EFFECT OF SPENDING IN ROAD INFRASTRUCTURE ON MANUFACTURING OUTPUT IN KENYA

BY

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DECLARATION

This research paper is my original work and has not been presented for any degree in any other University.

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This research paper is submitted for examination with my approval as university supervisor.

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Prof. Anthony Wambugu

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DEDICATION

To My husband for his great support, patience and love and our beautiful daughter Kaya, who is my unending inspiration.

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LIST OF ABBREVIATIONS

ADF	Augmented Dickey-Fuller
AfDB	African Development Bank
ARDL	Autoregressive Distributed Lag
CBA	Cost Benefit Analysis
EAC	East African Community
ECS	Export Compensation Scheme
EPC	Export Promotion Council
ERS	Economic Recovery Strategy
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GoK	Government of Kenya
HQIC	Hannan-Quinn Information Criterion
ISS	Import Substitution Strategy
IT	Information Technology
ITRARR	International Transport and Road Research
KAM	Kenya Association of Manufacturers
KNBS	Kenya National Bureau of Statistics
KRB	Kenya Roads Board
MUB	Manufacturing Under Bond
RoK	Republic of Kenya
SAPs	Structural Adjustment Programmes
SEZ	Special Economic Zones
SIC	Schwarz's Information Criterion
SMEs	Small and Medium Enterprises
SSA	Sub Saharan Africa
VAR	Vector Auto-Regression

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

The manufacturing sector in Kenya is considered to be important in developing the economy and improving its citizen's welfare. It is intended that the sector should enhance its portion of Gross Domestic Product (GDP) by 15% in the year 2022 and generate jobs annually (GoK, 2018).

The contribution of GDP in the sector has remained stagnated with limited increases since 1960's. A contribution of 10% has been recorded from 1964-73, 13.6% from 1990-2007 and 10% from 2010-2016 (KAM 1988, 2018). This stagnation is explained by a number of reasons. First, costly infrastructure is required to attract investment in Special Economic Zones (SEZ) and Small and Medium Enterprises (SMEs) business parks. Second, inefficient flow of goods and services, which is one of the greatest impediments in enabling industries in the sector to get access and compete in regional markets. Third, transportation cost of both raw materials and finished goods is high due to poor state of roads. The volume of output of the sector has also been adversely affected by high costs of production, inflation, competition from goods that have been imported and the ban on plastic bags in Kenya (KAM, 2018).

The manufacturing sector depends significantly on road infrastructure sector. Kotler and Keller (2007) recognize that transportation choices affect product prices, condition of goods, firm profit and customer satisfaction. Supply of products from the point of manufacture to the target marketplace on time with the right quantity and quality is vital to ensure customer satisfaction. Any significant disruption of the flow of goods and people will impact economically a great number of businesses and individuals adversely (Smith, 1994). Lack of a high quality transport system impedes efficient flow of goods and services. Consequently, this affects access and competition among local manufacturers in both regional and international markets.

Road infrastructure, the most important means of moving goods overland, faces many challenges. These include high cost of building roads, insufficient equipment to maintain and repair roads, poor implementation of axle weight guidelines, road rehabilitation backlogs, overpopulation, overloading by vehicles and inadequate research on cheap options for construction materials, (RoK, 2007). The high costs of goods and services affects sustainability in production leading to massive losses and low profitability whose overall effect is low contribution by the sector to the GDP in a country (Winston, 1991).

1.2 Manufacturing Sector Policies and Strategies in Kenya since 1960s

The manufacturing sector has been a multifaceted mix of historical influences, economic policies and macro-economic situations in which it operates. At independence, Kenya aimed to achieve faster industrial evolution, an advanced structure of production, growth of import substituting industries, development of export of manufactured goods and promoting the private sector to attain a balance in the manufacturing sector (RoK, 1965).

1.2.1 Import Substitution Strategy (ISS): 1960s and 1970s

Kenya's first Development Plan (1966-70) relied heavily on foreign aid to supply capital and technology. The economy was dependent on developed countries in terms of the market, technology, managerial and entrepreneurial skills and capital (Mwaura, 1986). This dependence was to be reduced by implementing import substitution strategy that protected domestic firms from import competition. The firms were supported with tariff protection to ensure the sector grows significantly, encourage domestic participation, enhance production and increase employment (Meilink, 1982).
The manufacturing sector's growth rose to 8% from exploiting profitable opportunities for import substitution behind high tariff and non-tariff barriers (Odhiambo, 1991). This led to industries expanding with a variety of products that include textiles, paper, food processing and leather due to the large work force (Coughlin, 1988; KAM, 1988). During the implementation of ISS, there was a lot of optimism and supported widespread economic performance.

Kenya in the 1970s was marked by poor overall economic performance. The government's efforts to reduce imports plus discouraging external dependency affected implementation of new projects in industries. Production for exports decelerated because of the fall of the East African Community (EAC). The deterioration of external trade following the oil shock in 1977 increased oil prices causing the import bill to explode (Fouroutan, 1993). The ISS was slowed down by structural stringencies, decrease in output and macroeconomic volatility (Chege et al., 2014). It was further affected by reduced competition within the domestic industries, as many of the companies grew into monopolies, which yielded great returns despite inadequate capacity and price inflation of goods haphazardly (Chege et al., 2014). Industries made their profits by producing goods for the local market therefore leading to a reduction on exports due to lack of incentives to reduce costs because they could not compete in the export market industries (GoK 1994). The government imposed higher tariffs and import licensing procedures to cope with the major foreign exchange crisis (Bigsten, Kimuyu and Söderbom, 2010). This undermined export incentives, therefore decreasing manufacturing exports.

1.2.2 Structural Adjustment Programmes (SAPs): 1980s and 1990s

Kenya's manufacturing policy faced a major turning point with Structural Adjustment Programmes (SAPs). Price controls were removed, and imports liberalized by banning foreign exchange licensing and downsizing tariff administrations (Gerdin, 1997). Policies were developed and institutional frameworks implemented through the "Economic Management for Renewed Growth" (RoK, 1986). It emphasized on increased use of domestic resources, promoting exports and creating employment for locals. It was expected that this reform would enhance efficiency, improve the environment for exports, investments and employment.

In spite of the government pulling its resources to reform the sector, the industry was still extremely focused on capital intensive ventures and was highly import dependent and not capable of promoting employment due to lack of government commitment (GoK, 1994; Swamy, 1994). Lack of clear regulations discouraged importation whereas investment was affected by ineffective fiscal policies.

(Chege et al., 2014). There was still bias against exports despite the government's effort to move away from import substitution (Wignaraja and Ikiara, 1999). Both private and public sectors displayed adverse attitudinal positions that would encourage increase in the export of manufacturing goods (Chege et al., 2014).

Exporters were frustrated and faced major challenges in attaining foreign exchange to enable them expedite their activities. Whereas there was massive delay in claiming export compensation, the private sector was not willing to take the necessary measures to ensure international markets were competitive (KAM, 1988).

The SAPs neither stimulated economic growth nor improved the livelihood of the people. The government therefore came up with initiatives to discourage importation by establishing the Export Promotion Council (EPC), Manufacturing Under Bond (MUB) Export Compensation Scheme (ECS) and tax remission systems that would increase exportation (Bigsten et al., 2010). There was still weak impact even with the introduction of export promotion schemes due to poor implementation of the programs (Chege et al., 2014).

1.2.3 Millennium Policies: 2000s

In 2003, the Economic Recovery Strategy (ERS) was adopted. Its main focus was stimulation of the economy. This strategy focused on eliminating poverty, promoting prosperity and ensuring there's sustainable food security. The implementation of the ERS made the manufacturing sector perform well above its expectation and increased employment as had been envisaged. The Government was focused on removing any barrier to investment and encouraging a conducive business platform in the industry (RoK, 2007). Measures that were undertaken included liberalization of trade, enhanced infrastructure, security was greatly improved and facilitation of the use of technology license. Wages for laborers were reviewed and there was improved access to trade. The ERS stimulated the economy during its implementation period which expired in 2007.

The Kenya Vision 2030 is the official long-standing plan for the nation. Its goal is to have a competitive and wealthy nation that will give its citizens a decent way of life (GoK, 2007). The manufacturing sector's role in the development blueprint is to create wealth, employment and increase the contributing of GDP for the sector by 10% per annum. (RoK, 2007).

The Third MTP of Kenya Vision 2030 set out several objectives touching on the manufacturing sector. These include: a) Improving the Ease of Doing Business b) Improving Kenya's Global Competitiveness index; c) Create 3,850 manufacturing enterprises; d) Grow export incomes from textiles and clothing manufacture and; e)establish Special Economic Zones at Dongo Kundu in Mombasa, Athi River and Naivasha (GoK, 2018).

In 2018, the government launched the 'Big Four Agenda' focusing on food provision, sustainable and cheap housing, enhanced manufacturing and a healthcare that is affordable. Enhancing manufacturing in the Big Four Agenda will provide other means of creating adequate and effective supply of energy that is less costly that is necessary for industrialization, will ease the cost of doing business by reducing unnecessary regulations which will spur healthy competition in various enterprise sub-sectors and project new tax initiatives that will boost manufacturing growth (GoK, 2018).

1.3 Infrastructure under ERS and Kenya Vision 2030

In 2003, the Kenyan government put in place strategies that would ensure that the status of infrastructure would be upgraded, and new ones put in place. These included the ERS whose main goal was to produce and sustain a business atmosphere which would enable investment by the private sector, growth and job creation (ERS, 2003). It was projected that these strategies would lead to provision of suitable infrastructure which would further improve macroeconomic stability and a sustainable economy through long-term development blueprints for the country.

The need for ERS arose from findings that despite government spending on road infrastructure, Kenya was still characterized by road and railway networks that were dilapidated, electricity supply that is unreliable and very costly, inadequate telecommunications, unstable Information Technology (IT) and unreliable water supply (RoK, 2006). Specifically, the ERS recognized that the poor road infrastructure network had led to high cost of doing business in Kenya and poor welfare for its citizens who spend much of their income on transport every day.

The ERS strategy achieved construction of the dual carriage ways; construction of roads which provided rural access; decongestion of urban centers using bypasses in Nairobi and Mombasa; development of reforms on legal, institutional and regulations on design, integrity in road related service provision and private investor participation (RoK, 2006). The end of ERS led to the launch of the Kenya Vision 2030 which is believed to attain steady economic growth through social, economic and political pillars (RoK, 2007). The Infrastructure sector is anticipated to provide affordable outstanding infrastructure amenities and services in support of the development blueprint (RoK, 2013). Since the beginning of the second MTP1, 304 km of roads in the country have been constructed, 535 km of roads have been rehabilitated and 4,212 km of roads have been maintained. The Third MTP seeks to Construct 10,000 kms of conventional roads & low volume seal roads (GoK, 2018).

1.4 Research Problem

According to KNBS (2018), the expenditure of funds to various road agencies by KRB was boosted from Sh60.5 billion in 2016/2017 to Sh63.5 billion in 2017/2018with resources for maintenance and repair of roads increasing from Sh60.5 billion in 2016/2017 to Sh63.5 billion in 2017/2018. This huge investment in roads is expected to reduce transport costs but also spur economic activity in the country. Lower manufacturing and supply costs brought by transport advancement can lead to higher overall productivity due to more productive firms (Nocke, 2006).

However, even with the large disbursements on road infrastructure, the volume of manufactured output has been affected by the state of poor roads hampering the growth of economy and seriously affecting movement of goods (ITRARR, 2018). A report by African Development Bank indicates that the expense of moving goods in Sub-Saharan Africa (SSA) is very high globally (AfDB, 2013). Road Infrastructure has been deteriorating due to inadequate maintenance, because of public sector inefficiency, insufficient government revenue, and corruption (World Bank, 1995). Kenya Roads Board (KRB) conducted a baseline survey in the roads sub-sector and reported that transport costs 30% of total production costs (KRB 2015).

The existing studies that have focused on investing on road infrastructure have focused on the overall economy in SSA. Kayoed et al. (2013) explored the effect of road transport in Nigeria while in South Africa, Ashipala (2003) examined, the association between road infrastructure spending and economic development. Fedderke and Bogeti (2006) analyzed "the effect of road investment on South Africa's economy". In Kenya, Mugambi (2016) examined "the effect of road infrastructure on Kenya's economy." There is scarce empirical evidence relating investment on road infrastructure to the manufacturing sector despite the large expenditures on road infrastructure in Kenya.

1.5 Research Questions

i. How are expenditures in road infrastructure related to manufacturing output in Kenya?
ii. Is there a long-run association between road infrastructure and manufacturing production in Kenya?

1.6 Objectives

The key objective is to examine the effect of spending in road infrastructure on the manufacturing output in Kenya.

The specific objectives are:

i. To examine how expenditures in road infrastructure are related to manufacturing output in Kenya.
ii. To determine whether there is a long-run association between road infrastructure spending and manufacturing production in Kenya.

1.7 Justification

This study is justified on several grounds. Firstly, this study will contribute to knowledge through provision of additional empirical evidence link between road infrastructure spending and manufacturing output. Secondly, it is anticipated that the study will be able to influence policy formulation in line with increased funding to the road infrastructure sector as an impetus to the manufacturing sector. Policy makers and financiers will use the findings in this study in decision making and development of better strategies that will help spur economic development. Around the world, evidence of the impact of transport investments has been taken into consideration by policy makers in developing a Cost Benefit Analysis (CBA) (Patricia C. et al, 2013). Thirdly, the study could also act as a foundation to other studies by supporting other scholars who may wish to conduct research studies on the subject matter and therefore form a basis for further work using other forms of infrastructure or sectors.

1.8 Organization of the proposal

The balance of this paper will focus on literature review in the second chapter, the methodology that the study uses in chapter three, results and discussions in chapter four and finally the key findings, recommendations and suggested areas for further research in chapter five.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter provides an insight into several studies done by outstanding researchers with regards to the impact of spending in road infrastructure on manufacturing. The chapter also gives the present status of the problem described by a review of previous studies through a summary and explanation of theoretical and empirical knowledge as found in a range of secondary data sources.

2.2 Theoretical Review

This study reviews some economic theories which support the relationship between road infrastructure investment and manufacturing output. One such theory is the neo-classical (exogenous) growth model. The major supporters of this theory are Domar (1946) and Solow (1956, 1957). The theory allows lab or as a substitute of capital and vice versa in determining output.

In this theory, public investment augments private capital production, increasing returns therefore, boosting investment. Nevertheless, growth in capital will have a momentary influence on increasing output (Solow 1956). The endogenous model is an alternative approach to the neo-classical growth model with Barro (1990) and Romer (1986) as major proponents. The theory suggests that growth is contingent on efficient road networks (Barro & Sala-i-Martin 2004). The government has the responsibility to regulate and resolve market failures linked to different types of investment. Therefore, investment in transport will create employment and enhance growth of the economy exponentially. The Endogenous growth model supports that investment in infrastructure complimented with advanced technology will generate economic development in the future (Hlotywa, 2017). The endogenous growth model introduces government expenditure on infrastructure (G) as public good into the model such that;

$Y = f [K, L, G]$

The theory emphasizes that the economy is built on public capital and increase in investment in infrastructure can be achieved when there is steady state income per capita. The model was further extended with the addition of technology (A) factor such that Y= Af(K, LG)

Romer (1986) proposes that human capital investment will boost productivity in any economy. Lucas (1998) stresses that human capital investment remains as an impetus to produce spill over effect, increasing the level of technology and ultimately increases the aggregate output. This is reflected in the inclusion of human capital investment (H) hence, Y= Af(K, LG, H).

The endogenous growth theory assumes: (1) "A", technology is continuous rather than rising over time; (2) capital stock 'K', affects all outputs positively at the manufacturing level, increasing returns to scale therefore explaining why growth depends on rate of capital investment 'K'. (3) The aggregate production function can change with the assumption of symmetry across industries implying industries will have to use the same level of capital and labour.

The study also reviews the works of Solow and Swan (1957) on accumulation of productive resources, efficiency of resource allocation and technical progress as vital elements of growth and development. Solow and Swan have argued that technological progress increases input thereby, increasing efficiency and therefore leading to an increased productivity. Solow and Swan argue that government expenditure on basic infrastructure is capable of influencing the dynamics of industrial growth through efficiency of resource allocation and accumulation of productive resources, which further assumes influence on the productivity level of private sector (Solow and Swan, 1957).

The model underscores the significance of technology in transforming the economy of a country. The advancement of technology in road transport investment will lead enhanced performance in productivity sectors like manufacturing. Infrastructure has been proven to complement private capital and enhance its marginal product. Road transport investment is expected to increase private investment in equipment and plant which is key in manufacturing output in Kenya. Arrow (1962) and Sheshinski (1967) have proven that productivity increases when there is technological progress, even though it may decrease employment in the sector.

2.3 Empirical Review of Literature

Several scholars have made reference to the effects of road infrastructure investment on industries, specifically manufacturing with a regional focus. There have been wide discussions on empirical research with regards to how investment in infrastructure affects manufacturing output, the methodological approaches followed and respective conclusions. The production function approach is used in numerous studies estimating investment functions founded on Cobb-Douglas and trans-log production functions. Authors have used different approaches in estimating production functions where in some cases, public capital represents infrastructure and enhances productivity. Aschauer (1989c) used a Cobb-Douglas function to examine the association between investment and production. He used data from 1966 – 1985 for transport capital which resulted in 0.34 to 0.73 as output elasticity therefore establishing that public investment is important for production and growth. Another study by Aschauer (1990) informed that a contribution of up to 55% of non-military capital stock positively enhances growth in 12 OECD countries over time.

Using panel data, Evans and Karras (1993) examined the degree to which public capital contributes to production in the manufacturing sector. They used a Cobb-Douglas function as model specification. It was concluded that public capital is significantly productive and enhances economic growth.

Fenald (1993) used panel data for seven states in the US between 1953 and 1985, to investigate Infrastructure productivity and its contribution to the manufacturing sector. He used a Cobb-Douglas function and trans log production functions as model specifications and concluded that public investment annual rate of return improved. Pinnoi (1992) examined the contribution of private productivity in various regions and industries including the manufacturing sector. He used a trans log function with difference public infrastructure amenities including roads.

The data set had input from water, transport and sewer infrastructures as productive factors under private production. An analysis of the data showed that the output elasticity had negative and positive elasticity, therefore, supporting the hypothesis that diverse sectors respond inversely to diverse forms of public investment.

Other studies have used the Cost Function Approach as a method of estimation to study the impact of spending in road on industries, more specifically, manufacturing sector. Nadiri and Manuneas (1994) to examine the impact of publicly financed structures on output of industries using cost function approach. The generalized Cobb Douglas and a log function were used as estimation techniques. They concluded that costs differ across sub-sectors and the demand for different factors of production is affected by capital.

Seitz (1994) investigates 31 German industries uses the same cost approach to analyze the effect of government spending as a fixed production factor on private input. He uses the Generalized Leontief estimation technique. He proves that employment and capital are substitutes. He concludes that public capital will stabilize and decrease steadily decreasing the demand for private input.

Shah (1992) investigates Mexican manufacturing data from 1970-1987. He uses a cost function approach using a trans log technique of estimation. He concludes that there are significant positive returns to capital; however, some variability across time exists. Further, economic growth could be greatly attained by investing in infrastructure capital.

Several authors have used Vector Auto-Regression (VAR) as an estimation method.
Pereira and Andraz (2003), use VAR method to study the outcome of public capital on the production sector. They analyse the effect of public spending on 12 industries in the US and they conclude there is a positive impact on output an indication that when public investment is enhanced, there will be direct employment towards wholesale trade and manufacturing at the industry level.
The cost function shifts down therefore improving output and demand in all industries. Pereira and Andraz (2007) evaluate the effect of public spending in manufacturing. The VAR model is used for the Portuguese economy and industries covering all economic activity in Portugal. They conclude that there is positive impact

on labor and productivity even though investment has the power to boost economic performance, it is biased across industries.

Pereira and Roca-Sagales (2001) analyze how private sector is affected bycapital formation in Spain. They use VAR to estimate output, investment and employment in 4 sectors; services, agriculture, manufacturing and construction. The study deduces that there exists a positive effect on the sectors. They also conclude that public capital makes manufacturing industries more labor intensive while that of services, capital intensive.

2.4 Overview of chapter two

Largely, the literature indicates a slight harmony of empirical evidence, a clear concurrence has occurred with regards to methodology. The indirect impact of public spending on road infrastructure is widely recognized. There is very scarce evidence on the association between road expenditure and sector productivity especially in East Africa. A better understanding is required on the impact of road investment within productive sectors in the economy. The methodology to be used will be further expounded on in the subsequent chapter.

CHAPTER THREE
METHODOLOGY

3.1 Theoretical Framework

The Cobb Douglas production approach (Gentanjali, Ranjau & Pravakar, 2010; Zhu, 2009; Aschauer, 1989a) will be used in this study to incorporate road expenditure variables. Government spending is measured as a factor of input taking into account that public goods are characterized as non-rival. Therefore, this explains why public services are integrated as input in private production. Production assumes a constant return to scale with regards to the services granted by government.According to Barro (1990), governments purchase output from private sector and then provide services to households. Government is not involved in the production process.

3.2 The Econometric Model

Road expenditure is introduced as public spending defined as G yields;

$Y_t = A_t K_t^{\alpha 1} L_t^{\alpha 2} G_t^{\alpha 3}$…………………………….. (1)

Y_t=manufacturing sector output

A_t= Total Factor Productivity

K_t=Gross capital formation in private sector

Lt = Employment in the manufacturing sector

Gt = Government expenditure on roads

α_1 α_2 α_3 = Elasticities with respect to K_t, L_t and G_t

After taking natural logarithm on the two sides of equation (1) the linear form is

$lnY_t = lnA_t + \alpha_1 lnK_t + \alpha_2 lnL_t + \alpha_3 lnG_t$……………………………………… (2)

The econometric model corresponding to (2)is specified as follows:

$lnY_t = \alpha_0 + \alpha_1 lnK_t + \alpha_2 lnL_t + \alpha_3 lnG_t + \mu$ ……………………………………… (3)

Where;

lnY_t = Natural logarithm of manufacturing output

lnK_t= natural logarithm of fixed capital formation

lnL_t= natural logarithm of labour force

lnG_t= natural logarithm of expenditure in road infrastructure

μ represents the stochastic error term

α_1 α_2 α_3 are the coefficients to be estimated

3.3Estimation Procedures

3.3.1 Stationarity Tests

Brooks (2008) has defined stationarity as a series with a mean and auto-co-variances for every lag. Time series will be used in this research proposal to test stationarity. To avoid spurious regression where variables are based time series that are unrelated, stationarity will be confirmed using the Augmented Dickey Fuller (ADF) test. The tests will be first applied to the different variables i.e, manufacturing output, labour and spending in roads, in log-levels. The ADF will assume that Hypothesis 0 (H_0) shows the data is non-stationary thus the null hypothesis cannot be rejected. The variable will be differenced and the test run on the variable that has been differenced, if calculated value is greater than critical value then the alternative will be accepted. The deduction therefore is, all variables at first difference are all stationary.

3.3.2 Cointegration test

After the stationarity test, I will inspect if there is cointegration in the long run among the variables. A sign of cointegration will imply a long-run association (Inder 1993). This study will test for Cointegration which will estimate short and long term among variables. The Cointegration method preferred is the ARDL bounds testing approach (Pesaran et al. 2001) will examine the presence cointegration.

3.3.3 Multi-collinearity test

The multi-collinearity test will determine whether variables have an early seamless association or not. This test will be undertaken since it can lead to biased conclusions that will arise due to inefficient variance that is not the least minimum possible. If the variance is inappropriate; it implies that the standard error and the conclusion made will also be inappropriate. The Variance Inflation Factor (VIF) approach will test for multi-collinearity in this study. Inference is made based on the value of the VIF such that multi-collinearity is present if this value is more than 10. It is absent if it is less than 10.

3.3.4 Heteroscedasticity

Heteroscedasticity postulates that the error terms variance is not constant. Heteroscedasticity will affect minimum variance that leads to biased conclusions. This study will apply the Whites Test for heteroscedasticity. The null hypothesis assumes homoscedasticity while the alternative hypothesis assumes heteroscedasticity.

3.3.5 Autocorrelation

Autocorrelation is the situation where the error term of subsequent periods is correlated. Analogous to heteroscedasticity, this problem makes the variance inefficient and in turn leads to wrong conclusions using the t-test. I will apply the Durbin Watson test. Where a value close to 2 assumes no autocorrelation while a value of 0 or 4 assumes presence of autocorrelation.

3.4 Data Sources

The secondary data is sourced on data ranging from 1986 to 2016. Data on Output (q) represented by Manufacturing, value added, will be sourced from the database of the African Development Bank. Private capital (k) and Labour (l) data whose indicator is manufacturing employment as a proportion of total employment will be obtained from KNBS, the World Bank and African Development Bank databases. Data on Road Infrastructure (g) represented as Government Expenditure on Roads will be obtained from the KNBS database.

3.5 Data processing and analysis

Descriptive analysis, t tests, correlation and regression analysis will be conducted.

CHAPTER FOUR

EMPIRICAL FINDINGS

4.1 Introduction

This Chapter encompasses the findings of the empirical study. Section 4.2 shows the descriptive analysis. This is done in three ways: graphical analysis, summary statistics and correlation analysis to portray basic features of our data. Next, section 4.3 contains findings of the necessary tests undertaken in the study while the regression results are discussed in secion 4.5.

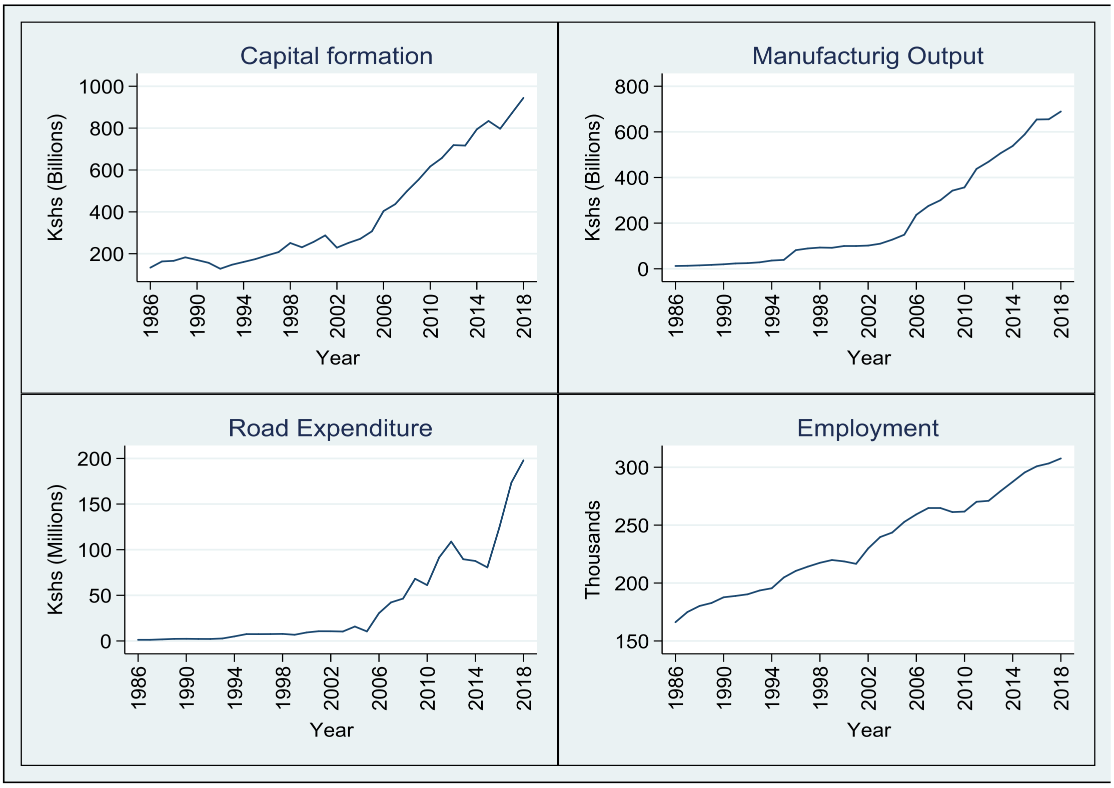
4.2 Description of Data

Description of data is important in understanding the basic features of the variables prior to regression analysis. In the subsequent sections, the descriptive statistics is conducted in two ways. Section 4.2.2 shows the graphical trend of the variables. This is important in showing the time series characteristics of the data. Section 4.2.3 describes data using mearsures of central tendency and dispersion. These preliminary results are important in understanding the distribution of data.

4.2.1 Graphical Analysis

Graphical analysis of variables is aimed at examining their time-series properties. This is essential to determine further empirical analysis to be conducted. Figure 1 presents the trends of all the variables from 1986 to 2018.

Figure 4.1 : Graphical trend of variables at level



According to Figure 4.1, all variables have an upward trend. This means that capital formation, manufacturing sector output, road expenditure and employment in manufacturing have been rising in Kenya. Econometrically, this indicates that these variables are likely to have a unit root with trend at level. Nonetheless, unit root is formally tested in section 4.4.

4.2.2 Descriptive Statistics

Besides the graphical description of variables, I also describe variables using measures of central tendency and dispersion. The results for every variable is given in Table 4.1.

Table 4.1: Summary Statistics

Variable	Mean	Std. Dev.	Min	Max	Skewness	Kurtosis	Shapiro-Wilk (Prob>z)
Manufacturing output (Kshs. Billion)	221.90	223.44	12.16	689.34	0.86	2.29	0.00012
Road expenditure (Kshs. Billion)	40.25	52.49	1.26	197.93	1.50	4.49	0.00000
Gross capital formation(Kshs. Billion)	391.24	261.88	128.19	944.61	0.78	2.10	0.00017
Manufacturing employment ("1000")	235.01	41.90	166.2	307.6	0.13	1.80	0.00003

Findings in Table 4.1 show the average output from the manufacturing sector is Kshs. 221.90 billion. That of gross capital formation is Kshs. 391.24 billion while road expenditure is Kshs. 40.25 billion. On average, 235,010 individuals are employed in the manufacturing sector. This is for both private and public sector. Standard deviation results show that variables are not widely dispersed from their means except road expenditure, employment in the manufacturing sector and gross capital formation. The maximum and minimum indicate that variables are widely dispersed. All variables are positively skewed. This implies that variables have long right tails as opposed to their left tails. Kurtosis results show that all values fall away from 3 indicating that none of the variables is normally distributed. A kurtosis value of 3 or approximately 3 indicates that a variable is distributed normally (Crawshaw and Chambers, 2001).

Shapiro-Wilk test is conducted to formally test whether a variable is distributed normally or not. The variables presented in Table 4.1 are less than 0.05 leading to the null hypothesis being rejected; therefore, all variables are not normally distributed.

4.2.3 Correlation analysis

This analysis demonstrates the direction of the relationship amongst variables (Crawshaw and Chambers, 2001). The relationship between independent variables gives an insight on the possibility of multicollinearity. Variables are said to cause multicollinearity if they have an almost perfect relationship (Greene, 2018). This is presented in Table 4.2.

Table 4.2: Correlation analysis results

	Manufacturing output	Road expenditure	Gross capital formation	Manufacturing employment
Manufacturing output	1.0000			
Road expenditure	0.9520	1.0000		
Gross capital formation	0.9938	0.7451	1.0000	
Manufacturing employment	0.9380	0.6520	0.5315	1.0000

Results in Table 4.2 indicate that manufacturing output which is the dependent variable is highly correlated with independent variables; road expenditure, gross capital formation and manufacturing employment. The correlation is positive which implies that a rise in any of the variables increases manufacturing output. As for independent variables, the correlation is positive. The highest correlation is between gross capital formation and road expenditure at 0.7451 while the least is between manufacturing employment and gross capital formation. Nevertheless, the levels of correlation are below 0.8 which is the threshold of multicollinearity (Greene, 2018). This means that it is less likely to find multicollinearity in the variables.

4.3 Diagnostic Tests

4.3.1 Multi-collinearity test

The Variance Inflation Factor (VIF) approach tests for multicollinearity in this study. Inference is made based on the value of the VIF such that multicollinearity is present if this value is more than 10. It is absent if it is less than 10. Findings are shown in Table 4.3.

Table 4.3: Multicollinearity Results

Variable	VIF	1/VIF
Gross capital formation	9.89	0.101112
Road expenditure	9.93	0.100705
Manufacturing employment	8.01	0.124844
Mean VIF	9.28	

Results in Table 4.3 imply that road expenditure and gross capital formation do not cause multicollinearity. This is because their VIF values are less than 10. These results confirm those of the correlation analysis on independent variables.

4.4 Unit Root Test

This study used the Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test to test for unit root. Prior to running these tests, I established the optimal lag length of each variable using the Akaike Information Criterion (AIC). Afterwards, I make inference on the stationarity by comparing the test statistic with the critical value at different levels (1%, 5% and 10%). Table 4.4 encloses the findings of the variables at level while Table 4.5 contains results after first differencing.

Table 4.4: Unit-Root Test Results (At level)

Variable	**Restriction**	**ADF test**		**PP test**		**Lags**	**Inference**
		t-statistic	Critical value (10%)	t-statistic	Critical value (10%)		
Manufacturing output	Constant, trend	-1.809	-3.226	-1.756	-3.226	1	NS
Road expenditure	Constant, trend	-2.660	-3.226	-3.004	-3.226	1	NS
Gross capital formation	Constant, trend	-3.368**	-3.226	-2.075	-3.223	5	S
Manufacturing employment	Constant, trend	-3.317**	-3.226	-3.068	-3.226	1	S

Note: NS- Non-Stationary, S-Stationary. ** indicates significance at 10% level of significance.

Findings in Table 4.4 indicate that gross capital formation and manufacturing employment are stationary at level. This is founded on the result of the ADF test. Gross capital formation is stationary at level with 5 lags while manufacturing employment is stationary at 1 lag.

The conclusion on manufacturing output and road expenditure is that they are non-stationary at level. Both variables have a maximum lag of 1 using AIC. I therefore test for their unit root at first difference. This entails establishing the maximum lags and conducting the ADF and PP tests. I fail to conduct the tests of the first differences of gross capital formation and manufacturing employment because they are expected to stationary. Respective results are presented in Table 4.5.

Table 4.5: Unit-Root Test Results (At first difference)

Variable	Restriction	ADF test		PP test		Lags	Inference
		t-statistic	Critical value (10%)	t-statistic	Critical value (10%)		
Manufacturing output	Constant, trend	-5.423**	-3.226	-5.423**	-3.226	0	S
Road expenditure	Constant, trend	-6.372**	-3.226	-6.372**	-3.226	0	S

Note: S-Stationary. ** indicates significance at 10% level of significance.

The findings in Table 4.5 find that all the variables are stationary at first difference. I proceed to formally check for Cointegration using the ARDL bound test approach.

4.5 Cointegration test

Using the ARDL Bounds test, inference is made by comparing the F-statistics with the lower and upper bounds levels of significance. The ARDL Bounds test findings confirm that variables are cointegrated. The F Statistic is 3.964 and it is greater than the critical values for the lower and upper bounds at 10% level of significance. The lower bound at 10% level of significance is 2.72 while the upper bound is 3.77. Both values are less than the F-statistic of 3.964. These results confirm the presence of cointegration. For this reason, I estimate the an ARDL model to identify determiants of the manufacturing sector output. This addresses my objectives. Respective results are in Table 4.7.

4.6 Model SelectionCriteria

The ARDL model is preffered for this analysis mainly because it appropriate for situations where *I(0)* and *I(1)* variables exist and it is good for small sample sizes. To execute this model, the optimal lag length of each model is first determined using the Akaike Information Criterion (AIC). Compared to other model selection approaches (Schwarz's Information Criterion (SIC) and Hannan-Quinn Information Criterion (HQIC)), AIC is preferred because of its ability to forecast a model and applicability in autoregressive models like ARDL (Gujarati and Porter, 2014, p. 494). The model establishes that the otimal lag for all variables is 1. This is in Table 4.7.

4.7 Regression results

Regression findings are presented in Table 4.7. This contains a mixture of both long and short run results. In my interpretation of these findings, I start with the short run then embark on the long-run.

Table 4.7: ARDL regression results

Dependent variable: Manufacturing output	Short-run results	Long-Run results
ECM term	-0.377^{***}	-
	(0.129)	-
Capital formation	0.406^{*}	-0.802
	(0.230)	(0.470)
Road expenditure	-0.0679	0.621^{**}
	(0.109)	(0.260)
Manufacturing employment	-0.546	4.493^{**}
	(1.522)	(1.636)
Constant	6.214	-
	(4.392)	-
N=32		Optimal lags= (1,1,1,1)
R^2=0.438		Durbin Watson=2.258238
Adjusted R^2=0.273		White=0.4960

Note: *, ** and *** presents levels of significance as follows; $^{*}p< 0.10$, $^{**}p< 0.05$, $^{***}p< 0.01$. Standard errors are in parentheses. White- Whites test for heteroscedasticity.

The coefficient for the error correction term (ecm) in Table 4.7 is negative and significant. For a more elaborate interpretation, I conclude that the short-run manufacturing sector output shock corrects 37.7% of disequilibrium in the first year and it will take around 2.7 years to clear all disequilibrium.

In the short run, only capital formation significantly increases manufacturing sector output. Ideally a percentage increase in capital formation raises output in the manufacturing sector by 0.406%. This effect is significant at 10% thereby implying that increased investement is good for manufacturing output. Road expenditure and manufacturing employment affect manufacturing output negatively in the short-run.

In the long-run, all variables impact output from the manufacturing sector significantly except capital formation. Road expenditure which is my variable of interest grows manufacturing sector output by 0.621%. Hence, it might be that road infrastructure is not significant to manufacturing output in the short-run but its importance increases with time. These results are similar to Pereira and Andraz (2007) in Portugal. Capital formation in contrast to the short-run period has a negative effect on manufacturing sector output in the long-run. I arrive at a similar conclusion to Shah (1992) who found that the effect of capital formation varies across time.

Increasing employees in the manufacturing sector has a signifcant and positive effects in the long-run. Ideally, a percentage rise in employees in the manufacturing sector increases output in the sector by about 4.5%. This is similar to Pereira and Andraz (2007). There are specific tests which are supposed to be conducted to validate the results. In this study, I test for autocorrelation and heteroskedasticity.

Heteroscedasticity This study applied the Whites test establish for the presence of heteroscedasticity. The null hypothesis assumes a constant variance of the error term while the alternative hypothesis assumes heteroscedasticity.

Autocorrelation I apply the Durbin-Watson test.. Results of these tests are presented at the bottom of Table 4.7. The Durbin Watson statistic is close to 2 as shown in Table 4.7. This indicates that the results do not suffer from autocorrelation. As for the Whites Test, the p-value is 0.4960. This indicates that I fail to reject the null hypothesis of homoscedasticity. I therefore determine that the model does not suffer from heteroscedasticity.

CHAPTER FIVE

SUMMARY, CONCLUSION AND POLICY IMPLICATIONS

5.1 Introduction

This study examines the effect of spending in road infrastructure on the manufacturing output in Kenya. This was complemented by the following specific objectives; to examine how expenditures in road infrastructure are related to manufacturing output in Kenya, and to determine whether there is a long-run association between road infrastructure and manufacturing production in Kenya.This Chapter discusses the key findings on whether my objectives were met. Based on this, I recommend policies and suggest areas for further research.

5.2 Summary of findings

Time series data ranging from 1986 to 2018 was used to address the aforementioned objectives. I described data in the beginning before conducting unit root test which is vital for time series data (Greene, 2018). I establish that all variables are integrated at order zero (*I(0)*) and order one (*I(1)*). This warranted for a cointegration check using the ARDL Bounds test. The test confirmed that the variables are cointegrated. Meaning that they had a long-run relationship thereby answering my second objective.

With regards to regression results, I analyzed an ARDL model and obtained both long and short run results. The dependent variable was output from the manufacturing sector while independent variables were road expenditure, capital formation and labor in the manufacturing sector.

Expenditures in road infrastructure are related to manufacturing output has a negative effect in the short run but the impact is positive in the long-run. The short-run effect is not significant but that of the long-run is significant. This shows that the effects of road expenditure evolve over time. Ultimately, a 1% rise in road expenditure increases manufacturing output by 0.621%. This result implies that both objectives are met. Road expenditure has a long-run relationship with manufacturing output and its effect is significant. Other results indicate that capital formation is positive and significant in the short-run but the effect is negative and insignificant in the long-run.

Hence, excess capital formation can have negative returns to scale in the long-run. A rise in manufacturing employment has a negative and insignificant effect in the short-run but the effect is positive and significant in the long-run. Just like road expenditure, manufacturing employment produces positive returns to scale.

5.3 Conclusions

Based on these results, I conclude that road expenditure and manufacturing employment have a long-run effect while capital formation has a short-run effect. I also infer that road expenditure and manufacturing employment have a negative effect in the short-run. This means that the benefits of these variables are realized after some time. As for capital formation, the effect is negative in the long-run meaning that it has diminishing returns in the long-run.

5.4 Recommendations

It is a reality that structural transformation has occurred and the manufacturing sector has been worst hit (Rodrik, 2016). Employment and level of value addition from the sector to GDP have been on a decline at the expense of the services sector. As a result, this study gives pertinent recommendations on how to revive the manufacturing sector.

First and in line with my objectives, road expenditure should be enhanced to improve output of the manufacturing sector. This policy should be applied with knowledge of all stakeholders because positive effects will be realized after some time. Similarly, policy should be enforced to establish an enabling business environment for manufacturing companies to be established so as to increase employment in the sector. As for scholars, future studies should establish the effect of not only road expenditure but also other forms of expenditure like communication.

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