literature for their future studies. They might identify gaps which they might intend to fill in future for purposes of adding more knowledge to the topic.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter on literature review outlines various sections. The theoretical review under which the Solow-Swam model, endogenous growth theory and production theory are presented, form part of the first section. Empirical literature review under which subsections on transport infrastructure vis-à-vis production, long-run economic growth, investment and economic growth, investment and labour are presented. The last section outlines the summary of literature review.

2.2 Theoretical Review

The study is anchored on three (3) theoretical insights namely; the Solow-Swam model, the endogenous growth and production function theory.

2.2.1 The Solow – Swan Model

The model seeks to clarify long-run growth through change in capital stock, labour and technological progress and it's derived from the production function. Model states that equilibrium can be achieved by varying amounts of labour and capital which make capital and output growth less than labour force. Further, the model emphasizes on significance of technological advancement in influencing growth. Depreciation of capital is taken into consideration with implication being that when investments are greater than effective depreciation of capital, then capital to labour ratio increases and vice versa.

The progression, nevertheless, does not last because for any growth rate of labour, an increasing proportion of investment is required to maintain high capital-labour ratio. The flow of investment determines available capital stock which measures the supply or demand for services (Solow, 1956). In addition, population increase has negative impact on growth since available capital is spread thinly to more people.

2.2.2 Endogenous Growth Theory

It was advanced in 1980s and was intended to address weaknesses of neo-classical model. The latter, technology is exogenously determined while endogenous theory explains growth through internal processes. Among its proponents are Romer (1986) and Schumpeter (2006). The theory gave prominence to enhancement of a country's human capital and technological advancement for efficient and effective production process. Unlike in neo classical theory where physical capital is prominent, this theory considered human capital to be key to improved rates of return (Mankiw *et al.*, 1992). Therefore, improvement in productivity is attributed to investment in human capital and faster innovations. Other tenets of the model include increasing returns to scale for capital investment and need for research and development in support of technological progress, the state activity is crucial especially in provision of the long-term economic growth via making investments in infrastructures (Calderon & Serven, 2008).

2.2.3 Theories of production function

Scholars posit that nations can improve their capacities and outputs in three major channels; investing in human capital, physical capital, and creation of new knowledge. Economic output emanates from the use of inputs such as capital and labour and enhanced efficient use of those inputs. Therefore, Economic growths rely on addition inputs and the TFP (Calderon & Serven, 2008.

Transport investments' role can be direct through development of transport infrastructure, procurement of vehicles, enhanced logistics systems, and enhanced physical capital. It could be indirect through improving supply efficiency in delivery of goods and raw materials. Nevertheless, due to diminishing returns on capital accrual, effects of increased investment on the capital stock growth as well as increase in output growth sometimes weather over time. Consequently, in this structure, advanced investment gives rise to increased output per person instead if permanent rise in economic growth. In these theories, growths in incomes per person rely on growth in factor productivity, which was considered to be inexplicable constant that indicate a change in technology.

Not long ago, more attention was given to identification of situations where diminishing returns of the capital accumulation is not applicable such that rate of growth can be affected by long-term investments (Ghosh *et al,* 1998). In this situation there are two models of endogenous growth theory that have been established. The first one broadens capital definition, such as human capital or infrastructure and physical capital. Due to this wide classification, diminishing returns is more likely to be less severe, such that boosting investment growth would take time for an economy to experience any growth and also taking time to getting back on planned growth path. An elevated level, economic growth is influenced by incentives on businesses to invest and innovate. This is often captured through expected returns denotation. This means that the profit flows as part of expected is accrued by person making decision and major determinants are innovations and accumulation of capital for investment (Calderon & Serven, 2008).

In transport sector, a major question asked is on the transport advancements since transport provision significantly promoted higher total factor productivity and growth through incentivization and innovative activities (Bakht *et al.,* 2009). The impetuses of long-term economic growth include growth in productivity and investment. Transport systems that have great impacts are those that follow effective channels and they therefore impact the decisions made by households and entities. Among the already known impact of improved transport infrastructure is possibility of reducing cost of travelling to trade and integrating markets. Whenever there is imperfect competition especially in transport sector, it is difficult to measure the cost and benefits of the transport.

An economy cannot operate without transport system. More specifically, a change in transport supply significantly affects economic activities which lead to high level of demand for the same (Straub & Terada-Hagiwara, 2011). Transport demand is usually derived demand since it arises from the needs for economic and social activities. Purchasing and selling goods and services requires transportation from the source to the market or industry this is a clear indication of derived demand.

2.3 Empirical Literature Review

Various studies find a strong effect on link between infrastructure, growth, or productivity where as others indicate a negative link.

2.3.1 Transport infrastructure and production

Canning and Pedroni (1999) did a study on infrastructure contribution to aggregate output used panel data from sixty-seven countries between 1960 and 1990. It used Granger causality test on labour, education and 3 categories of infrastructure, that is, paved road in km, electricity generating capacity in Kilowatts, and telephones on GDP. The study finds evidence of causality amid each of those variables and GDP in most of the countries.

Fedderke *et al.,* (2006) analyzed productivity effect of public infrastructure by taking panel data from 1970-2000 in South Africa and 19 infrastructure measures. The study uses ARDL and vector error-correction model. It finds significant effect of infrastructure on labor productivity and indirect effect on total factor productivity. In addition, it affirmed that effects on manufacturing labor productivity is attached to railway and ports infrastructure while roads infrastructure has opposite effect, and telecommunications have little impact. However, this study measures elasticity of various infrastructure investments on labor productivity and total factor productivity, instead of economic growth.

Inmaculada and Osvaldo (2011) did a study with an objective of identifying effect which infrastructure have on total factor productivity (TFP) and its components in Mexican State. They employed Data Envelopment analysis using panel data for the period 1970-2003 on variable such as Km of roads, Airports and sea ports, Electricity supply and Telecommunication and found that infrastructure positively affect private productive factors and the component of technical change. In addition, there is positive influence exercised by transport and telecommunication investment by public sector on growth.

Kumo (2012) investigated causal relation among economic growth, investment in infrastructure and employment in South Africa for 1960 and 2009 by using bivariate vector Auto regression model without and with structural break. The study found definite causal relationship between investment in infrastructure and long term growth of GDP. Similarly, public sector employment and investment in infrastructure were found to have causal relationship. The study further uses bounds test or ARDL to determine long- term equilibrium connection between economic growth, infrastructure investment and control variables. The study indicates there is a strong indication of long-term co-integrating relationship between economic growth, economic infrastructure investment, exports and imports formal employment of goods and services.

Chingoiro and Mbulawa (2016), In a bid to establish causality between infrastructural expenditure and economic growth in Kenya using labour as control variable to analysis whether innovations in variable could affect prospective behavior of another, using time series data from 1980 to 2013 using Granger Causality model. The study findings indicated presence of bi-directional causality between infrastructure investments and economic growth while economic growth shocks elaborate eight year's period change in infrastructure. There were also findings that infrastructure investment explained previous years' innovations and recommend government to increase funding in transport development in short term.

2.3.2 Transport infrastructure and long-run economic growth

Cigu *et al.*, (2018) who have examined the link between transport infrastructure development, public performance alongside the European Union's long-run economic growth between 200-2014, employed panel data approach. In their analysis, they detail the various components of transport infrastructure and policy-implications based on a production model. They execute the factor analysis for the purposes of weighing the policy implication. Their results reveal that transport infrastructure components have significant effects on economic growth, ceteris paribus. Specifically, a unidirectional long-run causality between transport infrastructure, growth and Public Sector Performance (PSP) is established. Whereas transport infrastructure status was found to have significant impact on economic growth, it was underpinned by graft, lack of enabling regulatory environment, infant mortality, unemployment, inflation and income disparities among

those that are employed. These pull factors posed negative effects on growth but a positive relationship was established with education achievement, improved life expectancy and improved judiciary services with together resulted to a significant and positive effect overall economic growth.

Rudra, Tapan and Bagchi (2013), examine impact of transport (road and rail) infrastructure in India using time series data 1970 to 2010 and vector error correction model. Study establishes direct causality between road transportation to gross domestic capital formation, economic growth and indirect causality from rail transport toward capital formation and economic growth. The study concludes that both, rail transport infrastructure and capital formation lead to economic growth.

Sanchez-Robles (1998), researched on long-run effects of infrastructure expenditure on growth using panel data for countries between the periods 1950-1997. They use unit root test, causality tests, co-integration test, and error correction model to determine long-run and short-run relation between public infrastructure (electricity generating capacity per capita, paved roads per capita, telephones per capita) and growth (GDP per capita). Study finds that infrastructure induces long-term growth effects in majority of countries but there is a great variation across individual countries. The study indicates that long-run impacts of electricity generating capacity, telephones and paved roads on growth are almost negligible on average across countries but, there are significant long-term effects of growth found in individual countries.

Calderon and Serven (2010), considered the effect of transport development on growth and equity in Sub-Saharan Africa for 100 countries for the period 1960-2005 to experiment long run relationship between investment in infrastructure (roads, air travels, electricity, telephones) and long-run economic growth by using bounds analysis of Sanchez-Robles (1998) F-test, Co-integration test and Vector Error-Correction Mechanism. Study indicates investment in infrastructure appears to lead economic growth. It states that infrastructure seems to have both direct and indirect impact on output. The study concludes that potential growth and equity are contributed by infrastructure development across Africa.

2.3.3 Transport infrastructure investment and economic growth

Crafts (2009) researched on implication of transport infrastructure investment on growth and productivity by using annual data from 43 countries and regression model to determine the link between the components of central government expenditure such as spending for transport and communication, defense, education and health on economic growth. The paper found public capital had positive effect on output and private investment. Study indicate that transport infrastructure contribute to productivity and lead to cost-benefit analysis. It recommended that investment in transport should be implemented along with efficient national pricing scheme.

Canning and Pedroni (2004) explore public investment macroeconomic effects on infrastructure in India for period 1978-1979 and 2002-2003 by using the structural, macro-econometric model. The study has taken significant macroeconomic variables relating to four broad sectors (real, fiscal, monetary, and external sectors) of Indian economy. The real sector is further fragmented into four sub-sectors: agriculture, manufacturing, infrastructure and services. Study reports that significant crowding-in effect found between private and public-sector investment in all the four sub-sectors in the real economy in India. The study also indicates that public sector investment in infrastructure potentially provide accelerated growth process in Indian economy.

Bottini *et al.,* (2013) explore the relation between economic growth and infrastructure investment on 75 countries through structural growth model. The study used variables such as population growth rate, per capita growth rate of telephones, private ownership in telecoms sector, growth rate of per capita power production, secondary education average years, trade terms changes, exchange rate black market premium, population density, and urbanizations share of industry on GDP. The paper proposed that institutional credibility, capabilities and effectiveness of government policy affects development process through infrastructure growth. The studies indicate that increase in infrastructure investment leads to greater country performance. Snieska and Simkunaite (2009) assess the impact of infrastructure development (telecommunication sector, the power sector, and transportation sector) on economic growth GDP per capita and income distribution data of 121 countries by using the GMM model. Study finds that size of infrastructure stocks has a direct effect on long-term economic growth while an infrastructure standard has

negative impact on income equality. They concluded that infrastructure affect growth and inequality.

Gramlich (2004) explored the effect of investment on road infrastructure and poverty reduction in Uganda by using panel data from 1990 to 2005 using Gini index to assess whether development of various categories of road network lead to secondary communal benefits. The finding indicated rural roads in rural areas have greater impact in lowering poverty levels in Uganda. However, additional million shillings channeled to construction of "feeder roads" in that country leads to at least thirty-three people escaping from poverty. In addition, wherever an additional million shillings is channeled towards construction of murram and tarmacked roads nine people are lifted from extreme poverty.

Olufunmilayo (2016) considered China investment activity in light of existing and prevalent infrastructure deficit in Africa. The study viewed infrastructure in pre-colonial period and reconstruction of those infrastructures so as to reduce deficit by considering Chinese infrastructure deals in Africa. The study found that future populace increase, ensuring new infrastructure projects are truly transformative will lead to actualization of economic growth prediction. In addition, transformation will guarantee that such projects are source for knowledge transfer, development of capacity and asserting idea for future projects that can be constructed and maintained locally.

In their much detailed research on the performance of the transport infrastructure, Skorobogatova and Kuzmina-Merlino (2016) have observed that recent empirical investigations have placed emphasis on the development of the transport infrastructure. They argue that transport, as system, is an important estimate of economic growth and development. Cognizant of the intricate nature of drawing transport-related policies, they have dwelt on an assessment of the viability of the present policy mechanisms used in the estimation of transport-industry activities. Further, they have weighed on the interconnectedness of warehousing, handling, packaging and information technology infrastructure vis-à-vis transport infrastructure. They then provide a dep analysis of how these infrastructure fair on the Global Competitiveness Index (GCI) and on the Logistics Performance Index (LPI). They have concluded that GCI and the LPI models are advantageous (in transport) since they are flexible, account for globalization and time variations. They have

recommended that investment and development transport infrastructure are critical for reliable transport systems that can drive growth.

2.3.4 Transport infrastructure investment and Labour

Schwartz *et al.* (2009) assessed the effect of stimulus package especially those that boost investment on employment in the Latin America and Caribbean (LAC). The authors used World Bank Data to come up with the share of investment spending on labor. They joined spending share on labor with the average wage data and computed the share of direct jobs created in billions. It was found out that the infrastructure spending significantly boost direct jobs created in the transport industry. Equally, a study aimed at finding out how infrastructure spending boost employment in china by Wenming, Hee-Seok, Kevin (2016). The findings from an econometrics analysis indicated that in china, labor output elasticity was 0.45, thus which was greater than the elasticity of capital stock. It was concluded that greater labor elasticity on output reflects increased share of wages in the gross domestic product of a country.

Naliniprara, Maram and Lagesh (2016) investigated whether growth is dynamically led by investment in infrastructure growth or vice versa .The study employed Granger Causality test and Autoregression Distribution Lag (ARDL) model and Error Correction model to examine relationship in long-run and short run changes in economic growth and investment using time series data from 1971-2012 and by considering variables such as domestic capital formation, government revenue, public and private employment, inflation and export on Indian economy. The study found that infrastructure foster economic growth by aggregate productivity of capital and labour thereby reducing cost of production and raises production, profitability, employment and income levels.

2.4 Summary of Literature Review

From the literature, economic growth is affected by infrastructure investment by growing the productive capacity of a locality, region, state, or the nation as a whole. However, how financing gap of infrastructure is met affects its economic impact. Both theory and empirical literature provided in the preceding sections of the study agree that resource endowment, labour productivity

and mart accessibility are important in determining a country's trade which in turn drives productivity and competitiveness of an economy. Underdevelopment of infrastructure may limit a country from integrating well with the rest and may exacerbate poverty levels. This implies that a country is unable to effectively link production to markets as the trade facilitation factors (infrastructure) are underdeveloped.

Some studies reviewed indicate positive and robust impact on economic growth from increased infrastructure investment (Odongo & Ojah, 2016). On the other hand, other studies indicate insignificant effects (Craft, 2009). It is also apparent that most of the studies reviewed above concentrated on the assessment of the output results from public capital in general. The uniqueness of this paper is that it will study the effect of transport sector to economic growth in Kenya by incorporating public capital investment.

Literature reviewed has identified the following variables as important in transport investment and growth; spending on transport infrastructure, inflation, technological development and labour force participation.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

Under this chapter on the research methodology, the theoretical and empirical model are linked. The chapter explains definitions and measurement of variables used, data type and source as well as the analysis method used.

3.2 Model Specification

This study adopts Cobb-Douglas production function and reveals that domestic production depends on capital stock and labor force. Bakht *et al.,* (2009); Fedderke *et al.,* (2006) as well as Snieska and Simkunaite (2009) report that transport infrastructure significantly boosts economic activity, which affects domestic production and economic growth, as well. The production function is modeled as follows:

$Y = AK^{\alpha} L^{\beta}$ …… (1)

Where Y indicates real income, K is capital investment on transport, and L signifies labor force. A refers signifies technology whereas e is the error term. α and β are the production elasticities with respect to capital and labor force respectively.

Even though this study looks at transport infrastructure effects on economic growth, an instrumental aspect of transport ventures is capital. After confining Cobb-Douglas technology to $\alpha + \beta = 1$, the study obtains a constant return to scale.

This study model empirical equation as follows:

$Y_t = \beta 0 + \beta 1\ CIT_t + \beta 2\ LWE_t + \beta 3\ INF_t + \varepsilon$ …… (2)

Where:

Y = Gross Domestic Product (GDP)

CITt = is the Capital investment in transport

LWEt = is the labour or wage employment

INF = is the rate of inflation

β_0 = Constant

$\beta_1, \beta_2, \beta_3 \; and \; \beta_4$ Coefficients

3.3 Variables and definitions

Table 2: Definition of the Variable and the Expected Signs

Name	Unit of Measure	Description	Expected Sign and Literature Source
Capital Investment on Transport (CIT)	Kenya shillings	Capital Investment in transport, it is the investment on construction of roads, Rail, Airport and drenching of seaport	+ve (direct relationship between Capital Investment on transport and GDP)
Labour or wage employment (LWE)	Number	LWE is the number of people who are formally and casually employed in a certain area	+ve (Capital Investment on transport lead proportional increase in number of persons employed)
Real GDP growth at market value (GDP)	Annual Growth	GDP is monetary measure of consumable commodities in a country for a given time period.	+ve. (Capital Investment on transport lead to proportional increase in real gross domestic product (Ojiambo, 2013)
Inflation (INF)	Annual percentage	Increase in price products	-ve. This means that inflation rate increase reduces the gross domestic investment level (Kimura *et al.*, 2007).

3.4 Data Type, Source and collection

The employed time series data set between years 1984-2016. This time period will be suitable due to availability and accessibility of data. Data for all the variables will be sourced from World Bank Database, KNBs, MTEF sector Reports, State Department of Infrastructure and the State Department of Transport. Data on GDP and inflation will be obtained from the World Bank. The state department of infrastructure will be instrumental in introducing availing data on the number of persons employed in the infrastructure development and the amount invested in transport infrastructure.

3.5 Pre-diagnostics test

This study used time series data. Therefore, before estimation of data pre-diagnostic tests to establish data stationarity was carried out.

3.5.1 Testing for Stationary

Stationary check is an essential pre-estimation analysis made to make sure that the dataset has both constant mean and variance so as to obtain expressive findings. The test was conducted to do away with the non-stationarity problem that could give spurious findings and Augmented Dickey Fuller Test was used.

3.5.2 Co-integration Test

Co-integration analysis was carried out for non-stationary of the series data to ensure that long-run relationships are established. Explicitly, Johansen test was used to find out if there is a long-run effects between the variables (Johansen, 2000). Cointegration test allow a blend of long-run and short-run information. In addition, it is helpful in preventing obtaining unpredictable and spurious results (Elder & Kennedy, 2001).

3.5.3 Auto Regressive Distributed Lag Model (ADRL) and Error Correction Model (ECM)

ADRL and ECM method are used to examine long-run and short-run effect between infrastructure investment and economic growth. If they are co-integrated, it can be said that there exists stable long-run link between variables. ECM is used to discover short-term dynamics of the relationship. Based on equation 2, the ECM will be specified as follows;

$$\Delta Y_t = \beta_0 + \beta_1 \Delta CIT_{t-1} + \beta_2 \Delta LWE_{t-1} + \beta_3 \Delta INF_{t-1} + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3)$$

Auto-Regressive Distributed Lag (Pesaran and Pesaran, 1997; Pesaran et al., 2000) approach is preferred to conventional co-integration techniques. This is due to its versatility such as the method can be used regardless of whether the underlying regressors are pure I(0) or I(1) or mutually co-integrated. Also, it is very robust and more applicable when sample size is small. Considering the above-cited advantages, ARDL model was used in this paper.

3.5.4 Testing Normality

Histogram or the graphical method and Jarque-Bera a method of testing normality was used as residuals of regression models are usually normally distributed. This ensures all the used variables in the study are normally distributed. Under a null assumption of the normal distribution, the data will be normally distributed if probability is greater than 0.05 and will consider using natural logs of variables found not to be normally distributed.

3.6 Post- Estimation Diagnostics

3.6.1 Test for Autocorrelation

The data will be tested for autocorrelation using Durbin- Watson Statistic. The value ranges from zero to four. Autocorrelation will be corrected by adding lags.

3.6.2 Test of Multicollinearity

It occurs when there is correlated error term overtime. Perfect multicollinearity exists whenever two regressors (or a linear combination of regressors) exhibit perfect correlation in sample data

set. Variance inflation factors (VIF) test will be employed to confirm if correlation between variables is high enough to yield misleading results. The VIF values of more than 10 and 1/VIF values which are less than 0.10 implies existence of multicollinearity. If found, one of the correlating variables in the correlating pairs is either dropped or under go first differencing as a remedy in correlation matrix as well as VIF analysis.

3.7 Limitation of the Study

The capacity of local contractors is limited this limit their involvement in high profile infrastructure projects which end up be done by foreigners. In addition, transport infrastructure project suffers from misappropriation of fund and inflated cost of construction. The expensive loans which Kenya has borrowed from china may lead to crown out effect of private sector investment which may affect the economic growth negatively.

CHAPTER FOUR

EMPIRICAL RESULTS AND DISCUSSION

4.1 Introduction

Chapter four provides summary statistics for the overall transport investment variates and for the modes of transport. The unit root test(s), correlation results using Durbin-Watson test(s), the Praise-Winstein AR(1), variance inflation and lag-selection technique are executed and results provided. The Autogressive Distributed Lag results for the overall transport investment variates and the Vector Autoregression results for the modes of transport variates are provided and discussions with literature referred.

4.2 Summary Statistics

Table 3: Summary Statistics

	N	St.Dev	Mean	se(Mean)	Median	range	min	max	variance	cv	skewness	kurtosis
Gross Domestic Product	34	2.75e+11	3.93e+11	4.71e+10	3.02e+11	8.67e+11	1.01e+11	9.68e+11	7.55e+22	.7	.69	2.1
Capital Investment Transport	34	6.04e+10	3.29e+10	1.04e+10	5.28e+09	2.68e+11	1.02e+09	2.69e+11	3.65e+21	1.83	2.65	9.76
Rate of Inflation	34	7.81	10.5	1.34	8.68	41.06	.93	41.99	60.94	.74	2.24	9.23
Labour Wage Employment	34	17271	46948.38	2961.95	41000	79100	34000	113100	2.98e+08	.37	2.96	11.1

Summary statistics are important. Essentially, they provide insights into the distribution and variance of the data under analysis. For the four (4) variables under analysis in this study, namely; the Gross Domestic Product (gdp), the Capital Investment Transport (cit), Rate of Inflation (inf) and the Labour Wage Employment (lwe), the following summary statistics are provided, the number of observations (N), the observations' standard deviation, the standard error, measures of central tendency including the mean and median but not the mode. The range; minimum and maximum observations, variance, coefficient of variation (cv), which are the standardized estimate of dispersion of a probability distribution. Finally, the skewness which indicates the peakeness of the distribution of a given data variable about its mean and kurtosis, which indicates "tailedness" or "flatness" of the probability distribution away from the mean zero. It is important to note that these two latter statistics, define the boundary within which the distribution of data about the mean zero is assumed to be normal. Nonetheless, skewness can take a positive or negative sign or even remain undefined.

In this study, the number of observations (N) for all variables of interest is 34. For gdp, the minimum observation was Kshs. 101,000Million (M) while the maximum observation was Kshs. 968,000M. Both the skewness and the kurtosis for the gdp were positive and within the statistically acceptable limits while for the remaining variables (cit, Inf and lwe), their asymmetry and kurtosis were exceedingly skewed above the conventional statistical limits of absolute 2. Details into other statistical inferences are as shown on **Table 3.**

The summary statistics by modes of transport are as detailed in **Table 4.** It is revealed that while the skewness was well within the conventional limits, the kurtosis was greater than 2 for all variates. It is important that the statistics accounted for 17 observations from 2001 to 2017. It is also revealed that road attracts the highest level of infrastructural transport investment with a minimum of Kshs. 8,734 M across the period of observation while air is the least utilized mode of transportation.

Table 4: Summary statistics (by modes of Transport)

	St.Dev	Mean	se(Mean)	Median	min	max	variance	Skew.	Kurtosis
GDP	2230000	3410000	541748.8	2863688	1020222	7926308	4.99e+12	.68	2.26
Air	4515.94	4113.82	1095.28	2285	28	13134	2.04e+07	.79	2.21
rail	44228.14	23714.41	10726.9	1715	294	145600	1.96e+09	1.88	5.1
Marine	4503.31	3689.12	1092.21	914	77	14740	2.03e+07	1.05	2.94
Road	45801.33	59143.71	11108.45	56927	8734	157073	2.10e+09	.56	2.31

4.3 Pre-Estimation Tests

4.3.1 Unit root test

A time-series set y_t is said to be stationary if the series exhibits independent autocorrelation, variance and expectation with time. In time series analysis, it is important that the series is stationary and while the series may not be stationary, through differencing i.e. $[y_t - y_{t-1}]$, this objective of stationary series is achievable.

In this study, the test will be executed and implemented using the ADF test. The ADF test allows for the testing and determination of a series is stationary in its identity or is the series attains stationarity upon differencing. In executing and implementing the test, a null hypothesis that a series is stationary was tested against an alternative hypothesis that the series is non-stationary. While a range of tests can be employed in this case, the study restricts itself to the ADF approach, as aforementioned.

The ADF procedure entails a sequential triple-model test(s), whereby the series are tested on the intercept only, trend and intercept as well as the constant trend and intercept model as shown on **Table 4** to determine under a combination of how many lags and order of integrations that the series is stationary. The results reveal that the series for the variables of interest were stationary at zero (0) number of lags and at the first order of integration I(1).

Table 5: Unit root test (overall) results

			Model		
Variable Name	Number of lags	Order of Integration	Intercept only	Trend and intercept	Constant trend and Intercept
Gross Domestic Product	0	1	-5.292	-5.208	-5.297
Capital Investment Transport	0	1	-8.338	-10.203	-7.845
Rate of Inflation	0	1	-9.244	-9.096	-9.396
Labour Wage Employment	0	1	-3.536	-4.032	-3.306

Subsequently, a unit root test, using the ADF approach was executed for the sector variates. Unlike the overall ADF results, the sector variates were stationary at zero (0) number of lags but different orders of integration as presented in **Table 6.**

Table 6: Unit root test (by modes of transport) results

			Model		
Variable Name	Number of lags	Order of Integration	Intercept only	Trend and intercept	Constant trend and Intercept
Gross Domestic Product	0	3	-5.684	-5.505	-5.903
Air	0	1	-5.738	-5.622	-5.980
Rail	0	2	-6.597	-6.516	-6.835
Marine	0	1	-5.838	-6.126	-5.403
Road	0	2	-7.962	-7.992	-7.540

4.3.2 Correlation of Variables (overall matrix)

Correlation depends on two variates and is a statistical approach of determining two important attribute of the variates under analysis, namely; strength of the relationship between variates/variables and also the sign or direction (-ve or +ve). The strength of the relationship ranges from –ve 1 and +ve with correlation coeffients about zero (0) implying a weak relationship. This study employs the Pearson correlation approach. As shown on **Table 7,** all variables were positively correlated but the rate of inflation (inf) and the gross domestic product (gdp) with the

coefficient of determination, r^2 is -0.055. Further, all variates were weakly correlated but labour wage employment (lwe) and capital investment transport (cit) with 0.704 as the coefficient of determination.

Table 7: Overall Matrix of correlations

Variable Name	Gross Domestic Product	Capital Investment Transport	Rate of Inflation	Labour Wage Employment
Gross Domestic Product	1.000 33			
Capital Investment Transport	0.123* 0.495 33	1.000 33		
Rate of Inflation	-0.055 0.762 33	0.018 0.920 33	1.000 33	
Labour Wage Employment	0.131 0.468 33	0.704* 0.000 33	0.054 0.764 33	1.000 33

* shows significance at the 0.5 level.

The sector matrix of correlation revealed generally weak correlations that took different signs between variates but the correlation of road and rail whose coefficient of determination was -0.823 and significant at 0.5 as shown on **Table 8.**

Table 8: Matrix of correlations (by sector)

Variable Name	Gross Domestic Product	Air	Rail	Marine	Road
Gross Domestic Product	1.000 14				
Air	-0.021 0.943 14	1.000 14			
Rail	-0.115 0.695 14	0.195* 0.486 14	1.000 14		
Marine	0.085 0.773 14	0.480* 0.060 14	-0.212* 0.449 14	1.000 14	
Road	0.129 0.669 14	0.133 0.636 14	-0.823* 0.000 14	0.411* 0.128 14	1.000 14

* shows significance at the 0.5 level.

4.3.3 Durbin-Watson Test (overall results)

As noted in the previous chapter, the Durbin Watson, whose values range from zero (0) to four (4) was executed. The null hypothesis for the Durbin Watson is that the error terms are not correlated (over time) against the alternative that the error terms are correlated (over time). Upon execution, the Durbin-Watson statistic was established to be 1.9, implying a positive autocorrelation.

The Durbin-Watson index for the sector variates was 2.7508, implying negative autocorrelation. Because of this detection, the Prais-Winsten correction procedure was execute, which is lag-dependent.

4.3.4 Prais-Winsten AR(1) Overall regression

Essentially, the Prais-Winsten estimator first order of auto-regression [AR(1)] serves to remedy the problem of serial correlation detected in the previous subsection **4.3.3.** But the values of the p value and R^2 can be a pointer to the suitability of the model. This procedure, whose results are as shown on **Table 9,** uses the Ordinary Least Square (OLS) estimates, which depend on the values of their antecedent periods alongside an error term. It is noted that none of the coefficients was significant.

Table 9: Prais-Winsten AR(1) regression

Gross Domestic Product	Coef.	St.Err.	t-value	p-value	[95% Conf. Interval]	
Capital Investment Transport	0.30	1.29	0.23	0.820	-2.340	2.950
Rate of Inflation	-1090000000	3070000000	-0.36	0.720	-7370000000	5180000000
Labour Wage Employment	2030000	5920000	0.34	0.730	-10100000	14100000
Constant	14000000000	32300000000	0.43	0.670	-52000000000	80100000000
Mean dependent var		20878788887.27	SD dependent var		164856517088.92	
R-squared		0.02	Number of obs		33.00	
F-test		0.22	Prob > F		0.88	
Akaike crit. (AIC)		1804.52	Bayesian crit. (BIC)		1810.51	
*** p<0.01, ** p<0.05, * p<0.1						

The Prais-Winsten AR(1) for the sector variates indicated an improved R^2 but still remained low to legitimize the model and only the Rail-transport coefficient was significant at 1 percent as detailed on **Table 10.**

Table 10: Prais-Winsten AR(1) sector regression results

Gross Domestic Product	Coef.	St.Err.	t-value	p-value	[95% Conf. Interval]	
Air	-4.749	13.046	-0.36	0.724	-34.262	24.765
Rail	3.276	1.711	1.92	0.088*	-0.593	7.146
Marine	15.138	17.379	0.87	0.406	-24.177	54.453
Road	7.983	9.794	0.81	0.436	-14.173	30.138
Constant	-31000.000	36886.032	-0.84	0.422	-114000.000	52397.235
Mean dependent var		-18504.071	SD dependent var			228077.031
R-squared		0.361	Number of obs			14.000
F-test		1.270	Prob > F			0.350
Akaike crit. (AIC)		384.461	Bayesian crit. (BIC)			387.656
*** p<0.01, ** p<0.05, * p<0.1						

4.3.5 MULTICOLLINEARITY

As shown on **Table 11** and **Table 12**, the statistics suggest a low degree of collinearity among the variates. Specifically, the tolerance index, which is given by an inverse of the VIF convene to 1 than zero (0) and the VIF fall below 10. An observed collinierity of negligible amount can be presumed for estimation purposes.

Table 11: Variance inflation factor and Tolerance for the overall variates

Variable Name	VIF	Tolerance [1/VIF]
Labour Wage Employment	1.987	.503
Capital Investment Transport	1.982	.505
Rate of Inflation	1.004	.996
Mean VIF	1.657	.

Table 12: Variance inflation factor and Tolerance by modes of transport

Variable Name	VIF	Tolerance [1/VIF]
Road	4.48	.223
Rail	4.41	.227
Air	1.74	.574
Marine	1.54	.649
Mean VIF	3.04	.

4.3.6 Lag-length selection

It is pre-supposed that if the current value of the dependent variate can be explained by the current value of a variate determined outside the model, lag selection becomes a desirable option. In this study, the ARDL model necessitated the adoption of this approach using the Akaike Information Criterion (AIC) that determined the number of maximum lag length. In this study, the maximum number of lag length was four (4).

4.4.1 Autoregressive Distributed Lag (ARDL) Model (overall) Results

The Autoregressive Distributed Lag model results reveal that the coefficient of determination R^2 was 0.87 implying that the explanatory variates on the ARDL model explained the dependent variable by 87 percent. The chi^2 was significant at 5 percent, implying the alternative hypothesis that the dependent variates have significant effect on the gross domestic product (gdp) was not rejected at 5 percent.

From the results, the capital investment transport coefficients for the intermediate past, second, third and fourth periods are -1.278, 6.367, -3.746 and 15.120, in that order. While the coefficients for the first three lapsed periods are insignificant, it is significant for the last period. This means that the effects of capital investment in transport are not immediate and that it takes time before making meaningful contributions to the gross domestic product. It is also noted that as much as it takes long, the gains can spike well up to 15.12 times. These findings are consistent with those of Bakht *et al.,* (2009) that additional investments on transport infrastructure is important in ensuring

delivery of produce to the market other than opening up new markets and opportunities. These findings are also consistent with the World Bank (2017) observations that if developing countries improved their transport investments, this will incentivize industries to lower their production cost and improve accessibility to the market. However, as suggested by the results, investment in transport infrastructure (regardless of the mode of transport) may not yield gainful results within the short-run as opposed to the long-run. Agencies involved in the planning, execution of the plans, monitoring and evaluation, should coordinate cognizant that the desired results may not be immediate and that if the coordination in expertise is maintained, in the long-run, gains are very promising towards economic growth. Most importantly, however, proponents of the Solow-Swan model (e.g Crafts, 2009; Cockburn *et al.,* 2013) have articulated that developing countries can improve their economic growth if investments in transport infrastructure are accompanied by investments in communication infrastructure.

The coefficients of the rate of inflation are for the immediate past period, 1.24e+10 for the second past period and 1.71e+10 and -5.52e+09 for the second last and last periods, respectively. The results reveal that the effect of the rate of inflation to the gross domestic product is immediate and can increase to the second period but over time, the contribution becomes insignificant. It is thus revealed only changes in inflation in the first two periods lead to significant contributions in gross domestic product with a unit change in inflation resulting to 12 and 12.4 increases in gross domestic product, respectively. In the third and fourth past periods, variations in inflation are insignificant. It can be generalized from the results that the rate of inflation has immediate effects on GDP. Policy makers should make urgent (monetary and fiscal) policies that can maintain the rate of inflation within appropriate levels and that distortion on the price of goods (and services) does not undermine GDP growth as observed by Bottini *et al.,* (2013).

Coefficients of the labour wage employment were insignificant throughout the four time periods. Because of this observation, the results were neither consistent nor inconsistent with those of Schwartz *et al.* (2009) who established that infrastructure investments (positively and) significantly lead to direct jobs creation in the transport sector. Perhaps, future studies should consider using different estimation approaches or data types in estimating the aspect.

Table 13: Autoregressive Distributed Lag (ARDL) Model Results

Variable Name		Coefficient
Capital Investment Transport	(1)	-1.278
		(2.581)
	(2)	6.367
		(4.687)
	(3)	-3.746
		(4.357)
	(4)	15.120**
		(5.465)
Rate of Inflation	(1)	1.20e+10***
		(2.87e+09)
	(2)	1.24e+10***
		(3.21e+09)
	(3)	1.71e+10
		(4.04e+09)
	(4)	-5.52e+09
		(4.60e+09)
Labour Wage Employment	(1)	1.38e+05
		(6618752)
	(2)	8126920
		(7049623)
	(3)	-8609073
		(6754110)
	(4)	-9683262
		(6845413)
Constant		2.63e+09
		(2.17e+10)
R^2		0.8700
Chi^2		5.02**

**** p<0.01, ** p<0.05, * p<0.1*

4.4.2 The Vector Autoregression Results by sector

The sector Vector Autoregression estimation results reveal that the coefficient of determination R^2 was 0.7124 implying the model explained the dependent variable by well over 71 percent. The

chi^2 was significant at 1 percent, implying the alternative hypothesis that the dependent variates have significant effect on the gross domestic product (gdp) was not rejected.

As shown from the model results, the effect of marine transport investment on gross domestic product was insignificant. However, the remaining modes of transport (Air, Rail and Road) investment were significant on the gross domestic product. With the effect of marine insignificant at 5 percent, Rail and Road had a positive effect on gross domestic product while air had a negative effect on gross domestic product with a unit change in air transport leading to a reduction in gross domestic product by 27.32.

A unit change in Road and Rail transport investment contributes by 15.43 and 3.25 improvements in gross domestic product, respectively as detailed in **Table 14**.

Table 14: Vector Autoregression Results by sector.

Gross Domestic Product	Coef.	Std.Error	z	P>z	[95% Conf. Interval]	
Air	-27.317	11.939	-2.290	0.022	-50.718	-3.916
Rail	3.253	1.299	2.500	0.012	0.706	5.799
Marine	-4.494	11.872	-0.380	0.705	-27.763	18.776
Road	15.433	6.840	2.260	0.024	2.026	28.839

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

The findings on the relevance of the road network infrastructure are consistent with those of Rudra *et al.* (2013) as revealed under literature. In their assessment, a causal relationship between road investment and GDP. In their further analysis, they reveal that the nexus between rail and GDP is only indirect. In this study, however, it is established that the nexus is direct and significant at 5 percent. Their overall conclusion on the significance of both road and railway investment infrastructure resonates well with this study finding.

The finding on the air transport infrastructural investments although significant at 5 percent, had reverse effects on GDP. Policy makers in the relevant regulatory agencies should leverage on technology and find innovative ways of turning around the sector.

Relevant transport agencies should leverage on sectoral cooperation. Inter-sectoral benchmarks can provide basis of understanding on planning and strategy, thereby ensuring discovery of potential success.

CHAPTER FIVE

SUMMARY, CONCLUSION AND POLICY RECOMMENDATIONS

5.1 Introduction

5.2 Summary

In this study, the role transport infrastructure and infrastructure investment in various modes of transport such as road and rail, air and marine on GDP growth. The role overall transport infrastructure on GDP was estimated using the ARDL model while the Vector Autoregressive model was run to determine how investments in various modes of transport affect GDP growth. Under the ARDL model, the dependent variable was by 87 percent explained by the independent variates as indicated by the coefficient of variation. Under the VAR model, the dependent variable was by 71 percent explained by the independent parameters. For the ARDL model, parameters of consideration were the GDP (dependent), capital investment transport and labour wage employment. The three latter parameters were independent in the within the model.

While capital investment transport and rate of inflation were found to be significant, the labour wage employment was insignificant. However, it is important to note that that the ARDL allows for estimation or comparison of estimates in the short-run as well as in the long-run. Capital investment in transport estimates were only significant in the latter period implying financial injections through capital investments in the transport sector however significant, take time to be realized. This is in contrast to the time it takes for inflation to affect GDP growth; the effect is immediate and was detected in the first and second period of the four-lagged periods as informed by the lag-length selection technique. It is also important to articulate for the results that were significant, they all affected the dependent variate, GDP in one direction, positively.

The VAR model was used in determining the influence of investing in the various modes of transport on GDP. As aforementioned, investment in the four modes of transport, namely; road, rail, air and marine were estimated. All parameters were found to have a significant effect on GDP but marine. While investments in road, rail and air were found to be significant, it is only

investments in road and rail that had a positive effect on GDP while air had a reverse effect on GDP.

5.3 Conclusion

It can be concluded from the results that the findings are consistent literature that investment in transport infrastructure networks have potential to increase industrial expansion and scaling up markets (e.g. Bakhti *et al.,* 2009). Since the Vision 2030 considers transport sector as an enabler for socio-economic growth, there is need to increase budgetary allocations as proposed by the World Bank (2017) to position the country on the right path to achieve 10 percent GDP growth as espoused in the blueprint.

5.4 Policy Recommendations

Inter-agency coordination through the signing of the memorandums of understandings with an ultimate aim of deepening seamless connectivity should be a priority. This is important to expand on the possibility of leveraging on economic growth within the short-run (when the rate of inflation influences on GDP positively as opposed to the long-run, when its influence is insignificant). Gains in capital investment in transport are only realizable in the long-run, necessitating sustained inter-agency coordination and collaboration.

Since the various modes of transport have different regulatory agencies governing them, it is important to implement an integrated transport policy that can link the sectors. Equally important is the need to leverage on the public private partnerships to widen transport investment opportunities. This partnership is key in meeting the much needed cost but simulation models can be used to determine on the viability of user charges. User charges will ensure construction of new roads and railways. The charges will also go a long way for meeting maintenance of existing infrastructures. As the Standard-Gauge Railway (SGR) nears completion, it is essential developing a comprehensive railway policy that will ensure proper operationalization of the railway sector and open up additional opportunities.

5.5 Areas of Future Studies

It is observed through literature that expansive budgetary allocation on transport infrastructure sector can lead to growth. But critics caution that this is not always the case due to an increasing external debt to develop the much needed infrastructure. Therefore, future studies should provide an empirical understanding on the link between external debt and infrastructural development in Kenya.

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