UNIVERSITY OF CAPE COAST

RELATIONSHIP BETWEEN CONSTRUCTION EXPENDITURE AND ECONOMIC GROWTH IN SUB-SAHARAN AFRICA

BY

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

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Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

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ABSTRACT

The importance of the construction industry cannot be overemphasized because of its strong linkages with other sectors of the economy. Despite this, the empirical literature on the non-linear (Bon curve) relationship between construction expenditure and economic growth remains unclear and hence, leave much space for further engagements. Therefore, this study seeks to find answers to these questions: Does construction expenditure matter in economic growth, and does the Bon curve hold in sub-Saharan Africa (SSA)? Using panel data for 33 countries in SSA spanning from 1990 to 2014, the study analysed relationship between construction expenditure and economic growth. The main estimation techniques employed were the panel Autoregressive Distributed Lag (ARDL) model and the Dumitrescu Hurlin panel causality test respectively. The results revealed a positive relationship between construction expenditure and economic growth both in the long run and short run, although the latter was statistically insignificant. There was also a non-linear (inverted U-shaped) relationship found between construction expenditure and economic growth with a turning point of 11.28%, suggesting that the Bon curve holds for SSA. The study further showed a bidirectional relationship between construction expenditure and economic growth, at least for a four-year lag period. These findings highlight the importance of the construction industry to economic growth in SSA and hence, the study recommends that policy makers and various governments need to be circumspect in controlling the level of construction expenditure because expansion of construction expenditure beyond the turning point may not bring the desired impact on economic growth.

KEY WORDS

Bon curve

Construction

Construction expenditure

Economic growth

Panel Autoregressive Distributed Lag (ARDL)

Sub-Saharan Africa

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DEDICATION

In memory of my late grandmother, Madam Abena Serwaah

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LIST OF ACRONYMS

ADF	Augmented Dicky Fuller
AIC	Advanced Industrialised Countries
ANOVA	Analysis of Variance
ARDL	Auto Regressive Distributed Lag
BERU	Building Economics Research Unit
CADF	Cross-sectionally Augmented Dicky-Fuller
CD	Cross-sectional Dependence
CIPS	Cross-sectionally Augmented Im Pesaran Shin
CPI	Consumer Price Index
CVA	Construction Value Added
ECM	Error Correction Model
ECT	Error Correction Term
EDI	Economic Development Index
ERP	Economic Recovery Programme
EU	European Union
GDP	Gross Domestic Product
GMM	Generalised Methods of Moments
GNP	Gross National Product

GVA	Gross Value Added
GVCW	Gross Value of Construction Works
HIPC	Highly Indebted Poor Countries
HNC	Homogenous Non Causality
IMF	International Monetary Fund
IPS	Im Pesaran Shin
LDC	Less Developed Countries
MDRI	Multilateral Debt Relief Initiative
MG	Mean Group
NIC	Newly Industrialising Countries
OLS	Ordinary Least Square
PADS	Port and Airport Development Strategy
PMG	Pooled Mean Group
SAP	Structural Adjustment Programme
SC	Schwarz Criterion
SSA	Sub Saharan Africa
TFP	Total Factor Productivity
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
VAR	Vector Auto Regressive

VECM	Vector Error Correction Model
WDI	World Development Indicators

CHAPTER ONE

INTRODUCTION

Background to the Study

The Construction industry is considered as one of the dynamic industries of today that contributes greatly to the economic growth of a nation. The activities of the industry could affect every aspect of the economy and hence, are vital for socio-economic development. Thus, construction is to contribute significantly to economic development by satisfying some of the basic objectives of development such as employment creation, output generation, and income generation and re-distribution. It is a key barometer of the health of an economy because of its strong linkage to output fluctuation (Alagidede & Mensah, 2016).

Globally, the volume of construction output is expected to grow by 85% to $15 trillion by 2030, with three countries namely China, United States and India, leading the way and accounting for 57% of all global growth (PricewaterhouseCoopers, 2015). Thus, this is to emphasize how construction output is expected to grow and the importance of industry as a whole. In developing economies, construction industry plays a significant role in achieving socio-economic development by providing shelter, employment and needed infrastructure that helps in the provision of goods and services. The construction of physical facilities could make up more than one half of gross domestic investment and tends to be concentrated on basic infrastructure in agriculture, mining, transportation, communication and utilities. Moreover, infrastructural services make some contribution to gross domestic product (GDP), but also stimulate the development of other industries which, in turn, contribute more directly to economic growth.

Construction is a broad term which comes from the investment component of GDP. It is generally used to describe the activity of the creation of physical infrastructure, superstructure and related facilities (Wells, 1985). It is not only limited to physical structures of various types used as inputs by industries but its description can simply be divided into both residential and non-residential construction or public and private construction depending on ownership during construction period. Construction mostly deals with all civil engineering works, procurement and all types of new building projects as well as the alterations, renovations, demolition and improvements of infrastructure. This is actually what is captured in the measures of construction expenditure as used in this study.

The construction industry is large, complex and geographically spread out. It is also diverse, with many factors influencing its performance, well-being and prospects at many levels. The industry is fragmented in terms of its roles of the participants as well as the distribution of the sizes of its component firms (Ofori, 2012). The industry has many participants which include architects, engineers, management consultants, contractors, construction workers and users of constructed facilities. It also uses the services of building finance and insurance agencies, land developers, real estate brokers, material and equipment suppliers, manufacturers, among others. Furthermore, the government cannot be left out of construction industry. It interacts with the industry as a purchaser, financier and regulator.

The industry contributes directly to GDP by entering into the national accounts as a component of fixed investment. All products of the construction industry are regarded as investment goods or part of gross fixed capital formation in every country. In fact, the output from the construction industry constitutes a substantial portion of gross fixed capital formation ranging from 40% to 60% (Wells, 1985). It cannot be over-emphasized that the importance of the construction industry in both developing and developed economies stems from the strong forward and backward linkage it has with other sectors of the economy. Thus, a vibrant and thriving construction sector could well be a proxy for healthy and well-functioning economy (Alagidede & Mensah, 2016).

In sub-Saharan Africa (SSA), data from the United Nations Conference on Trade and Development (UNCTAD) during the period of 1970 to 2014 revealed that the percentage share of construction expenditure in GDP ranges from about 3.2 % to 7.5 % and it is still projected to be getting higher. In Ghana, from a low point in the 1970s and 1980s the share of construction expenditure in the gross domestic product (GDP) has shown an increasing trend over the past decades. Recently, Gross Domestic Product from the construction industry increased from GHS 2,888 million in 2014 to GHS 2,949 million in 2015 (Ghana Statistical Service, 2016). The industry so far has contributed significantly to the economic growth of the Ghanaian economy. For example, the construction industry can boast of employing both skilled and unskilled labour, engineers, consultants, artisans and among others. Similarly, Kenya construction sector continues to see robust growth and remains a central component of the country's immediate and longer-term economic growth agenda (Oxford Business Group, 2016). The Kenyan construction industry contributes 7% of the gross domestic product (GDP), which makes it clear that Kenya has a well-developed construction industry. With an increase in population in Kenya, opportunities exist in the construction of residential, commercial and industrial buildings, including prefabricated low-cost housing (Wawira, 2016).

On the other hand, economic growth in most part of the world has recently occurred in developing regions. The case of sub-Saharan Africa shows the reverse as economic growth has slowed down recently. The economy decelerated in the first half of 2016 and monthly indicators from major economies point to another weak expansion in the second half. The sharp slowdown is being driven by both external and domestic headwinds. In particular, the deterioration in the external environment due to subdued commodity prices and tight financial conditions have negatively affected growth. Moreover, the governments' policy responses aimed at counteracting the economic slowdown have been very slow, thus deterring investment and raising uncertainty (Mançellari, 2016) .

The discourse on construction and economic growth has deepened in recent times, based on the outcomes of empirical studies that seeks to examine the role of construction industry in economic growth, relationship between construction and economic development, linkages between construction sector and other sectors of the economy, causality between construction industry growth and economic growth and among others. Most of these studies have been conducted empirically in developed economies, with few studies in developing economies. In the construction economics literature, a number of studies (Alagidede & Mensah, 2016; Field & Ofori, 1988; Ofori, 1990) have empirically shown a positive relationship between the construction sector and economic growth. Specifically, these studies have highlighted backward and forward linkages with other sectors of the economy as well as strong multiplier effect. But the empirical challenge which has not been properly addressed is that most of these studies take the positive relationship between construction and economic growth as linear, which has been highlighted by Bon (1992) as intrinsically non-linear. Also, there is still no consensus on whether construction causes economic growth or vice versa.

The non-linear relationship between construction and economic growth and development is widely known in the literature as Bon curve (inverted u-shaped), where investment in construction as a proportion of GDP rises with economic growth and development at the initial phases of development, reaches its maximum and thereafter, declines as the economy achieved higher levels of output growth and development. The intuition behind Bon curve is that earlier stages of economic development is characterized by intense processes of urbanization, demographic growth, creation of basic infrastructures and construction of industrial plants. Thus, the construction sector tends to grow faster than the rest of the economy during this phase, increasing its share in output. In later stages, as these processes reach maturity and start slowing down, growth in construction investment tends to slow down with respect to the overall economy (Girardi & Mura, 2014).

Statement of the Problem

It must be stress that a quite number of studies (Alagidede & Mensah, 2016; Crosthwaite, 2000; Field & Ofori, 1988; Gruneberg, 2010; Ofori, 1990; Rameezdeen & Ramachandra, 2008) have empirically analysed the relationship between construction expenditure and economic growth and stressed that there is a positive relationship between the share of construction expenditure in GDP and economic growth. Most of these studies that have analysed the relationship between output from the construction sector and economic growth and also, tested for the non-linearity (Bon Curve) between these underlying variables, both at the country and cross-country level, have yielded mixed results. While some studies (Crosthwaite, 2000; Girardi & Mura, 2014; Ruddock & Lopes, 2006) confirms the non-linear relationship (inverted U-shaped) between various measures of construction output and economic growth, the remaining other studies (Alagidede & Mensah, 2016; Choy, 2011) found contradictory evidence for the validity of the Bon curve.

Although some attempts have been made with regards to the analysis of the validity of the Bon curve, the empirical challenge is that most studies (Crosthwaite, 2000; Wong, Chiang & Ng, 2008) stopped at non-linear relationship between construction and economic growth and do not extend the analysis to find the turning point associated with such relationship. Again, there have been some methodological flaws that have led to inconclusive findings. Thus, most studies (Ruddock & Lopes, 2006; Yin, Lu & Jin, 2004) have been rather descriptive and also, did not consider the inclusion of control variables in their model specification. Hence, making the robustness of such findings questionable. This study, however, is taking further by analysing non-linear relationship between construction expenditure and economic growth using appropriate methodologies and then move beyond to establish the turning point or threshold level.

A research close to this study is Alagidede and Mensah (2016) which examined construction, institutions and economic growth in SSA. In the study, the non-linear relationship between construction and economic growth was analysed using a panel generalized methods of moments (GMM) approach for 26 sub-Saharan African countries for the period of 2000-2013. The study found no support for the Bon curve but rather suggest that construction sector is a marginal increasing function with output growth. Falling in line with this study, the validity of the Bon curve is re-examined by testing for inverted U-shaped relationship between share of construction expenditure in GDP and economic growth. The point of departure is that this current study widens the scope of analysis in terms of number of cross-sectional units (countries) and the time periods. Specifically, the study used 33 countries in sub-Saharan Africa over the period 1990-2014 for the analysis. This was done to capture the true nature of the Bon curve in SSA. The Bon curve is a long run phenomenon and needs to be re-examined especially for the case of SSA using a considerably time period. Furthermore, the study would extend the analysis to find the turning point, if any, associated with non-linear relationship which has been mostly ignored in the construction economics literature. This was done to know the point where the impact of construction expenditure on economic growth changes from positive to negative.

In addition to the above, current literature on the causal relationship between construction expenditure and economic growth have focused entirely on country specific studies (Anaman & Osei-Amponsah, 2007; Khan, 2008 Chen & Zhu, 2008; Alhowaish, 2015). No study to the best of the author's knowledge have tested for the causality between construction expenditure and economic growth across countries. On the basis of the above, this current study fill in these gaps to help learn more about the construction expenditure and economic growth nexus in SSA.

Objective of the Study

The general objective of the study is to re-examine relationship between construction expenditure and economic growth in 33 sub-Saharan African countries from 1990-2014.

Specifically, the study seeks to:

1. determine long run relationship between construction expenditure and economic growth.
2. determine short run relationship between construction expenditure and economic growth.
3. test for inverted U-shaped relationship between construction expenditure and economic growth.
4. establish direction of causal relationship between construction expenditure and economic growth.

Hypotheses of the study

1. H_0: There is no long run relationship between construction expenditure and economic growth.

H_1: There is long run relationship between construction expenditure and economic growth.

2. H_0: There is no short run relationship between construction expenditure and economic growth.

   H_1: There is short run relationship between construction expenditure and economic growth.

3. H_0: There is no inverted U-shaped relationship between construction expenditure and economic growth.

   H_1: There is inverted U-shaped relationship between construction expenditure and economic growth.

4. H_0: There is no causal relationship between construction expenditure and economic growth.

   H_1: There is causal relationship between construction expenditure and economic growth

Significance of the Study

The findings of this study are important to policy makers, researchers and development experts. Although significant progress have been made in terms of investment in construction in sub-Saharan African continent like Kenya, Ghana, Nigeria, Malawi, Tanzania, etc., still more needs to be done in terms of policies directed to the investment in construction activities as well as policies to shape the industry. This is because little attention has been given to the construction industry as a major driver of economic growth. This study is therefore used to highlight the importance of the industry as part of advocacy drive to convince policy makers in SSA. Moreover, the findings of this study will bring to the fore the significant role construction industry plays in an economy so as to enlighten policy decisions in relation to construction investments.

Adding to the above, this study which is updated and enriched version of the construction expenditure and economic growth nexus in SSA would serve as a useful template for further research and also, contribute to existing literature by enhancing knowledge on non-linear relationship (inverted U-shaped) between construction expenditure and economic growth. Besides, the study contributes to existing literature by examining causal relationship between construction expenditure and economic growth across countries in SSA.

Scope of the Study

The study analysed relationship between construction expenditure and economic growth using annual data from 1990 to 2014 for 33 SSA countries. The countries included in the sample are: Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Comoros, Congo Republic, Cote d'Ivoire, Equatorial Guinea, Gabon, Ghana, Guinea, Guinea-Bissau, Kenya, Madagascar, Malawi, Mali, Mauritius, Mauritania, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Tanzania, Togo, Uganda and Zimbabwe. For this 33 countries included in the sample, the following are the breakdown of the countries in each sub-region of SSA: Eastern Africa- 11 out of 19 countries; Western Africa- 13 out 17 countries, Central Africa- 6 out of 9 countries; and Southern

Africa- 3 out of 5 countries. This clearly shows the distribution of countries in SSA included in the sample of the study, and also justifies the representativeness of the countries in the sample as more than 50% of these countries are from the various each sub-regions in SSA. The study used panel Autoregressive Distributed Lag (ARDL) model - Mean group estimation technique (MG) developed by Pesaran and Smith (1995) and Pooled mean group estimation technique (PMG) developed by Pesaran, Shin and Smith (1999) - to analyse relationship between construction expenditure and economic growth.

Organisation of the Study

The study is organised in five chapters. Chapter one presents a background to the study, statement of the problem, objectives of the study, hypotheses of the study, significance of the study, scope of the study and the organisation of the study. Chapter two presents overview of the sub-Saharan economy with specific focus on the construction industry, theoretical and empirical literature review on the relationship between construction expenditure and economic growth. Chapter three also presents methodology of the study and techniques used in carrying out the study. Chapter four present findings of the study. Discussions and analyses were made with reference to the literature. Finally, chapter five concludes the study by presenting the summary, conclusion, recommendations based on the findings of the study, limitations and directions for future research.

CHAPTER TWO

LITERATURE REVIEW

Introduction

The broad aim of this chapter is to present the review of related literature on the relationship between various measures of construction and economic growth. This was aimed at getting supporting theories and empirical evidence for the study. This chapter was organised in three sections. The first section presents an overview of the sub-Saharan African (SSA) economy with specific focus on the construction industry. The second section focuses on the theoretical literature review on the relationship between construction expenditure and economic growth. Finally, the third section reviews empirical literature with specific focus on the non-linear relationship as well as the causal relationship between construction expenditure and economic growth.

Overview of the Sub-Saharan African Economy

According to the United Nations (UN), SSA is that part of Africa that lies south of the Sahara desert. It is very huge consisting of 49 countries, and according to data from World Bank (2016), SSA has a population of 1.001 billion people as at the end of 2015, with Nigeria and South Africa accounting for a greater share of the population. Sub-Saharan Africa has the world fastest growing populations estimated at 2.7% a year compared to 2% and 2.2% a year in Asia and Latin America respectively (Haggblade, Kirsten, Mkandawire, & de Vries, 2004). The region is generally regarded as the poorest region in the world and mostly, tagged with wars, hunger, squalor and diseases but it can also boast of rich culture and is abundant of natural resources. SSA have gross national income per capita of US$1,631.119 and life expectancy at birth is approximately 59 years at the end of 2015. The total land area of the region is 23,618,356 sq. km as at the end of 2015 (World Bank, 2016).

The economies of SSA are diverse and mostly consist of agriculture, industry and services. Generally, economic growth in SSA after independence in the 1960s have been quite disappointing. According to United Nation Conference on Trade and Development (2001), there was moderate economic growth in Africa as a whole from the mid-1960s to the end of the 1970s. The average growth rate achieved matched or exceeded the growth rate experienced in many developing countries in other regions but at the same time, the average growth rate was well below the rate achieved by handful of East Asian economies. Specifically, SSA during the 1970s achieved a remarkable improvement in economic growth as a result of commodity price boom and foreign aid. Also, savings gap remained relatively moderate and at the same time, investment in most countries in the region was above 25% of GDP.

Between the late 1970s and early 1980s, most economies in SSA got stagnated and worsened due to a combination of adverse external shocks, structural and institutional bottlenecks and policy errors (United Nation Conference on Trade and Development (UNCTAD), 2001). In most cases the stagnation was largely due to inappropriate economic policies which led to price distortions notably overvalued exchange rates, poor investment choices, increasingly budgetary deficits, growing inflationary pressures, loss of international competiveness, corruption in management of public resources and many others. These problems were compounded by rapid population growth, neglect of human resource development, deteriorating infrastructure and outburst of ethnic conflict and political instability (Calamitsis, 1999).

In an attempt to recover from the worsened economic conditions in the region, most countries in the late1980s and early 1990s adopted the Structural Adjustment Programme (SAP) and Economic Recovery Programme (ERP) under the World Bank and International Monetary Fund (IMF) initiatives. Although there were some initial setbacks in the implementation of these programs, it gained grounds in most of the countries in SSA and hence, notable transformations were seen in diverse areas of the economies. In 1995, there was a major turnaround in the SSA's economic performance as real GDP per capita growth rate showed an increasing trend. Besides, during the period of 1995 to 1998, real GDP of SSA was estimated to have grown at an annual average rate of more than 4%. Hence, per capita income began to rise appreciably in many countries. Also, inflation rates fell sharply from a peak of 47% in 1994 to an estimated 10% in 1998. Thus, for the first time in the region, there was a great transformation and economic progress as this was evident in the sound fiscal and monetary policies.

In 1999, the IMF and World Bank agreed on a new approach. Thus, low income countries in the region wanting financial aid or debt relief under the Highly Indebted Poor Countries (HIPC) initiative were required to develop poverty reduction strategies. Limited debt relief was eventually made available to some governments that accepted this conditionality. This program was, therefore, designed more to ensure that the remaining debts were repaid than to assist economic development. The HIPC initiative has not provided a significant reduction in the debt burden actually suffered by many African countries (Olamosu & Wynne, 2015). But notwithstanding that it continues to support most sub-Saharan African countries. For instance, 29 of 33 countries in Africa eligible under the HIPC initiative had reached completion point and qualified for irrevocable debt relief and Multilateral Debt Relief Initiative (MDRI) debt cancellation (African Development Bank Group, 2014). From the year 2000 to 2007, most African countries including sub-Saharan African economies have achieved notable economic growth largely from significant increase in the prices received for primary products. In the mid-2010s, private capital flows primarily from the private-sector investment portfolios and remittances began to exceed Official Development Assistance (Wikipedia, 2017a).

Most of the recent growth in the world economy has occurred in developing regions. International Monetary Fund (2013) indicates that of the top 10 fastest growing economies in the world, half were based in sub-Saharan Africa, with GDP growth in double digits. While some of this growth is linked to commodity price booms, the effect of investment and expansion in construction activities cannot be ignored. At the same time data from the United Nation Conference on Trade and Development, UNCTAD (2011), show that the construction sector has grown by about 5% in sub-Saharan Africa and it is on an upward trajectory (Alagidede & Mensah, 2016). According to International Monetary Fund (2016) current economic activity in sub-Saharan Africa has decelerated sharply and this is as a result of lower commodity prices and less-supportive global environment. It is worth noting that despite these headwinds economic growth is expected to reach 5.1% by the end of 2017 through significant investment in infrastructure, increase in agriculture and vibrant services.

The broad trend of economic growth measured using real GDP per capita growth rate is shown in Figure 1:

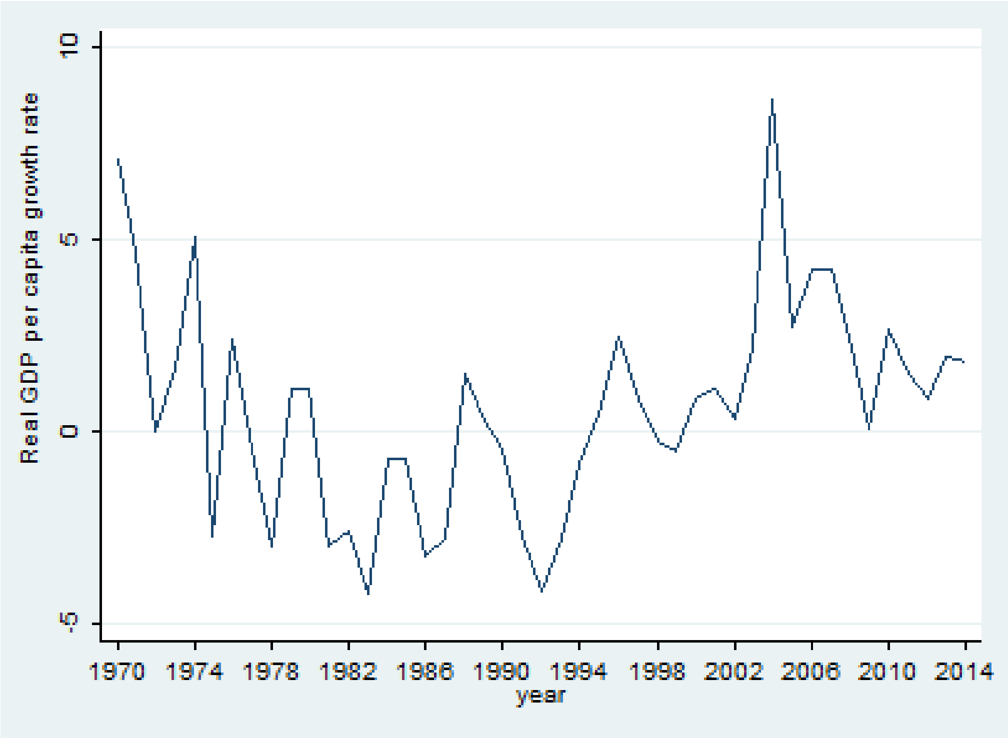

Figure 1: Trend of Real GDP per capita growth rates in Sub-Saharan Africa (1970-2014)

Source: Author's Construct based on data from WDI, 2016

Figure 1 shows the trend of real GDP per capita growth rate in SSA covering the period of 1970 to 2014. Looking closely at the trend analysis indicate that economic growth in the region since 1970s was generally low and quiet disappointing. Real GDP per capita growth rate between the early 1970s and early1990s has been very low and keeps fluctuating as most economies in SSA went into stagnation. There was a massive turn around in economic growth in the region in the mid-1990s and early 2000s as it is shown in the growth trend. During the period between the late 2007 and 2009 there was a slight decrease in economic growth caused by the effect of the global financial crisis and since then economic growth has been declining steadily with slight fluctuations.

The Nature of the Construction Industry in Sub-Saharan Africa

Construction industry is an industry of economic activity concerned with myriad of activities from the design phase to the engineering, procurement and the execution of small, medium and large-scale buildings and infrastructure projects. The activities of the industry include alterations, renovations and improvements of buildings and infrastructures. The construction industry in SSA is large, complex and geographically spread out. It is also diverse, with many factors influencing its performance, well-being and prospects at many levels. The industry is fragmented in terms of its roles of the participants as well as the distribution of the sizes of its component firms (Ofori, 2012). The industry has many participants which includes architects, engineers, management consultants, contractors, construction workers and users of constructed facilities. It also uses the services of building finance and insurance agencies, land developers, real estate brokers, material and equipment suppliers, manufacturers, among others. Furthermore, the government cannot be left out of construction industry. It interacts with the industry as a purchaser, financier, regulator and policy maker.

These participants are traditionally grouped into three namely clients, professionals and the contractor sectors which aid in the construction process. The client sector which serve as financers of various projects is made up of owners who may be an individual, a corporation, government, private and public organisations. Normally, what the client does is to first show interest or the need for a new facility and therefore, makes requirements for the facility and define his/her budgetary constraints. The selection of the site for the project, also, needs to be done by the clients. Although some of the client's responsibilities are often delegated to professionals on the project, the rest of the construction process primarily involve the assessment and approval of the activities of the participants. The professionals in the construction industry, on the other hand, includes engineers, architects and consultants. Generally, they perform a special task in the construction process which includes: ascertaining the needs and desires of the clients; developing a satisfactory design and drawing up plans and specification; aiding in the selection of the contractor and finally, overseeing that the project is performed in accordance with the construction contract documents while serving as a link between owner and a contractor.

In SSA, the professionals group is the underdeveloped part of the construction industry. This can be attributed to the fact that most construction activities in the region is carried out without professionals because of the high service fees they charge. These professionals are often employed by the public sector and other big private companies. Developing nations like SSA rely much on aid from developed countries in this area. Lastly, the contractors in the construction industry serves as resource managers whose main task is to assembly operations. The contractor sector of the industry is made up of general contractors, speciality contractors or sub-contractors, construction workers, and material and equipment manufacturers and suppliers (Rossow & Moavenzadeh, 1976).

The industry contributes directly to GDP by entering into the national accounts as a component of fixed investment. All products of the construction industry are regarded as investment goods or part of gross fixed capital formation in every country. In fact, the output from the construction industry constitutes a substantial portion of gross fixed capital formation ranging from 40% to 60% (Wells, 1985). It can, therefore, be over-emphasized that the importance of the construction industry in both developing and developed economies stems from the strong forward and backward linkage it has with other sectors of the economy.

In SSA, the construction industry is plagued with a lot of challenges and this is as a result of the economic weakness in these economies making it impossible for government to devote enough resources to the industry. The industry fails to receive the enough stimuli in terms of job opportunities and also, the market forces which support innovations are not present. Furthermore, many government of these countries do not recognise the importance and needs of the construction industry and therefore, do not formulate and implement programmes for upgrading the industry (Ofori, 2012). It is not surprising that the industry is also plagued by technical and managerial difficulties arising from skill shortages, and as a result, applications of technological and management techniques to construction processes. These attributes owe much to the fact that most construction firms are owned and managed by sole trader-type entrepreneurs with little knowledge of the workings of the construction industry (Ofori, 1991).

Construction Industry and Economic Growth in Sub-Saharan Africa

Construction is a key sector of every economy (Hillebrandt, 2000). The industry is very important because it contributes significantly to national socio-economic development by providing shelter, employment as well as contributing to output and income generation. In most economies, the construction industry constitutes a large part of the economy. It is significant to note that most studies have highlighted that construction contributes between 5% and 10% of GDP in all countries and also, employs about 10% of the working population as well as contributes to about half of the gross fixed capital formation (Lopes, 2012). It is also estimated that the investments in housing alone account for 2% to 8% of gross national product (GNP); between 10% and 30% of gross capital formation; between 10% and 40% of household expenditure; between 20% and 50% of accumulated wealth (Badiane, 2001). In this regard, it is imperative to note that the construction industry has the potential to contribute greatly to the economic growth of nation because of its size.

In SSA, the construction industry has seen some major improvements and also, contributed significantly to GDP. The construction industry share in GDP indicates the importance of the construction industry in SSA. Several examples can be cited but few of them have been highlighted using examples from the Kenyan and Nigerian construction industries. According to the Kenya National Bureau of Statistics, the real estate and the construction industry has contributed immensely to economic growth in the last five years. For instance, the output of the construction industry in Kenya grew by 13.1% in 2014 compared to 5.8% in 2013. The building and the construction industry contributed 4.8% to GDP, which rose to Sh 5.36 trillion from Sh4.73trillion in 2013 representing a nominal growth of 13.3%. At the same time, the growth in construction output was also mirrored in cement consumption which registered a 21.8% to 5,197 thousand tonnes in 2014, buoyed by enhanced construction activities. Some of the factors that contributed to the registered growth include the construction of the Standard Gauge Railway between Mombasa and Nairobi, the construction of roads and energy infrastructure and the improvement of the port of Mombasa (Kenyan Business Review, 2017). A similar example can also be seen in the construction industry of Nigeria. The construction industry in Nigeria is booming and it is regarded as a second largest employer of the economy, with around five percent of the population employed by the industry. The most important reason why the industry is enjoying massive growth can be attributed to the level of profits most firms are able to make on construction projects. For instance, the average profit margin on building projects is between 25% and 30%. All these advantages of the industry helps in contributing to economic growth and development.

An important revelation from Figure 2 shows that generally percentage share of construction expenditure in GDP for SSA during the period between 1970 and 2014 ranges from 3.2% to 7.5%, showing the important contribution the industry makes to economic growth and also, giving an indication of the unexplored potentials of the industry. From the late 1970s to the late 1980s, the share of construction expenditure in GDP for SSA decline sharply and this is actually the same time most economies in the region experience stagnation. Thereafter, it remained steadily until the early 2000s where there was a persistent increase in the share of construction expenditure in GDP. Given the upward trend of the share of construction expenditure in GDP recently, the potential question that needs answer is whether this rising trend in the construction industry really translates into economic growth.

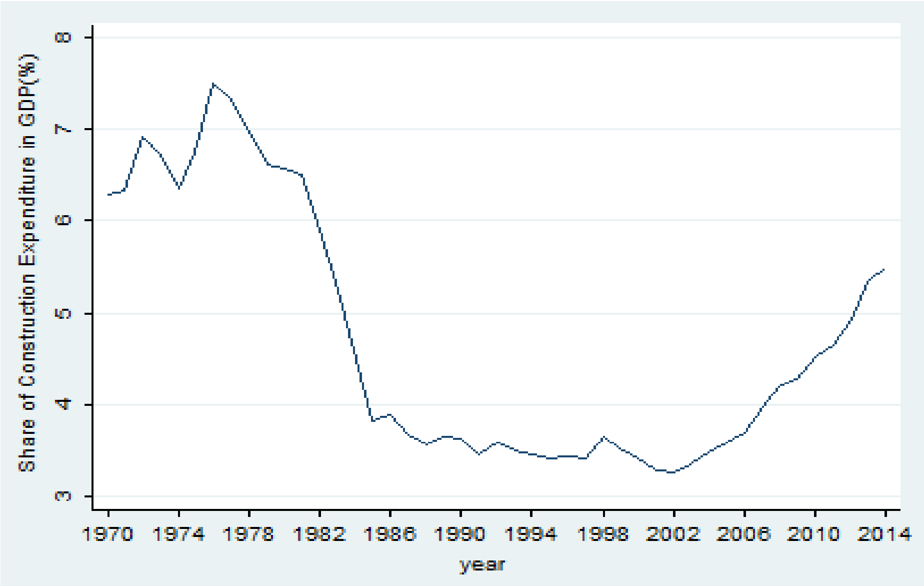

Figure 2: Trend of the share of Construction Expenditure in GDP in SSA (1970-2014)

Source: Author's construct based on data from UNCTAD, 2016

Figure 3 highlights the importance of the construction industry for the 33 individual countries used in the study from the period of 1990 to 2014. It is worth noting that a careful look at the figure shows generally that the values of the average share of construction expenditure in GDP for the individual countries differs slightly, with the highest figure of 10.24% to the lowest figure of 2.02%. The top five countries were Guinea (10.24%), Benin (6.98%), Tanzania (6.97%), Botswana (6.61%) and Ghana (6.39%), while the last five countries were Cote d'Ivoire (2.31%), Zimbabwe (2.29%), Guinea-Bissau (2.11%), Central African Republic (2.10%) and Sierra Leone (2.02%).

This analysis clearly showing the importance of the construction industry to its economies in the region. It is significant to note that the differences in the average share of construction expenditure in GDP could possibly be the differences in construction demand and the peculiar problems in the construction industry in these individual economies in SSA.

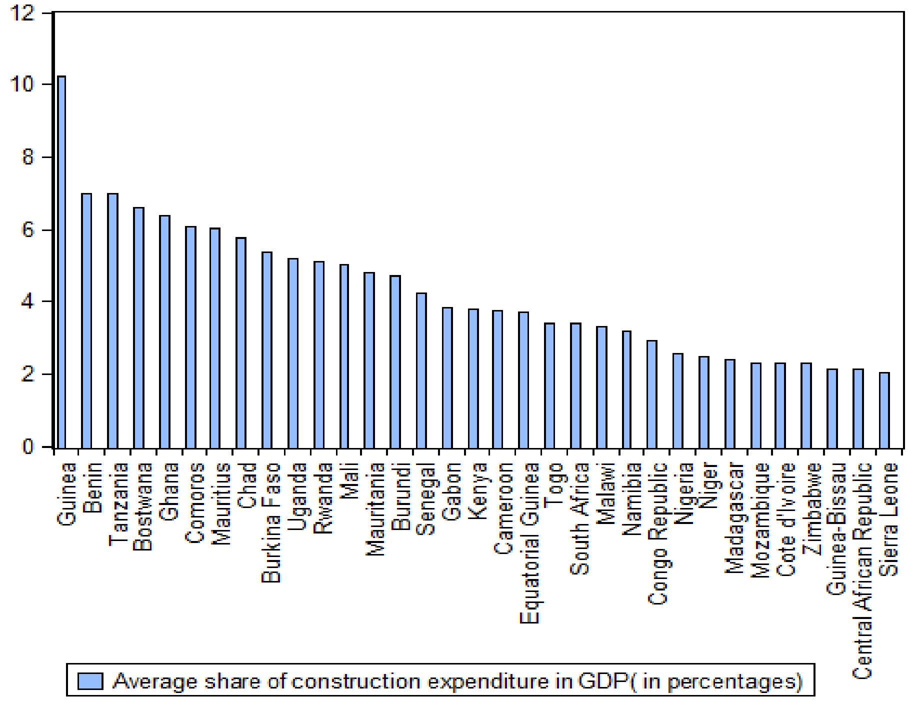

Figure 3: Average Share of Construction Expenditure in GDP (%) in SSA (1990-2014)

Source: Author’s construct based on data from UNCTAD, 2016

Theoretical Literature Review

Theoretical literature relating to the relationship between construction expenditure and economic growth was reviewed. In this section, the theoretical literature in construction economics is discussed according to the mainstream theory of economic growth and the non-linear relationship between construction and economic growth (Bon Curve).

Definition of Construction

Construction is part of investment and investment is a component of gross domestic product (GDP). Construction is not only limited to physical structures of various types used as inputs by industries but its description can simply be divided into residential and non-residential construction or private and public construction during ownership during construction period. It captures myriad of activities from the design phase to the engineering, procurement and the execution of small, medium and large-scale infrastructure projects. Also, it includes all activities relating to alterations, renovations and improvements of infrastructure. According to United States Census Bureau (2016), construction specifically includes the following:

1. New buildings and structures.
2. Additions, alterations, conversions, expansions, reconstruction, renovations, rehabilitations, and major replacements (such as the complete replacement of a roof or heating system).
3. Mechanical and electrical installations such as plumbing, heating, electrical work, elevators, escalators, central air-conditioning, and other similar building services.
4. Site preparation and outside construction of fixed structures or facilities such as sidewalks, highways and streets, parking lots, utility connections, outdoor lighting, railroad tracks, airfields, piers, wharves

and docks, telephone lines, radio and television towers, water supply lines, sewers, water and signal towers, electric light and power distribution and transmission lines, petroleum and gas pipelines, and similar facilities that are built into or fixed to the land.

5. Installation of the following types of equipment: boilers, overhead hoists and cranes, and blast furnaces.
6. Fixed, largely site-fabricated equipment not housed in a building, primarily for petroleum refineries and chemical plants, but also including storage tanks, refrigeration systems, etc.
7. Cost and installation of construction materials placed inside a building and used to support production machinery; for example, concrete platforms, overhead steel girders, and pipes to carry paint, etc. from storage tanks (United States Census Bureau, 2016).

The following are excluded from construction:

1. Cost and installation of production machinery and equipment items not specifically covered above, such as heavy industrial machinery, printing presses, stamping machines, bottling machines, and packaging machines; special purpose equipment designed to prepare the structure for a specific use, such as steam tables in restaurants, pews in churches, lockers in school buildings, beds or X-ray machines in hospitals, and display cases and shelving in stores.
2. Drilling of gas and oil wells, including construction of offshore drilling platforms; digging and shoring of mines (construction of buildings at mine sites is included); work that is an integral part of farming operations such as ploughing and planting of crops.

3. Land acquisition (United States Census Bureau, 2016)

Classification of Construction

Construction projects are classified as privately owned or government owned. The distinction is made on the basis of ownership during the construction period. According to the System of National Accounts (1993), construction is classified as residential buildings (dwellings) and non–residential buildings and other structures.

Residential Buildings (Dwellings)

Buildings that are used entirely or primarily as residences, including any associated structure such as garages, and all permanent fixtures customarily installed in residences. Houseboats, barges, mobile homes and caravans used as principal residences of households are also included, as are historic monuments identified primarily as dwellings. Cost of site clearance and preparation are also included.

Non-residential Buildings and Other structures

Buildings other than dwellings, including fixtures, facilities and equipment that are integral parts of the structures and cost of site clearance and preparation. Historic monuments identified primarily as non-residential buildings are also included. Examples include warehouse and industrial buildings, commercial buildings, buildings for public entertainment, hotels, restaurants, educational buildings, health buildings, etc.

Other structures consist of structures other than buildings, including the cost of streets and site clearance and preparation other than for residential and non-residential buildings. Examples include civil engineering works, such as highways, streets, roads, railways, airfield runways, bridges, elevated highways, harbours, dams, communication and power lines, local pipelines and cables, construction for mining and manufacture and construction for sports and recreation.

Construction Expenditure

Construction expenditure is the type of expenditure on all activities from the design phase to the engineering, procurement and the execution of small, medium and large-scale infrastructure projects. Thus, any expenditure on improving the built environment such as alterations, new structures and engineering and architectural works. Construction expenditure may be classified based on the classification of construction explained above.

Theories of Economic Growth

Economic growth in its simplest term can be explained as sustainable increase in the capacity of goods and services produced in economy from one time period to another. Overtime, several growth theories have emerged to explain economic growth as well as served as guide for policy formulations. These growth theories start from the classical growth theories to the recently neoclassical and endogenous growth theories. It is important to emphasize that both the classical and Harrod-Domar growth models provided the basic ingredients of economic growth and hence, have been usefully applied to develop other models such as the neoclassical and endogenous growth models.

For the purposes of understanding relationship between construction expenditure and economic growth, this study reviewed economic growth theories starting from one of the basic growth models, Harrod-Domar growth model, to the neoclassical and endogenous growth models.

Harrod-Domar Growth model

Harrod-Domar model is a basic economic growth model developed independently by two great economist namely Harrod (1939) and Domar (1946). This growth model named after its originators is a post-Keynesian growth model derived from the Keynesian economic thought. The basic premise of the Harrod-Domar model is that economic growth is driven by the level of savings and capital output ratio. Thus, the model emphasizes the importance of savings which must be used for investment to accelerate economic growth. The model was built based on the following assumptions: capital is the only scarce resource; capital and output are in constant proportion; consumption and savings are also in constant proportion to income; no depreciation assumed in the model as well as no gestation period for capital and finally, the model assumed a closed economy. These assumptions have been described by critics as very strong and rigid and hence, some of the rigid assumptions were later relaxed by some other economists.

The model was constructed on the following factors.

1. Savings (S) is some proportion (s) of national income (Y)

$$S = sY \tag{1}$$

2. Net investment (I) is defined as the change in capital stock and is denoted as ΔK

$$I = \Delta K \qquad (2)$$

Change in capital stock to national output is denoted by capital output ratio (k) and it is further simplified as;

$$K/Y = k \text{ or } \Delta K/\Delta Y = k \text{ or } \Delta K = k\,\Delta Y \qquad (3)$$

3. National savings (S) must equal net investment

$$S = I \qquad (4)$$

From equation (1), $S = sY$ and also, from equation (2) and (3), $I = \Delta K = k\,\Delta Y$

Therefore, the identity of savings equalling investment can be written as;

$$S = sY = k\,\Delta Y = \Delta K = I \qquad (5)$$

Or $$sY = k\,\Delta Y \qquad (6)$$

Dividing both sides of equation (6) by Y and k,

$$\Delta Y/Y = s/k \qquad (7)$$

where $\Delta Y/Y$ represent rate of growth

Hence, equation (7) is the simplified version of the Harrod-Domar growth model which states that the rate of economic growth ($\Delta Y/Y$) is determined jointly by national savings ratio (s) and national capital output ratio (k).

The model has several policy implications. As already indicated it is premised heavily on the Keynesian thought and that its strongest aspect lies on the implicit assumption it embodies regarding the stability of the consumption function. Thus, additional demand and consumption expenditure would be forth coming only if GDP expands. Therefore, since investment spending is the source of increases in aggregate demand needed to raise income from one period to another. Investment spending in the new period must exceed investment spending of the preceding period in order for the economy to realise the added potential income arising from that preceding period. Moreover, following from the Keynesian postulate of the tendency for the economy to be characterised by inherent instability over time, it is realised normal investment growth cannot automatically be sufficient to ensure the achievement of full employment (potential GDP). Therefore, this knife-edge growth path of the economy is up to result in incessant instability (spells of inflation and unemployment) unless it is actively managed by an active interventionist government policy. Additionally, the model also implies that the rate of savings is the principal determinant of growth of the economy under given levels of productivity of capital (capital output ratio) and the state of technology.

Although the Harrod-Domar growth model led to the renewed scholarly interest in the theory of economic growth, it was criticised on several grounds. Firstly, the model is less applicable to developing countries as it is difficult to increase the saving ratio in low-income countries. Most developing countries lack the capacity to generate the high level of savings. Secondly, the assumption of equality between savings and investment has been criticised as not been tenable in developing countries as most developing countries have open economies. Finally, the assumption of constant capital output ratio implies constant technology. However, technology changes overtime.

Neoclassical Growth Model

Another economic growth theory is the neoclassical growth theory. The neoclassical growth model used to examine hypothetical economy was developed by Solow (1956) and Swan (1956). This model is an extension of the Harrod-Domar model which assumes that labour force, capital accumulation and technology are the main factors which affect economic growth. It is worth noting that for an economy to experience economic growth, the Solow-Swan model believes that there should be an increase in labour and capital accumulation but economic growth becomes temporal because of diminishing returns. Once the steady-state is reached and the resources in a country are used up, economic growth rate can only be increased through innovation and improvement in technology. The model can be explained using a Cobb-Douglas production which assume constant returns to scale to capital (K) and effective labour (AL) and perfect competition. Thus, the Cobb-Douglas production function is shown below as;

$$Y = (AL)^{1-\alpha} K^{\alpha} \quad , 0 < \alpha < 1 \qquad (8)$$

where A denotes the current state of labour augmenting technological knowledge which is supposed to grow at an exogenously determined constant rate; Y represent aggregate output; K denotes capital. Although, the neoclassical model fits some stylized facts, when used for growth accounting it turns out that the model is unable to explain growth rates of output by relying on the accumulation of physical inputs (capital and labour), once output is corrected for increase in physical inputs, a large and persistently positive residual remains called the Solow – residual (Mulder, De Groot, &

Hofkes, 2001). The Solow-residual captures the fundamental driving force behind economic growth, namely technological progress. It must be stressed that neoclassical growth model emphasizes technological progress as the engine of growth but technological progress is exogenous. Thus, it does not explain technological progress but instead take it as given. The model explains balanced growth and conditional convergence and hence, served as a leading policy tool that guides development economists in their policy formulation.

Endogenous Growth Models

Endogenous growth models are also one of the widely used growth models put forward by Romer (1986) and Lucas (1988). This theory came about because most economist had registered dissatisfactions with the neo-classical growth theories which failed to explain technological progress but instead take it as exogenously given. The fascinating argument central to the endogenous growth theories is that economic growth is generated by internal forces but not external forces as argued by the neo-classical growth theorist. The endogenous growth theory relies on investment in human capital, innovation and knowledge as the main drivers of economic growth because it helps in the development of new technology and makes production more efficient. Thus, endogenous growth models endogenizes technological change by explaining the determinants of technological change that aid in economic growth.

Endogenous growth theory is made up of class of models that goes beyond the Solow growth model. The first of the class of models to endogenize technological change was made by Arrow who argued that growth rate of the effectiveness of labour is as a result of workers' cumulated experience in producing commodities, popularly termed as "learning by doing". This therefore implies that labour productivity is now endogenous and an increasing function of cumulated aggregate investment by firms. The distinguishing feature of Arrow model is that learning is conceived as a public good and is as a result of experience at the level of the whole economy with zero cost. A major step forward in endogenizing technological progress was set by Paul Romer who builds upon the contributions of Frankel and Arrow. The basic idea of his approach is that technology grows in proportion to the macroeconomic capital stock, potentially offsetting the effects of diminishing returns. Capital in such a setting should be considered as a broad concept, including human and intangible capital. This approach is currently known as the ''AK approach'' because it results in a production function of the form Y=AK with A constant. The individual firm's production function is specified below as;

$$Y_i = [A_i\,(K, L)\, L_i]^{1-\alpha}\, K_i^{\alpha} \qquad (9)$$

Here, it is important to note that when formulating this model the index of knowledge available to firm is related to the economy wide stock of capital and labour. The idea relating to this is simple and it remains that each firm's knowledge is a public good and hence, is accessible to every other firm at a zero cost. Also, the change in each firm's technology term A_i is related to the change in the aggregate capital and labour stock which are external to the firm. A simple specification for A_i is denoted below as;

$$A_i = [AK^{\beta}]^{1/1-\alpha} \qquad (10)$$

Aggregating over all firms, we arrive at the aggregate production function:

$$Y = AK^{\alpha+\beta} L^{1-\alpha} \tag{11}$$

Finally, in a special case in which $\alpha + \beta = 1$ and L is normalized at 1, the production function is simplified as follows;

$$Y=AK \tag{12}$$

Long-run economic growth can be sustained in the long run without relying on exogenous technological progress. An important idea in this model is that knowledge can be considered as a renewable capital, where K should be interpreted as knowledge. Within the model, long-run growth is determined by the (still unintended) accumulation of knowledge through representative individuals who maximize intertemporal utility (Ramsey model). The crucial assumption in this Romer model is that knowledge does have a non-decreasing marginal product, that is $\alpha + \beta \geq 1$. This can be interpreted as allowing for non-decreasing social returns to capital (knowledge) resulting in non-decelerating growth (Mulder, De Groot, & Hofkes, 2001).

The most recent development in endogenous growth theory is the so-called neo-Schumpeterian approach to endogenous growth theory. The essential characteristics of this approach is the existence of ‘‘creative destruction,’’ that is, the occurrence of a succession of innovations in one or more sectors, resulting from research activities, and implying a business stealing effect. An example of a Schumpeterian model of endogenous growth is where growth is fueled by a random sequence of quality improving innovations. The innovations ‘‘arrive’’ according to a stochastic Poisson process, and result from (uncertain) research activities. One of the implications of this model is again that the laissez-faire growth rate may be different from the socially optimal growth rate. The reason for this is the existence of three counteracting effects: the business stealing effect, the intertemporal spillover effect, and the appropriability effect (Mulder, De Groot, & Hofkes, 2001). In a nut shell, endogenous growth model examine the determinants of the rate of technological progress, which Solow takes as given. Thus, the endogenous growth model tries to understand and explain the economic forces underlying the engine of growth (technological progress). It also explains decisions that determine the creation of knowledge through research and development.

The development of the endogenous growth model was an improvement over the Solow model and hence, there existed some differences between them. Solow model treats technological progress as exogenously given but endogenous growth model endogenizes technological change by examining the determinants of the rate of technological progress; absence of diminishing returns to capital is another key difference between endogenous growth model and the Solow growth model; Solow model observes conditional convergence but endogenous AK model never observe this convergence and country factors like savings and investment lead to temporarily growth but in endogenous model these factors lead to permanent growth. All these explain the difference between Solow and endogenous models. There also exist some similarities between these models which include: the role of human capital is emphasized in both Solow and endogenous growth model and the fraction of output used for saving and investment, S, is also same for both models.

Keynesian Theory of Aggregate Demand

Before British economist John Maynard Keynes, classical economic theory argued that the economy would bounce back to full employment as long as prices and wages were flexible. As the unemployment rate soared and persisted during the Great Depression, Keynes formulated a new theory with new policy implications. Instead of a wait-and-see policy until markets self-correct the economy, Keynes (1936) argued that policy makers must take action to influence aggregate spending through changes in government spending. The prescription for the Great Depression was simple: increase government spending and jobs will be created. Although Keynes was not concerned with the problem of inflation, his theory has implication for fighting demand-pull inflation. In this case, the government must cut spending or increase taxes to reduce aggregate demand.

Instead of determining aggregate demand from the equation of exchange, Keynesians analyze aggregate demand in terms of its four components parts: consumer expenditure, the total demand for consumer goods and services; planned investment spending, the total planned spending by business firms on new machines, factories and other inputs to production, plus planned spending on new homes; government spending, spending by all levels of government (federal, state, and local) on goods and services (paper clips, computers, computer programming, missiles, government workers, etc.) and net exports, the net foreign spending on domestic goods and services, equal to exports minus imports (Mishkin, 2004). Using the symbols *C* for consumer expenditure, *I* for planned investment spending, *G* for government spending, and *NX* for net exports, aggregate demand (Y^{ad}) can be specified below as;

$$Y^{ad} = C + I + G + NX \tag{13}$$

Keynesian analysis, like monetarist analysis, suggest that the aggregate demand curve is downward-sloping because a lower price level, holding the nominal quantity of money constant, leads to a larger quantity of money in real terms. The larger quantity of money in real terms that results from the lower price level causes interest rates to fall. The resulting lower cost of financing purchases of new physical capital makes investment more profitable and stimulates or increase planned investment spending. The increase in planned investment spending adds directly to aggregate demand.

There are several factors that the Keynesians believe can shift aggregate demand curve. They actually believe that if the government spends more or net exports increase, aggregate demand rises and aggregate demand curve shift to the right. Again, a decrease in government taxes leaves consumers with more to spend, so consumer expenditure rises and hence, aggregate demand rises and aggregate demand curve shift to the right. Finally, if consumers and business optimism increases, consumer expenditure and planned investment spending rise and therefore, increase aggregate demand which shift aggregate demand curve to the right. Keynes described these waves of optimism and pessimism as "animal spirits" and considered them a major factor affecting the aggregate demand curve and an important source of business cycle fluctuations (Mishkin, 2004).

Bon Curve

In a seminal paper, Bon (1992) highlighted the future of international construction, secular patterns of growth and decline. It was one of the pioneering work that discussed the changing role of the construction sector at various stages of economic growth and development. Bon studied in detail the construction activities after World War II in Finland, Ireland, Italy, Japan, United Kingdom and United States of America, and proposed an inverted U-shaped relationship between construction and economic development (see figure 4). Specifically in the study, he was interested in some 50 years of historical development and at most 25 years of future development. Again, he was not concerned with economic cycles such as those of Kuznets (spans on 16 years on average) or Kondratiev (spans 45 -60 years and is related to major technological innovations) but was concerned only with secular trends. Finally, his definition of construction activity corresponds to that typical of national income accounts in use in most Advanced Industrialized Countries (AICs) since World War II. The definition of construction activity was rather narrow since it did not include a growing range of construction-related activities that took place off the construction site.

As highlighted by Bon (1992), the Bon curve is actually a bell-shaped curve or an inverted U-shaped relationship between construction and economic development, where investment in construction as a proportion of GDP rises with economic growth and development at the initial phases of development, reaches its maximum and thereafter, declines as the economy achieved higher levels of output of growth and development. According to Girardi and Mura (2014), the intuition behind Bon curve is that earlier stages of economic development is characterized by intense processes of urbanization, demographic growth, creation of basic infrastructures and construction of industrial plants. Thus, the construction sector tends to grow faster than the rest of the economy during this phase, increasing its share in output. In later stages, as these processes reach maturity and start slowing down, growth in construction investment tends to slow down with respect to the overall economy. Similarly, Tan (2002) also explained the Bon curve as follows: in low income countries construction output is low but as industrialisation proceeds, factories, offices, infrastructure and houses are required and construction output as a percentage of GDP reaches a peak in middle income countries and then tapers off in high income countries. At this stage infrastructure becomes more developed and housing shortages are less severe or are eliminated. The implication was that construction is a potential agent of economic development in the Keynesian sense and the idea was to accelerate construction projects and investment which in turn generate further growth.

The Bon curve is worth studying because it helps forecast construction sector dynamics and assess whether the size of the construction industry is in line with its long run pattern or short run factors (for example property bubble) are influencing it in a relevant way (Girardi & Mura, 2014).

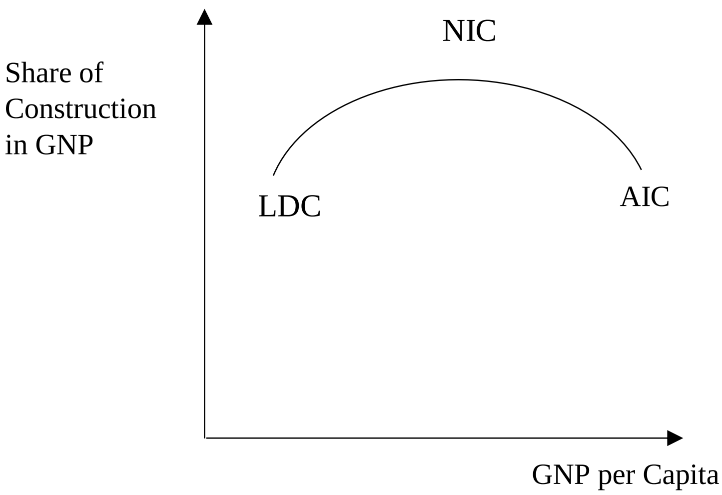

Figure 4: Share of construction in GNP versus GNP per capita

Empirical Literature Review

The discourse on various measures of construction activity and economic growth has witnessed significant increase in recent times, based on the outcomes of empirical studies that seek to examine the role of construction industry in economic growth, relationship between construction and economic development, linkages between construction sector and other sectors of the economy, causality between construction industry growth and economic growth and among others. Given the expansive empirical literature on the subject, this study present a review of related empirics with focus on the non-linear relationship between economic growth and various measures of construction activity as well as the causal relationship between the construction and economic growth. This was done to support this current study as well as points out some gaps and inconsistency in the existing literature.

Empirical Literature Review: Non-linear Relationship between Construction Expenditure and Economic growth

Turin (1978) examines briefly the place of construction in the world economy, its dynamic relationship with other major development indicators, the main technological problems facing the industry in developing countries and a set of broad policy issues. The argument and analysis of trend of the study were based on the author's personal experience of construction in the developing countries and on the results of research carried out by members of the Building Economics Research Unit (BERU) of University College London. The study used a sample ranging from 1960-1978 for 87 countries. The data from each country were plotted in a graph and a regression line was fitted. It was found out that the share of construction grows from 4-8% between US$100-400 per capita and that the highest rate of increase occurs in the middle range of countries (US$100-400). The study, therefore, concluded that there is an S- shaped relationship between the percentage value added in construction and GDP per capita. Thus, the share of construction in GDP grows first at an increasing rate and then at a decreasing rate with the level of economic development, measured in terms of GDP per capita. However, the intrinsic nature of the relationship remains unknown.

Drewer (1980) examined construction and development and argued that there is a reasonably well defined relationship between construction output and the level of development and also, highlighted an indication of positive correlation between per-capita value added by construction and per capita GDP. The study interpreted the positive correlation as the changing profile of construction within specific national economies moving through various stages of development. It also implied that an increase in expenditure in construction by lower income countries will stimulate economic and social development.

The influential study of Bon (1992) highlighted the changing role of the construction sector at various stages of economic development using data spanning 50 year period, mostly among European countries. The study proposed that there is bell-shaped or an inverted U-shaped relationship. Bon explained this bell-shaped relationship to mean that share of construction activity first grows in the early stages of economic development and then declines in the later stages. The inverted U-Shaped relationship is associated with less population growth, less migration and the assumption that most physical capital is already in place in later stages of economic development. Bon's study had the following caveats to his prepositions which includes: first, he was concerned with some 50 years of historical development and at most 25years of future development; second, he was also concerned with secular trends and not concerned with economic cycle and lastly, the definition of construction activity corresponds to that typical in national accounts used in most advanced industrial countries (AICs) since World War II. Bon (1992) inverted U-shaped relationship is different from Turin (1978) S-shaped. Bon argued that the main reason for Turin's S-shaped relationship is that his sample was from 1960-1970 and also, dominated with less developed countries (LDCs) and newly industrialized countries.

Also, Crosthwaite (2000) using cross-sectional data for 150 countries during 1996-1998 investigated the extent of international construction activity.

Specifically, the study sought to perform analysis on the data to establish whether any relationship exist. Additionally, values for construction were calculated to observe the role of the construction sector in various regional and national economies. The study used a quadratic least square regression to find an inverted U-shaped relationship between construction spending as a share of GDP and GDP per capita. Crosthwaite argued that this relationship suggest that the share of construction in GDP first grows during LDC status, peaks during newly industrializing countries (NIC) and then declines as countries move from NIC to AIC status. The study also suggested that average construction spending as a share of GDP is at its highest at approximately $3000 GDP per capita level. Furthermore, the study concluded that the role of construction changes as economic development proceeds from LDC to AIC status. It was again concluded that LDCs experience the fastest growth in construction spending and also, as economic development proceeds NIC to AIC status construction fails to maintain its share of GDP and therefore, declines in importance. The study identified the importance of construction within NICs at both the regional and national level. Finally, the study, therefore, recommended that future research can focus on time series analysis can be used to re-examine the relationship.

Yiu, Lu, Leung and Jin (2004) performed a longitudinal analysis on the relationship between construction output and GDP in Hong Kong using a quarterly data ranging from 1984q1 to 2002q2. The study first used Granger causality test to examine the causal relationship between real growth rate of construction output and real growth rate of GDP. It also explored the non-linear relationship between real growth rate of construction output and real growth rate of GDP using ordinary least square regression. With regards to the causality test, the study found that the growth of real GDP Granger caused the growth of construction output. Additionally, the regression model showed that construction growth and economic growth were not linearly related. Hence, the study concluded that the growth rate of GDP led that of construction output and as the growth rate of GDP increased, the growth rate of construction output was marginally diminishing. The study agrees with the proposition that construction industry is relatively inefficient in productivity improvement and accumulation of capital investment results in marginally diminishing growth of construction output. Finally, the study called for further study using panel data approach because its uses both cross-sectional and time series in one data set and also, because of the limitation of the longitudinal analysis which assumed no structural change of the industry over time.

Ruddock and Lopes (2006) examined construction sector and economic development. The study used graphical approach in analysing the validity of the Bon curve. First, 75 countries were grouped according to their stages of economic development using GDP per capita for the year 2000. It was shown that the share of construction in GDP varies widely across countries. In addition, the mean values for the percentage of GDP in construction were computed and depicted graphically. It was shown that the level of construction activity increased as the level of GDP rises but falls for final category, consisting of industrially developed countries. Again, the study compared the changing situation of these countries from 1994-2000. Data for both gross value added (GVA) in construction and GDP per capita were readily available for 35 countries and hence, were used to group the countries according to their stages of development. Relative change in GVA in construction were computed and its trend analysis was shown. The pattern of the graphs depicted in the study demonstrate that the inverted U-shaped holds for the share of construction in the national economy.

Wong, Chiang and Ng (2008) re-examined construction and economic development in Hong Kong. The study investigated the causal relationship between the gross value of construction works (GVCW) and GDP with Granger causality test using quarterly time series data from 1983q1 to 2006q4. The Granger causality test revealed that construction activity granger caused GDP implying that growth of the construction sector leads to general economic growth but not vice versa, at least in the medium term (8 and 12 quarterly lags). The results indicated that the past values of GVCW help predict GDP in Hong Kong. Additionally, using GVCW per capita and GDP per capita, the non-linear relationship was tested using least squares regression with a quadratic term of GDP per capita. The findings showed a non-linear relationship which supports the hypothesis that construction investment is a marginal diminishing function with the GDP in the economic development process of an advanced industrialized city. By sketchily scrutinising the graph of GDP per capita and GVCW per capita, the study found a V-shaped relationship instead of a U-shaped relationship and this was attributed to the substantial increase in construction works generated from the Port and Airport Development Strategy (PADS) and the aggressive public housing programme launched by the government of Hong Kong. Finally, the study concluded that the role of local construction industry changes as the economy matures from newly industrializing country (NIC) to advanced industrialized country (AIC) status, as revealed by the by the diminishing rate of capacity addition by construction. The study therefore complied with Bon's inverted U-shaped relationship between construction activity and gross domestic product (GDP).

In another study, Gruneberg (2010) investigated whether Bon curve holds in the infrastructure market using cross-sectional data for 26 European Union (EU) countries, Iceland, Norway, Turkey and Switzerland for 2005. Using a simple regression estimation technique with share of infrastructure investment in GDP as the dependent variable and the level of economic development, proxy by GDP per capita as the explanatory variable, the study tested the null hypothesis that GDP per capita does not explain the level of infrastructure investment. It was found that the t-statistic of GDP per capita was not statistically and therefore, the null hypothesis was not rejected implying that GDP per capita does not explain the level of infrastructure investment. The study, therefore, concluded that when comparing different countries in terms of the Bon curve, the stage of development is not a predictor of infrastructure investment. Thus, the Bon curve does not fit the cross –section data analysed.

Choy (2011) revisited the Bon curve using aggregated data on gross value added (GVA) in construction and GDP per capita covering 205 countries from 1970 to 2009. Specifically, the study sought to find out whether there is an inverted U-shaped relationship between the share of total construction in GDP and GDP per capita; whether the inverted U-shaped relationship holds for any one country over time and finally, whether the decline of construction activity switches from relative to absolute at some level of economic development. The study, therefore, relied on analysis of variance (ANOVA), post hoc test and quadratic regression to verify Bon's preposition. Also, both cross-sectional and longitudinal analysis were used to confirm Bon's prepositions. Evidence from the study showed that the inverted U-shaped relationship between construction activities and the level of economic development was not confirmed when the aggregated data of all countries over the time period was considered simultaneously. The relationships across countries at a given time were not confirmed in the majority of the yearly aggregated data. Within country analysis overtime confirm the relationship in 78 countries, mostly in high and upper-middle income countries. There was also not enough evidence to support Bon's preposition that 'volume follows share'. Declines in construction were found in most of the high income economies. Finally, it was concluded that Bon curve should be interpreted as explaining variation within the developed economies over time.

Girardi and Mura (2014) examined the construction – development curve using the between group estimator among 128 countries worldwide from 2000 to 2011. The panel study, therefore, divided the sample periods into two sub-periods (2000-2006 and 2007-2011) to take into account structural change and avoid a non-stationarity bias in the estimated coefficients. The first step the study took in examining the preposition of the Bon curve was to estimate a regression with a quadratic term using different measures of construction (construction investment as a share of GDP and construction share of value added) and economic development, proxy by GDP per capita. It was found that in both cases the inverted U- shaped relationship holds. Additionally, the study re-examined the Bon curve using a broader measure of economic development, Economic Development Index (EDI), to replace GDP per capita. It was also found out that the Bon curve holds but yields a higher explanatory power. To test for the robustness of the Bon curve, the study augmented the model with other control variables. It was found out that both linear and the quadratic coefficient was still significant with the expected signs, implying that there is an inverted U-shaped relationship. Hence, it was concluded that the curve fits better when employing alternative indicators to measure the level of economic development instead of per capita GDP. This supports the intuition that the size of the construction sector is not just a function of per capita output but is related to broader socio-economic trends which are intimately linked with economic development, namely urbanisation, industrialisation and creation of basic infrastructures. The curve was also robust to the inclusion of other control variables in the model.

Alagidede and Mensah (2016) in a related study using a panel data consisting of 26 countries in SSA from 2000 to 2013 investigated construction, institutions and economic growth. The study using panel generalized methods of moments (GMM) showed that construction activities have positive impact on economic growth with sub-regional differences. It was found out that the effects of the construction sector on economic growth is much greater in East Africa compared to West and Southern Africa. The study also tested for the non-linearity between construction and economic growth and found no evidence in support of the inverted U-shaped relationship between construction and economic growth. The results implying that the construction sector is a marginal increasing function with economic growth. Moreover, the study interacted construction with institutional variables and found a positive effect for the interaction term on economic growth. The study, therefore, suggested that improving institutional capabilities could aid in the effective realization of the impact of the construction sector on economic growth. Suggestions was therefore made that there should be further development of institutions that enforce property rights, reduce the burden of bureaucracy, foster economic freedom and ensure a corruption-free environment.

Although some attempts have been made with regards to the analysis of the validity of the Bon curve, the foregoing empirical literature review shows how sparse the literature on the relationship between construction and economic growth and development and also, points out the empirical challenge which remains that the findings from most of these studies has not been properly analysed. There are some methodological flaws which has led to inconclusive findings on the non-linear relationship between various measures of construction and economic growth. Most of the test for the validity of the Bon curve have been rather descriptive. Testing for the robustness of the Bon curve with the inclusion of other control variables in the model specification have not been analysed rigorously. The Bon curve is a long run phenomenon and needs to be tested using a considerable number of years or time periods in SSA. Alagidede and Mensah (2016) used a sample time period which is considered as small in testing the inverted U-Shaped relationship between construction and economic growth in SSA and hence, the time periods needs to be extended across countries in SSA to be able to examine the true nature of the Bon curve. Hence, this current study addresses these gaps by making use of recently developed Panel ARDL estimation technique as well as augmenting the model with some control variables such savings, trade openness, inflation and Polity2 to re-examine the inverted U-shaped relationship between construction expenditure and economic growth in SSA from 1990 to 2014.

Empirical Literature Review: Causal Relationship between Construction Expenditure and Economic growth

Studies on the causal relationship between various measures of construction and economic growth have witnessed significant increase, at least in the last two decades. In that regard this current study present a few empirical literature review on the subject.

Tse and Ganesan IV (1997) investigated lead-lag relationship between construction sector and the aggregate economy using Granger causality test from 1983q1 to 1995q1. The study first tested for unit root for construction flow and GDP and found that both variables are stationary at I(1). Granger causality test was then carried out between construction flow and GDP at both levels and first difference. It was realized that GDP granger cause construction flow, implying that GDP tends to lead the amount of construction flow and not vice versa, at least in the short term. The results of the study was significant for policymakers particularly in the short term because it is macroeconomic policy of the government which affects output and influences the construction activity.

Hongyu, Park and Siqi (2002) studied the interaction between GDP and housing investment as well as non-housing investment in China from

1981-2000. The study first used the Granger causality test and first difference Vector autoregressive (VAR) model to test the causality between housing investment and non-investment. The findings from both test showed that non-housing investment leads to housing investment, implying that there is a unidirectional relationship between non-housing investment and housing investment. Additionally, the study tested for both long run and short run causal relationship between GDP and housing investment as well as non-housing investment. Empirical evidence showed that housing investment has significant influence on GDP in the long run and vice versa, implying that there is bidirectional relationship between housing investment and economic growth in the long run. A similar effect was found between non-housing investment and economic growth in the long run. Again, with the short run findings, it was revealed that housing investment has a short run influence on GDP and not vice versa. The short run effect of housing investment on economic growth was clearly stronger than that of non-housing investment.

Chang and Nieh (2004) examined the causal relationship between construction activity and economic growth using multivariate Error Correction Model (ECM) for Taiwan from 1979q1 to 1999q4. The study tested for cointegration using Johansen, and Johansen and Juselius cointegration tests and found cointegration among four variables namely real GDP, real investment in construction activity, real government expenditure and real private consumption expenditure, with one vector. Granger causality test based on the vector ECM was performed and a unidirectional causal relationship running from construction activity to economic growth, both in the short run and long run, was found. It was concluded that the findings of the study has important implications with respect to developing economic policy regarding the role of construction activity in Taiwan.

Ching, Shao, Yu and Liu (2005) empirically examined the relationship between residential real estate price and national output in Hong Kong. They focused their testing methodology on the Granger causality test and employed time series data on residential real estate price and national output GDP from 1978 to 2004 for their analysis. They concluded that real GDP Granger-caused residential real estate price, but residential real estate price did not Granger-cause real GDP.

Anaman and Osei-Amponsah (2007) in a related study using Granger causality test analysed the causal links between growth in the construction industry, measured using construction value added to GDP and the growth in the macro-economy, measured using GDP from 1968 to 2004. The study controlled for political stability by including a dummy variable in its model specification. Empirical evidence from the study indicated that growth in the construction industry Granger caused growth in GDP, with a three- year lag. This implies that construction industry is the driver of economic growth and hence was recommended that the government of Ghana needs to consider construction industry as one of the major drivers of economic growth.

Khan (2008) examined the causal relationship between the construction sector and economic growth in Pakistan from 1950 to 2005. In analysing whether there is a unidirectional or bidirectional causal relationship between construction flow and GDP, the study used Granger causality test. It was realized that construction flow Granger cause GDP but not vice versa, implying that there is a unidirectional relationship between construction industry and aggregate economy of Pakistan. It was, therefore, concluded that because of the significance of the construction sector it is necessary to identify the major issues affecting the efficiency of the sector and take corrective actions for the increase in economic growth and development of Pakistan.

Jackman (2010) examined the impact of residential construction on economic growth in Barbados using a quarterly data ranging from 1990q1 to 2008q2. Specifically, the study sought to empirically analyse the direction of causation between residential construction and economic growth using Granger causality test. The results from the study indicated that there is a bidirectional relationship between residential construction and economic growth. Thus, residential construction Granger cause economic growth and vice versa. Hence, it was concluded that the findings are more so indicative rather than conclusive since the movement of construction activities and economic growth are driven by some underlying factors.

Chia, Skitmore, Runeson and Bridge (2011) studied property investment, construction and economic growth in Malaysia from 2000q1 to 2010 q4. Specifically, the study sought to find out, using Granger causality test, the nature of causality between construction value added and GDP; property value and GDP and finally, construction value added and property value. It was revealed from the test that a unidirectional causality from construction value added to GDP growth exist. Thus, the causality runs from construction value added growth to GDP growth at least between lag 2 to 10 quarters with the exception of lag 6 and 9 quarters. Again, it was found out that there is a bi-directional causal relationship between property value growth and GDP growth. Thus, causality runs from GDP growth to property value growth for 2, 10 and 11 quarters but the reverse holds at lag 7 quarters. Furthermore, empirical evidence from the study also suggest that there was no direction of causality between property value growth and construction value added growth.

Tiwari (2011) examined the lead-lag relationship between construction flow and economic growth, both in static and dynamic framework by incorporating endogenously determined structural changes of the construction sector and the economy of India ranging from the period of 1950 to 2009. The study employed Johansen cointegration test which test for cointegration among variables in the presence of two structural breaks. The cointegration test revealed a strong cointegration relationship between construction flow and economic growth. Moreover, to find the lead-lag relationship between construction flow and economic growth, the study employed Vector Error correction Modelling estimation technique to establish a bidirectional relationship between construction flow and economic growth in India. The study also found out a positive and significant value of the error correction term which implies that any disequilibrium in both variables would not be corrected, but would diverge. Empirical evidence from the dynamic Granger causality test revealed that one standard deviation shock in GDP had a negative impact on the construction sector for the first 10years while for the long run its impact starts working in the positive direction. On the other hand, for the first years any one standard deviation shock in the construction sector had a positive impact on the GDP of the economy while for the long run its impact starts working in the negative direction. Based on the findings of the study, it was therefore recommended that the government of India, in the short run, can focus on the development of the construction sector as its increases its GDP. But in the long run the government should gradually cut down expenditure on the construction sector.

Ozkan, Ozkan and Gunduz (2012) in a related study investigated the causal relationship between construction investment and economic growth in Turkey. The study highlighted the importance of the construction sector with much emphasis on its sub-sectors. Investment in the construction sector, in the study, was divided into public construction investment, private construction investment and infrastructure investment. Evidence from the study showed that there is cointegration or long run relationship between public construction investment and economic growth as well as infrastructure investment and economic growth. The reverse was found between private construction investment and economic growth. With regards to the causality test, it was realised that there is a bidirectional relationship between infrastructure investment and economic growth as well as public construction investment and economic growth. Hence, the study suggested that government should attach importance to the public construction investment in the long run because it positively affects economic growth.

Ramachandra, Rotimi and Rameezdeen (2013) investigated the direction of causal relationship between the construction sector and the national economy of Sri Lanka using annual data from 1990 to 2009. The study used Granger causality test to examine the lead-lag relationship between Construction Value Added (CVA) and GDP. It was found out that GDP Granger causes CVA and not vice versa. This implies that economic growth in

Sri Lanka leads the construction sector and not vice versa. It was, however, concluded that the findings could be justified for a developing country like Sri Lanka where generally construction is subject to fluctuations. Again, it was highlighted that during periods of rapid economic expansion, construction output usually grows faster than those of other sectors but during periods of stagnation the industry is the first to suffer. It was, therefore, suggested that government being the major client of the construction industry could use the construction industry as an economic regulator whereby it could reduce construction demand by cutting back on construction projects or investment funds when an economy is overheating. Thus, the Sri Lankan economy could prioritize investment so as to increase economic growth and optimize the use of the construction sector.

Kargi (2013) examined the interaction between construction industry and economic growth in Turkey using quarterly data from 2000 to 2012. In the study, the causal relationship between public construction expenditure and GDP as well as private construction expenditure and GDP was analysed using Granger Causality test. It was found out that the share of public construction expenditure in GDP Granger causes GDP and vice versa. This implies that there is a bidirectional relationship between public construction expenditure and economic growth. Similarly, evidence from the study, also, showed a bidirectional relationship between private construction expenditure and economic growth. Thus, the share of private construction expenditure in GDP Granger causes GDP and vice versa.

Oladinrin, Ogunsemi and Aje (2014) in a comparative study examined the causal relationship between construction growth and economic growth in

Nigeria and South Africa from 1982 to 2011. Also, the study tested whether economic growth in one country has a causal effect on the construction sector of the other. The study employed Granger causality test to carry out the analysis. Empirical evidence from the study revealed a strong relationship between construction and the aggregate economy of South Africa and Nigeria. For South Africa, it was found out that GDP Granger-caused construction sector and not vice versa at one-year lag, implying that the relationship is unidirectional which means that GDP tends to lead the amount of construction output by one year. Data from Nigeria, on the other hand, revealed that construction output Granger cause GDP and vice versa after one and three years. This implies that there is a bidirectional relationship or feedback effect between the construction sector and the aggregate economy. Therefore, it was concluded that construction activities is more volatile than the aggregate economy in Nigeria. Additionally, the study analysed the causality link between construction sector in Nigeria and aggregate economy of South Africa and vice versa. It was shown that economic growth of South Africa leads the growth in the construction sector of Nigeria by one and three-year lag and not vice versa. This implies that the relationship is unidirectional meaning that Nigerian construction sector is preceded by a growth in South African economy which could be linked to investment flow from South Africa into Nigeria that takes some time to manifest in the form of boom in the construction sector. Similarly, it was realised that construction sector in South Africa Granger causes economic growth in Nigeria and vice versa. Thus, the relationship is bidirectional meaning that economic growth in Nigeria leads construction sector in South Africa and vice versa. Finally, the study concluded that construction sector in Nigeria is more volatile than that of South Africa construction sector despite the leading economy of South Africa. It was, therefore, recommended that policy makers in Nigeria should recognize this formidable sector that is capable of leading its entire economy.

Bolkol (2015) examined the causal relationship between construction production and GDP for Turkey using quarterly data from 2005q1 to 2013q4. The study used VAR Granger causality test for short run causality because no long run relationship was found between the variables. The findings from the study revealed that the direction of causality runs from GDP to building production and building production to non-building production. Empirical evidence from the study also suggest that there is no long run relationship between construction production and GDP. Again, the causality in the short run runs from GDP to construction production. Based on the findings, it was, therefore, concluded that economic growth strategy based mainly on the construction sector is not a good idea since they are not related to each other in the long run.

Alhowaish (2015) examined the causal relationship between construction sector and economic growth in Saudi Arabia using Granger causality test and Vector Error Correction Model (VECM). The study used time series data on construction flow, oil revenue in local currency and real GDP from 1970 to 2011. Empirical findings using both estimation techniques revealed that that there is a bidirectional relationship between construction and economic growth in the long run. This implies that construction Granger causes economic growth and vice versa. For the short run analysis, the results suggested that there is a positive but insignificant causality between construction and economic growth in Saudi Arabia. Saudi Arabia is an oil rich resource country and hence, movement in construction activities and economic growth may be driven by underlying factors such as oil revenues. Therefore, the study included oil revenue as a conditioning variable in the VECM model. It was found out that there is a strong causality that runs from economic growth and oil revenue to the construction industry with feedback effects that run from construction to economic growth (bidirectional relationship). Again, the construction industry does not Granger cause oil revenues in the long run (unidirectional relationship). Additionally, there were also no causal relationship between economic growth and oil revenues in the long run but the reverse happen in the short run meaning that oil revenue have significant effects on economic growth.

Erol and Unal (2015) using three variables namely real growth rate, value of construction in GDP and real interest rate provided a new evidence with regards to the role of construction sector in economic growth of Turkey from 1998q1 to 2014q4. The Zivot Andrews test for structural break was used to determine structural break point in the data and hence, the whole sample period of 1998 - 2014 was divided into sub-sample periods of 2002-2007, 2010-2014 and 2002 -2014. The study, therefore, used both two-variable Granger causality test and the multivariate VAR model to analyse the causal relationship between construction investment and economic growth for the whole sample period as well as sub-sample periods. Empirical evidence from the study using both Granger causality test and Multivariate VAR model showed that for the period of 1998q1 to 2014q4 economic growth preceded construction activities with two to four quarter lag but not vice versa. For the first sample period of 2002-2007, both test indicated that there was no statistically significant causal relationship between GDP and construction investment. Additionally, for second sample period of 2010-2014 both test showed that expansion in construction activities causes GDP growth for at least four optimal lag quarters. The last sample period of 2002 -2014 showed that there is bidirectional relationship between GDP growth and construction investment using both Granger causality test and multivariate VAR model. It was therefore concluded that construction activities have short-lived effects on the economic growth and thus, cannot offer permanent solutions for the economic troubles in Turkey.

Okoye, Ngwu, Ezeokoli and Ugochukwu (2016) investigated the causal relationship between construction sector and economic growth in Nigeria using quarterly data from 2010 to 2015. Using the Granger causality test, the study showed that construction growth Granger causes GDP growth with a lag order of 2 and vice versa. This implies that there is a bidirectional relationship or feedback effect between construction sector growth and economic growth at an optimal lag of two. The study further explained that both construction growth and aggregate GDP growth can influence each other to a certain extent. Finally, the study recommended for positive construction policies as the construction sector has the potentials for improving and growing national economy and recovering economy from recession.

With regards to panel analysis, Chen and Zhu (2008) re-examined the relationship between housing investment and economic growth in China using quarterly province-level panel data for the period of 199q1 to 2007q4. Specifically, the study used panel error correction model to examine both short run and long run causal relationship between housing investment, non-housing investment and economic growth. Also, sub-panel analysis on the subject based on geographical decomposition of china was conducted to check for robustness of the results for whole country as well as to find out how the relationship between housing investment and economic growth vary with degrees of economic development. The findings from this study revealed that there is a strong bidirectional relationship between housing investment and economic growth as well as non-housing investment and economic growth in the short run. Similarly, long run bidirectional relationship was found between housing investment and economic growth as well as non-housing investment and economic growth. With the sub-panel analysis, a strong bidirectional relationship between housing investment and economic growth as well as non-housing investment and economic growth was found, both in the short run and long run, in the eastern part of China. However, in the middle part of China, the study showed that bidirectional relationship exist only between non-housing investment and economic growth both in the short run and long run. Rather, housing investment leads economic growth both in the short run and long run and not vice versa. Additionally, the study also revealed, in the western part of China, a unidirectional causality running from economic growth to non-housing investment both in the short run and long run. There was no causal relationship found between housing investment and economic growth in the long run but a weakly unidirectional causal relationship running from housing investment to economic growth in the short run. Finally, it was, therefore, concluded that there was bidirectional relationship between housing investments and economic growth in China, both in the short run and long run while the impacts of housing investment on economic growth differs in the three sub-regions of China.

The above empirical literature review on the issue of causality between various measures on construction and economic growth revealed mixed or inconclusive empirical findings. While some studies suggest that growth in construction investment leads economic growth, other studies also suggest that economic growth leads to growth in construction investment. There were also some remaining studies that suggest a bidirectional relationship or feedback effect between growth in construction investment and economic growth. Moreover, it was also clear from the review that apart from the work of Chen and Zhu (2008) which uses panel data at provincial level in China, no study, to the best of the author's knowledge, have tested the causality between construction and economic growth across countries. This current study fills in this gap by making use of the recently developed Dumitrescu Hurlin panel causality test to analyse the causal relationship between construction expenditure and economic growth in sub-Saharan Africa.

Summary and Conclusion

This chapter reviewed related literature on the relationship between various measures of construction and economic growth. Specifically, it presented an overview of the sub-Saharan economy with specific focus on the construction industry. Again, theories of growth such as Harrod-Domar, Neo-classical and Endogenous growth models as well as the Keynesian theory of aggregate demand and the Bon curve was explained extensively. The empirical literature review focused mainly on both the issue of non-linear relationship and causal relationship between the various measures of construction and economic growth. The review identified some methodological flaws which have led to inconclusive findings. Thus, most of the test for the validity of the Bon curve have been rather descriptive. Again, most studies that have tested the Bon curve did not consider the inclusion of control variables in its model specification. Hence, making the robustness of such findings questionable. Also, most studies always stop at non-linear relationship and do not extend the analysis to find the turning point associated with such relationship. The review argued that the Bon curve is a long run phenomenon and needs to be re-examined especially for the case of sub-Saharan Africa using a larger time period since the only study on the subject in SSA used a shorter time period which may not reflect the true nature of the Bon curve. Furthermore, on the issue of causality between measures of construction and economic growth, it was realized that there were mixed empirical findings and these findings were mainly from country-specific analysis. The study addresses these gaps by making use of recently developed panel ARDL estimation technique to re-examine the inverted U-shaped relationship between construction expenditure and economic growth in SSA from 1990 to 2014.

CHAPTER THREE

METHODOLOGY

Introduction

This chapter discusses the methodological model suitable for conducting the study. It discusses the methods and tools for conducting the study. Specifically, the chapter mainly consists of the research design, a detailed description of both theoretical and empirical specification of the model, the justification and measurement of variables, test of variables including cross- sectional dependence, unit root, cointegration and the estimation procedures.

Research Design

The quantitative research design was adopted to analyse relationship between construction expenditure and economic growth in SSA. Specifically, the quantitative research approach was used to address the research hypotheses of the study. The entire study followed the positivist philosophy which underpins quantitative methodology. Positivists believe that the reality is objectively given and measurable using properties independent of the researcher (Antwi & Hamza, 2015). They use validity, reliability, objectivity, precision and generalisability to judge the rigor of quantitative studies as they intended to describe, predict and verify empirical relationships in relatively controlled settings.

Theoretical Model Specification

Construction is investment and hence, the expenditure from this type of investment would definitely have some relationship with economic growth. Based on theoretical considerations and earlier empirical studies, economic growth models which continue to highlight the important role of investment can best capture and explain relationship between construction expenditure and economic growth in SSA.

In order to examine relationship between construction expenditure and economic growth, the neoclassical growth model based on the aggregate production function is used and is specified in equation 14 below as;

$$Y_{it} = A_{it}\, K_{it}^{\beta 1} L_{it}^{\beta 2} \tag{14}$$

where i = 1, 2, 3, ..., N is the cross-sectional dimension of countries, t = 1, 2, 3,....., T represent time, Y_{it} is aggregate production of the economies measured as real gross domestic product (GDP) per capita growth rate, K_{it} is the aggregate capital input measured as gross fixed capital formation, L_{it} is labour input measured as labour force participation rate (the percentage of total population aged 15 to 64 years who are active and economically productive) while A_{it} denotes total factor productivity (TFP). Total factor productivity is the portion of output not explained by the amount of inputs used in production (Comin, 2010). It is usually a measure of degree of technological progress associated with economic growth. β_1 and β_2 are the coefficients for capital and labour respectively.

For this study, total factor productivity (A_{it}) is assumed as a function of construction expenditure (CON_{it}) and other exogenous factors such as savings, trade openness, inflation and Polity2. Mathematically, this is formulated in equation 15 below as;

$$A_{it} = f(CON_{it}, SAV_{it}, OPENNESS_{it}, INF_{it}, POLITY2_{it})$$

$$= CON_{it}^{\beta 3}\ SAV_{it}^{\beta 4}\ OPENNESS_{it}^{\beta 5}\ INF_{it}^{\beta 6}\ POLITY2_{it}^{\beta 7} \quad (15)$$

Substituting equation (15) into (14) to obtain (16)

$$Y_{it} = f(K_{it}^{\beta 1}, L_{it}^{\beta 2}, CON_{it}^{\beta 3}, SAV_{it}^{\beta 4}, OPENNESS_{it}^{\beta 5}, INF_{it}^{\beta 6}, POLITY2_{it}^{\beta 7}) \quad (16)$$

where CON_{it} represent construction expenditure for country *i* at time *t* measured as the percentage share of construction expenditure in GDP; SAV_{it} stands for savings for country *i* at time *t* measured as the gross domestic savings as a percentage of GDP; $OPENNESS_{it}$ represent trade openness (how countries are open to trade at time *t)* which is the sum of exports and imports of goods and services measured as a share of GDP; INF_{it} denotes inflation for country *i* at time *t* measured as GDP deflator; $POLITY2_{it}$ is a score which measures political regime and transition effects of country *i* at time *t*. All other variables have been previously defined.

This study specifically focuses on construction expenditure which is a component of gross fixed capital formation. It is, therefore, prudent to drop gross fixed capital formation (K_{it}) to avoid the problem of multicollinearity since the study analyse relationship between construction expenditure and economic growth. The variable(K_{it}) was dropped from the model and hence, including country-specific intercept and error term yields an estimable equation 17 below as;

$$Y_{it} = \alpha_i + \beta_2 L_{it} + \beta_3 CON_{it} + \beta_4 SAV_{it} + \beta_5 OPENNESS_{it} + \beta_6 INF_{it} +$$

$$B_7 \ POLITY2_{it} + \varepsilon_{it} \tag{17}$$

where β_2, β_3, β_4, β_5, β_6, β_7 are parameters to be estimated*;* α_i and ε_{it} *are* country-specific intercept and white noise error term respectively; Equation 17 is the long run equilibrium relationship and if it is valid cointegration equation will have equivalent short run error correction model (ECM).

A priori expected signs of variables

Based on theory, the following are a prior expected signs: $\beta_2 > 0$, $\beta_3 > 0$,

$\beta_4 > 0$, $\beta_5 > 0$, $\beta_6 < 0$, $B_7 > 0$

Empirical Model Specification

In order to empirically examine relationship between construction expenditure and economic growth in SSA, panel Autoregressive Distributed Lag (ARDL) model developed by Pesaran and smith (1995) and Pesaran, Shin and Smith (1999) was adopted. This is because this estimation technique compared with GMM fit very well with the sample of this study. It also provides more consistent and efficient estimates and also, distinguishes between long run and short run relationship between construction expenditure and economic growth. The GMM estimation technique is more efficient when the number of cross-sectional unit of countries is large and the time period is less, usually less than 20 years span. Hence, it is less appropriate estimation technique for this study. Besides, the panel ARDL approach can be used whether the regressors are either endogenous or exogenous and also, irrespective of whether the underlying regressors are of different order of integration. Thus, purely I (0) or purely I (1) but not I (2). A panel ARDL (p, $q_{1 \ldots\ldots} q_k$) model where 'p' is the lags of endogenous variable and 'q' is the lags of the explanatory variables is formulated in Equation 18 as;

$$Y_{it} = \alpha_i + \sum_{j=1}^{p} \lambda_{ij}\, y_{i,t-j} + \sum_{j=0}^{q} \delta'_{ij}\, X_{i,t-j} + e_{it} \qquad (18)$$

where i = 1, 2, 3, ...,N is the cross-sectional dimension of countries; t = 1, 2, 3,.....,T represent time; X_{it} is k × 1 vector of explanatory variables; δ_{ij} is k × 1 coefficient vectors; λ_{ij} is scalars; α_i is the country-specific effect and e_{it} is white noise error term. It is therefore imperative to note that if the variables are I (1) and co-integrated then the disturbance term is an I (0) process. Hence, this co-integrated variables are sensitive to any deviations from long run equilibrium. It is also important to re-parameterise equation 18 into an error-correction form to distinguish between short run and long run dynamics. A panel ARDL model formulated in an error-correction form is specified in equation 19 as;

$$\Delta Y_{it} = \alpha_i + \emptyset_i\left(y_{i,t-1} - \theta'_i X_{it}\right) + \sum_{j=1}^{p-1} \boldsymbol{\lambda^*_{ij}} \Delta\, y_{i,t-1} + \sum_{j=0}^{q-1} \boldsymbol{\delta'^*_{ij}}\, \Delta X_{i,t-j} + e_{it} \quad (19)$$

where $\theta_i = \frac{\sum_{j=0}^{q} \delta'_{ij}}{1 - \sum_{j=1}^{p} \lambda_{ij}}$ and $\emptyset_{\boldsymbol{i}} = -(1 - \sum_{j=1}^{p} \lambda_{ij})$. The coefficient $\boldsymbol{\emptyset_i}$ is the error correction term which indicates the speed of adjustment and it is expected to be negative and statistically significant. The term $\left(y_{i,t-1} - \theta'_i X_{it}\right)$ represent long run relationship between the endogenous variable and the explanatory variables. θ_i contains long run coefficients whereas λ^*_{ij} and δ^*_{ij}

denotes short run coefficients of the lagged endogenous and explanatory variables respectively. Δ denotes the first difference operator.

From equation 17 and 19, the specific error-correction model can be specified as equation 20 below;

$$\Delta Y_{it} = \emptyset_i\big(Y_{i,t-1} - \theta_{0i} - \theta_{1i}\, L_{it} - \theta_{2i}\, CON_{it} - \theta_{3i}\, SAV_{it} - \text{OPENNESS}_{it} - \theta_{5i}\ INF_{it} - \theta_{6i}\, POLITY2_{it}\big) + \delta_{1i}\, \Delta L_{it} + \delta_{2i}\ \Delta CON_{it} + \delta_{3i}\, \Delta SAV_{it} + \delta_{4i}\, \Delta\text{OPENNESS}_{it} + \delta_{5i}\ \Delta INF_{it} + \delta_{6i}\, \Delta POLITY2_{it} + e_{it} \qquad (20)$$

where θ_{1i}, θ_{2i}, θ_{3i}, θ_{4i}, θ_{5i}, and θ_{6i} are long run parameters to be estimated; θ_{0i} and e_{it} are country-specific intercept and white noise error term; δ_{1i}, δ_{2i}, δ_{3i}, δ_{4i}, δ_{5i} and δ_{6i} are short run parameters to be estimated. All the variables denote their usual definitions. Following Pesaran and Smith (1995), and Pesaran, Shin and Smith (1999) equation 20 was estimated using Mean group (MG) and Pooled mean group (PMG) estimation techniques. These estimators were used because they provide more reliable and consistent estimates and also, distinguishes between long run and short run estimates. They address the issue of endogeneity by augmenting the model with lags of regressors and dependent variable to minimize the resultant bias and serially uncorrelated errors. The question now is how best can these estimation techniques be described and which of them is relevant to this current study.

Mean Group (MG) Estimation Technique

The Mean group estimation technique developed by Pesaran and Smith (1995) is a restriction free estimator in the sense that it allows both long run and short run coefficients to vary or be heterogeneous across countries used in a study. Thus, the intercepts, slope coefficients and error variances are all allowed to differ across countries. It is important to note that separate regression equation are estimated for individual countries and then the average (unweighted mean) coefficients are calculated across countries. For consistency, efficiency and validity of the MG estimation technique, a sufficiently large time series and cross-sectional dimension of data is required as the necessary condition. In the context of this study, this estimation technique would be very useful when there are significant reasons to expect that both long run and short run relationship between construction expenditure and economic growth differs across sub-Saharan African countries.

Pooled Mean Group (PMG) Estimation Technique

The pooled mean group (PMG) estimation technique introduced by Pesaran, Shin and Smith (1999) involves pooling and averaging. The distinguishing feature of this estimation technique is that it allows short run coefficients including intercepts, error variances and speed of adjustment to long run equilibrium to be heterogeneous among individual countries. The long run coefficients on the other hand are constrained to be the same among countries. It is imperative to note that there are good reasons to expect long run equilibrium relationship to be same across group of countries. Some of these reasons may be due to similar technologies, similar income and monetary structure, similar investment behaviour and similar arbitrary conditions that happens to same among group of countries understudy. In the context of this study, this estimation technique would be very efficient when there are important reasons to expect that countries in sub-Saharan Africa would exhibit same long run relationship between construction expenditure and economic growth. Short run relationships is allowed to differ among this group of countries because of different programs and policies, external shocks, among others that would impact on countries differently in the short run.

Capturing Non-Linearity (Inverted U-Shaped Relationship)

To test for the validity of the Bon Curve which is an inverted U-shaped relationship between output from the construction sector and economic growth and development, the study followed Samargandi, Fidrmuc and Ghosh (2013) and Zohonogo (2017) to put a quadratic term for construction expenditure in equation 20 to obtain equation 21 as follows:

$$\Delta Y_{it} = \emptyset_i\big(Y_{i,t-1} - \psi_{0i} - \psi_{1i} L_{it} - \psi_{2i} CON_{it} - \psi_{3i} CON_{it}^2 - \psi_{4i} SAV_{it} - \psi_{5i}\ \text{OPENNESS}_{it} - \psi_{6i}\ INF_{it} - \psi_{7i} POLITY2_{it}\big) + \varphi_{1i}\, \Delta L_{it} + \varphi_{2i}\, \Delta\, CON_{it} + \varphi_{3i} \Delta\, CON_{it}^2 + \varphi_{4i}\, \Delta SAV_{it} + \varphi_{5i}\, \Delta\ \text{OPENNESS}_{it} + \varphi_{6i}\ \Delta INF_{it} + \varphi_{7i}\, \Delta POLITY2_{it} + v_{it} \quad (21)$$

where $\psi_{1i}, \psi_{2i}, \psi_{3i}, \psi_{4i}, \psi_{5i}, \psi_{6i}\ \psi_{7i}$ are long run parameters to be estimated; ψ_{0i} and v_{it} are country-specific intercept and white noise error term; $\varphi_{1i}, \varphi_{2i}, \varphi_{3i}, \varphi_{4i}, \varphi_{5i}, \varphi_{6i}, \varphi_{7i}$ are short run parameters to be estimated. All the variables denote their usual definitions. Here, long run parameters to be estimated are of much interest, particularly the coefficient of CON_{it} and CON_{it}^2. The a priori expected signs of the coefficients for the inverted U-shaped relationship (Bon curve) are: $\psi_{2i} > 0$ and $\psi_{3i} < 0$. If this is the case, then the turning point where the inverted U-shaped curve reaches its maximum would be computed. This would be done to know the point where the impact of the share of construction expenditure in GDP on economic growth changes from positive to negative.

Justification and Measurement of Variables

Economic Growth

Economic Growth (Y_{it}) refers to the steady growth in the productive capacity of an economy over a given period of time. Following from literature, most studies that have analysed relationship between construction and economic growth have used either real GDP or GDP as a proxy for measuring economic growth. Similarly, other studies (Agyei, 2015; Hassan, Sanchez, & Yu, 2011; King & Levine, 1993; Moser & Ichida, 2001) have either used GDP per capita or GDP per capita growth rates. In line with these studies, this current study used real GDP per capita growth as a proxy for measuring economic growth which served as a dependent variable. GDP per capita growth is measure of total output of a country that takes gross domestic product and divides it by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. The real GDP per capita growth rates are computed as annual averages and represented as percentages. The rates of change from one period to the next are calculated as proportional changes from the earlier period (World Bank, 2016).

Construction Expenditure

Construction expenditure (CON_{it}) is defined as any expenditure on all activities from the design phase to the engineering, procurement and the execution of small, medium and large-scale infrastructure projects. Thus, any expenditure on improving the built environment such as alterations, new structures and engineering and architectural works. Following from literature, the most widely and commonest measure of construction expenditure in a particular country is the percentage share of construction expenditure in GDP or construction value added used in studies such as Alagidede and Mensah (2016); Girardi and Mura (2014);and Kargi (2013). Falling in line with previous studies, this study used the percentage share of construction expenditure in GDP as the main explanatory variable in analysing relationship between construction expenditure and economic growth in SSA and hence, a positive and significant relationship is expected.

Savings

Savings(SAV_{it}) is measured as gross domestic savings as a percentage of GDP and it is calculated as GDP less final consumption expenditure (total consumption). The neoclassical growth models postulates a strong relationship between savings and economic growth. Specifically, the model shows that higher savings leads to higher investment, which in turn leads to higher economic growth. In the context of this study, the presupposition is that higher savings leads to higher investment in construction, which in turn leads to higher economic growth. This present study based on theory and earlier empirical studies (Carroll & Weil, 1994; Maddison, 1992; Modigliani, 1970) used gross domestic savings as a percentage of GDP to measure savings in an economy and it is, therefore, expected to have a positive and significant impact on economic growth.

Trade Openness

Trade openness ($\mathrm{OPENNESS_{it}}$) is the sum of exports and imports of goods and services measured as a share of GDP. International exchange of goods and services as well as technologies fosters economic growth. This happens mainly through the investment and technology channels. Often, the traded sector tends to be more capital intensive than the non-traded sectors for most economies, thus requiring investment, which comes through opening up to international trade. In addition, imported intermediate goods are required in most instances in the production of investment goods (Baldwin & Seghezza, 1996). Opening up to international trade also comes along with technology spill overs as well as economies of scale in research and development (Baldwin & Seghezza, 1996; Grossman & Helpman, 1991; Krugman, 1990; Rivera-Batiz & Romer, 1991; Romer, 1990). In this study, a positive relationship between trade openness and economic growth is expected.

Political Regime and Transition Effects

Political regime and transition effects ($\mathrm{POLITY2_{it}}$) is measured using the polity2 variable which is simply derived by subtracting the autocracy (AUTOC) value from the democracy (DEMOC) value. This procedure provides a single regime score that ranges from +10 (full democracy) to -10 (full autocracy). Democracy is conceived as three essential interdependent elements. First, the presence of institutions and procedures through which citizens can express effective preferences about alternative policies and leaders. Second is the existence of institutionalized constraints on the exercise of power by the executive. Third is the guarantee of civil liberties to all citizens in their daily lives and in acts of political participation. Other aspects of plural democracy such as the rule of law, systems of checks and balances, freedom of the press, and so on are specific manifestations of these principles. Operationally, democracy indicator is an additive eleventh-point scale (0-10) which is derived from assigned codings for the competitiveness of political participation, the openness and competitiveness of executive recruitment, and constraints on the chief executive. Autocracy, on the other hand, is operationally defined as the presence of a distinctive set of political characteristics. In a mature form, autocracies sharply restrict or suppress competitive political participation. Chief executives are normally chosen in a regularised process of selection within the political elite, and once in office they exercise power with few institutional constraints. Most modern autocracies also exercise high degree of directiveness over social and economic activity. Operationally, autocracy, an eleventh-point indicator, is also derived from the codings of competiveness of political participation, the regulation of participation, the openness and competitiveness of executive recruitment, and constraints on chief executive (Polity IV, 2015). Following from literature, this present study used polity2 variable to capture political regime and transition effects in SSA and it is expected to have a positive impact on economic growth.

Labour

Labour input (L_{it}) is measured as labour force participation rate which constitutes the percentage of total population aged 15 to 64 years who are active and economically productive. This measure is an appropriate measure because of its authenticity in empirical literature on growth (Jayaraman &

Singh, 2007) as there can be no economic growth without the involvement of conventional input, labour. As postulated by existing growth theories, it is expected that labour input would impact positively on economic growth.

Inflation

Inflation (INF_{it}) is used to capture macroeconomic instability in an economy. Theoretically, inflation increases the cost of borrowing for investment activities leading to reduction in productivity and economic growth. Following from previous empirical studies, consumer price index (CPI) and its alternative measure GDP deflator has been used to measure inflation. It is, therefore, imperative to note that the widely used measure of inflation is CPI (see Ahiakpor & Akapare, 2014; Barro, 1996) but due to limited availability of data for all the countries included in the sample of this study, the alternative measure of inflation, GDP deflator, was used to capture macroeconomic instability. GDP deflator or implicit price deflator is a measure of the level of prices of all new, domestically produced, final goods and services in an economy. It is a measure of price inflation or deflation in an economy by calculating a ratio of nominal GDP to real GDP. Unlike the CPI, the GDP deflator is not based on a fixed “basket” of goods and services but its “basket” of goods is allowed to change from year to year with people’s consumption and investment patterns (Wikipedia, 2017b). Based on literature, studies such as Przybyla and Roma (2005); Salahodjaev and Chepel (2014) have used GDP deflator as measure of inflation and it is, therefore, expected that inflation would have a negative impact on economic growth.

Sources of Data

The study used secondary data in a panel setting. Specifically, the study employed panel data consisting of annual time series data covering 1990 to 2014 for 33 sub-Saharan African countries, mostly collected from different sources. Real GDP per capita growth rate, gross domestic savings, trade openness, labour force participation rate, inflation were sourced from World Development Indicators (WDI) of the World Bank. Construction expenditure was also obtained from United Nations Conference on Trade and Development (UNCTAD) database whereas, Polity2 was collected from Polity IV Project (Centre for Systemic Peace).

Estimation Procedure

In order to analyse short run and long run relationship between construction expenditure and economic growth as well as test for the validity of the Bon curve, the panel Autoregressive Distributed Lag (ARDL) model with its Mean group (MG) and Pooled mean group (PMG) estimation techniques was used. The study first tested for cross-sectional dependence using Pesaran (2004) cross-sectional dependence (CD) test to know the right panel unit root and cointegration tests to use since some of the panel unit root and cointegration test assume cross-sectional independence and others assume cross-sectional dependence. Next, the stationarity status of all the variables were examined by conducting series of panel unit root test. Specifically, both first and second generational panel unit root test namely Im-Pesaran-Shin (IPS), Cross-sectionally Augmented Dicky-Fuller (CADF) and Cross-sectionally Augmented IPS unit root test were employed. Additionally, the study tested for cointegration using Westerlund (2007) panel cointegration test. Besides, once cointegration was established, there was therefore the need to estimate long run and short run parameters using both MG and PMG estimation techniques as well as test for the validity of the Bon curve. Selecting the estimation technique which produces more efficient and consistent estimates for discussion, the Hausman test was used to test whether there is a significant difference between the MG and PMG. Finally, the causal relationship between construction expenditure and economic growth in SSA was examined using Dumitrescu and Hurlin panel causality test.

Cross-sectional Dependence Test

One major issue that inherently arises in every panel data study with potential implications on parameter estimation and inference is the possibility that individual units are interdependent or cross-sectionally dependent (Sarafidis & Wansbeek, 2012). Cross-sectional dependence arises when there are cross correlation of errors which could be due to omitted unobservable common effect, spatial effects, or as a result of interactions with socioeconomic networks (Chudik & Pesaran, 2013). Also, correlations may arise from globally common shocks with heterogeneous impact across countries, such as the oil crises in the 1970s or the global financial crisis. Thus, irrespective of the geographical distance between countries, they react very similar to the same event which then lead to correlation among them. Again, it can be the result of local spill over effects between countries or regions (Eberhardt & Teal, 2011). As a pre-estimation test, the study used Pesaran (2004) cross-sectional dependence (CD) test to determine whether cross-sectional dependence existed among the variables used for the study. This helped to know the right panel unit root and cointegration test to use since some of the panel unit root and cointegration test assume cross-sectional independence and others assume cross-sectional dependence.

The CD test was designed to test the null hypothesis of no dependence across the panel members. The test is based upon an average of all pair-wise correlations of the ordinary least squares (OLS) residuals from the individual regressions in the panel data model. The CD test statistic is defined as:

$$CD = \sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}\right) \qquad (22)$$

where $\hat{\rho}_{ij} = \frac{\sum_{t=1}^{T} e_{it}\ e_{jt}}{\left(\sum_{t=1}^{T}\ e_{it}^2\right)^{1/2}\left(\sum_{t=1}^{T}\ e_{jt}^2\right)^{1/2}}$, with e_{it} denoting OLS residuals based on T observations for each $i, \ldots\ldots N$. The test can be applied to balanced and unbalanced panels and is shown to have a standard normal distribution assuming that the errors are symmetrically distributed. Furthermore, simulation results have shown that the test has good small sample properties.

Panel Unit Root Tests

Testing for unit root in panel is essential and has now become a common practice among researchers since it helps to avoid spurious regression. With relatively large cross-section of countries and time period to analyse relationship between construction expenditure and economic growth, non-stationarity is of great concern and hence, to deal with this issue the study adopted both the first generation unit root test which emphasize cross-sectional independence namely Im-Pesaran-Shin (IPS) unit root test and the second generation test which emphasize cross-sectional dependence namely Cross-sectionally Augmented Dickey-Fuller (CADF) and Cross-sectionally Augmented IPS unit root test of Pesaran (2007).These panel unit root test would help to determine the order of integration of the variables which is essential in applying panel ARDL model. It is important to note that these tests are conducted to be sure that none of the variables are integrated of order two I (2).

Im, Pesaran and Shin (IPS) Panel Unit Root Test

In order to relax the assumption of same autoregressive parameter, Im, Pesaran and Shin (2003) proposed unit root test which allow for heterogeneous autoregressive parameter. The IPS test is based on individual Augmented Dicky-Fuller (ADF) test averaged across the groups. The starting point of the IPS unit root test is the specification of ADF regression model with individual effect and no time trend as follows in equation 23 below;

$$\Delta y_{it} = \alpha_i + \rho_i y_{i,t-1} + \sum_{j=1}^{pi} \gamma_{ij} \Delta y_{i,t-j} + \varepsilon_{it} \tag{23}$$

The null hypothesis is that each series in the panel contains unit root ($H_0 : \rho_i = 0$ for all i = 1,…..N) against alternative hypothesis that allows for some (but not all) of the individual series to have unit root ($H_1 : \rho_i < 0$ for i = 1,…N_1 and $\rho_i = 0$ for i = N_1 +1,…, N; with $0 < N_1 \leq 0$). The alternative hypothesis requires the fraction of the individual time series that are stationary to be non-zero. It is important to note that this condition is necessary for consistency of the panel unit root test (Baltagi, 2008). As already indicated, the IPS unit root test involves averaging individual ADF-statistics across groups and it is denoted by the t-bar statistic specified below as;

$$\bar{t}_{NT} \;= \frac{1}{N}\sum_{i=1}^{N} \mathrm{t}_{\boldsymbol{iT}} \left(\mathrm{p}_{\boldsymbol{i}}, \gamma_i\right) \tag{24}$$

The t-bar statistic is then standardized using the means and variances of $\mathrm{t}_{\boldsymbol{iT}}\left(p_{i}, 0\right)$ denoted as W_{tbar}, which is specified below as;

$$W_{tbar} = \frac{\sqrt{N}(\bar{t}_{NT} \; - 1/N \sum_{t=1}^{N} E[t_{iT} | \, \rho_{i=0} \;])}{\sqrt{Var}[t_{iT} | \, \rho_{i=0} \;]} \tag{25}$$

The W_{tbar} statistic approaches standard normal distribution as N and T approaches infinity. It must be emphasized that IPS has been shown to be more efficient in long run analysis but its major limitation is that it assume cross-sectional independence. Interestingly, Levin, Lin and Chu (2002) suggested that cross-sectional mean should be subtracted from the series to solve the problem of cross-sectional dependence. But this approach will not work when pair-wise cross-section co-variances of the error term differed across the individual series. In an attempt to account for cross-section dependence, various second generational panel unit root have been proposed. Most recent of them is the Cross-sectionally Augmented Dickey-Fuller (CADF) and Cross-sectionally Augmented IPS unit root test of Pesaran (2007).

Cross-sectionally Augmented Dickey-Fuller (CADF) and Cross-sectionally Augmented IPS Panel Unit Root Tests

Pesaran (2003) deals with the problem of cross-sectional d ependence by considering a one factor model with heterogenous loading factors for residuals. The approach used in solving cross-sectional dependence involves augmenting the standard Dickey-Fuller or Augmented Dicky-Fuller regression models with cross section average of lagged levels and first difference of individual series. The test has a null hypothesis of non-stationarity ($H_0 : \beta_i = 0$ for all i = 1,…..N) against alternate hypothesis that a fraction of the series is stationary ($H_1 : \beta_i < 0$ for i = 1,…N_1 and $\beta_i = 0$ for i = N_1 +1,…, N; with $\frac{N_1}{N}$ representing the fraction of the individual processes that are stationary). Pesaran test, denoted as CADF, is based on the estimation of the following p^{th} order cross-section/time series augmented regression:

$$\Delta y_{it} = a_i + b_i\, y_{i,t-1} + c_i\, \bar{y}_{t-1} + \sum_{j=0}^{p} d_{j+1} \Delta\, \bar{y}_{t-j} + \sum_{k=1}^{p} \phi_k \Delta\, y_{i,t-k} + \varepsilon_{it} \quad (26)$$

where $\bar{y}_t$ is the cross-section mean of y_{it} which helps to asymptotically take out the effects of the unobserved common factor. The test averages the individual CADF test statistics for all cross-section units in a heterogeneous panel, where the individual CADF test statistics are given by the OLS t-ratio of b_i . Though all the individual CADF statistics have similar asymptotic null distributions not depending on the factor loadings, they are all correlated due to the dependence on the common factor. So it is possible to calculate an average of individual CADF statistics. This led Pesaran (2007) to propose a cross-sectional augmented version of the Im, Pesaran and Shin (2003) test denoted as CIPS:

$$\text{CIPS} = \frac{1}{N}\sum_{i=1}^{N} CADF$$

$$= \frac{1}{N}\sum_{i=1}^{N} t_i\ (\text{N}, \text{T}) \quad (27)$$

where t_i (N, T) is the Cross-sectionally Augmented Dickey-Fuller statistic for the i^{th} cross-section unit given by the t-ratio of the coefficient of $y_{i,t-1}$ in the CADF regression above. This testing procedure has several advantages. Firstly, cross-sectionally augmented panel unit root tests have satisfactory size and power even for relatively small values of N and T. Secondly, it allows for cross-sectional dependence, which is an important consideration for a study like this where cross-section units are likely to be affected by a common factor such as changes in technology. Lastly, it allows for cross-sectional heterogeneity in the intercept, trend and autoregressive coefficients.

Panel Cointegration Test

Economic theory always imply that certain variables or pair of variables are linked by a long run relationship. This long run relationship is normally referred to as cointegration. The concept of cointegration implies that variables may drift way from each other in the short run but co-share movement in the long run. To test whether long run relationship exist among variables under study, the study used four panel cointegration test developed by Westerlund (2007) based on error-correction approach. This test was used because it allows for heterogeneous vectors and hence, do not impose a common-restriction factor. It is also normally distributed and generally accommodate unit specific short run dynamics, trend, slope parameters and cross-sectional dependence. The test was designed to test the null hypothesis that there is no cointegration implying that the error correction term is equal to zero. Hence, when the null hypothesis of no error correction is rejected it means that the null hypothesis of no cointegration is rejected as well.

Westerlund (2007) panel cointegration test based on error-correction model is specified below as;

$$\Delta Y_{it} = \delta_i' d_t + a_i \left(Y_{i,t-1} - \beta_i' X_{it-1}\right) + \sum_{j=1}^{Pi} \alpha_{ij} \Delta Y_{it-j} + \sum_{j=0}^{Pi} \gamma_{ij} \Delta X_{it-j} + \varepsilon_{it} \quad (28)$$

where d_t contains the deterministic components, Y_{it} represent real GDP per capita growth and X_{it} denotes a set of exogenous variables. Equation 28 can be re-written below as;

$$\Delta Y_{it} = \delta_i' d_t + a_i Y_{i,t-1} + \lambda_i' X_{it-1} + \sum_{j=1}^{\mathrm{Pi}} \alpha_{ij} \Delta Y_{it-j} + \sum_{j=0}^{Pi} \gamma_{ij} \Delta X_{it-j} + \varepsilon_{it} \quad (29)$$

where $\lambda_i' =- \alpha_i \beta_i'$. The parameter α_i is the error-correction term which indicates the speed of adjustment to long run equilibrium after a sudden shock. In a case where $\alpha_i < 0$, it means that there is error-correction in the model implying that Y_{it} and X_{it} are cointegrated. If $\alpha_i = 0$ then there is no error-correction and hence, no cointegration. Following from equation 28 and 29, Westerlund (2007) developed four different test statistics based on the ordinary least squares estimate a_i and its *t*-ratio for each individual *i*. The first two of these test statistics are referred to as group mean statistics while the other two are called panel statistics.

The group mean statistics are specified below in equation 30 as follows;

$$G_\tau = \frac{1}{N} \sum_{i=1}^{N} \frac{\hat{\alpha}_i}{SE(\hat{\alpha}_i)} \text{ and } G_\alpha = \frac{1}{N} \sum_{i=1}^{N} \frac{T\hat{\alpha}_i}{\hat{\alpha}_i(1)} \quad (30)$$

where $SE(\hat{\alpha}_i)$ is the standard error of $\hat{\alpha}_i$. G_τ and G_α statistics test the null hypothesis of $H_0 : \alpha_i = 0$ for all i against the alternative hypothesis $H_1 : \alpha_i < 0$ for at least one i. Therefore, rejecting the null hypothesis implies that there is cointegration for at least one cross-sectional unit in the panel. Similarly, the panel statistics are also specified below as;

$$P_\tau = \frac{\hat{\alpha}}{SE(\hat{\alpha})} \quad \text{and} \quad P_\alpha = T\hat{\alpha} \qquad (31)$$

P_τ and P_α statistics test the null hypothesis of $H_0 : \alpha_i = 0$ for all i against the alternative hypothesis $H_1 : \alpha_i < 0$ for all i. Thus, rejecting the null hypothesis implies that there is cointegration for whole cross-sectional unit in the panel. To sum up, this test allows for all forms of heterogeneous specification of both long run and short run parts of the error-correction model and also, its computed p-values are robust since it accounts for cross-sectional dependence via bootstrapping.

Estimation of Panel ARDL Regression

Once cointegration relationship is established among the endogenous variable and explanatory variables in the entire panel, the study proceeded to estimate long run cointegration parameters using the error-correction based panel ARDL model specified in equation 20. Specifically, the panel ARDL model with its Mean Group (MG) and Pooled Mean Group (PMG) estimation techniques was used. The novelty of these estimation techniques are that both long run and short run parameters can be estimated simultaneously from dataset with relatively large cross-section of countries and time periods. After obtaining estimates of both long run and short run parameters using MG and PMG estimation techniques, the Hausman (1978) specification test, which would be discussed into details below, was carried out to find out whether there is significant difference among these estimation techniques. Additionally, a quadratic term for construction expenditure was included in the model specification to test for non-linearity between construction expenditure and economic growth.

Post Estimation - Hausman Specification Test

In trying to answer the question of whether the MG or PMG is the efficient and consistent estimation technique to be considered, much emphasis was based on the assumption of long run homogeneity since there are reasons to believe that long run relationship between construction expenditure and economic growth would be more homogenous in sub-Saharan Africa countries. Some of these reasons may be due to similar technologies, similar income and monetary structure, similar investment behaviour in construction and finally, arbitrary conditions that is similar in most or subset of sub-Saharan Africa countries. Short run relationships would differ among this group of countries because of different programs and policies, external shocks, among others that would impact on countries differently in the short run. Based on the above explanations, it can be assumed that long run relationship between construction expenditure and economic growth among SSA countries is homogenous whereas, short relationships is heterogeneous. Hence, the PMG would be more relevant for the analysis in this study because of its increase in efficiency.

However, the Hausman test can be used to conclude on these estimation techniques. Thus, whether there is significant difference between MG and PMG estimation techniques. Hausman (1978) proposed a specification test which compares an estimator $\hat{\theta}_1$ that is known to be consistent with an estimator $\hat{\theta}_2$ that is efficient under the assumption being tested. The null hypothesis is that the estimator $\hat{\theta}_2$ is indeed an efficient (and consistent) estimator of the true parameters. If this is the case, there should be no systematic difference between the two estimators. If there exists a systematic difference in the estimates, you have reason to doubt the assumptions on which the efficient estimator was based. For this study, the null hypothesis is that there is no systematic difference between MG estimates that is known to be consistent and the PMG estimates that is known to be efficient based on the assumption of long run homogeneity. If the null hypothesis is failed to be rejected it implies that the PMG estimation technique is the efficient (and consistent) estimator. On the other hand, if the null hypothesis is rejected it means that there exist a significant difference between MG and PMG estimates. It, therefore, implies that it is appropriate to use MG estimation technique. The Hausman test statistic follows a chi-square (χ^2) distribution and is computed below as;

$$H = (\beta_c - \beta_e)' (V_c - V_e)^{-1} (\beta_c - \beta_e) \tag{32}$$

where β_c is the coefficient vector from the consistent estimator; β_e is the coefficient vector from the efficient estimator; V_c is the covariance matrix of the consistent estimator; V_e is the covariance matrix of the efficient estimator.

Panel Causality test

The study analysed direction of causality between construction expenditure and economic growth in SSA using panel Granger Homogenous Non-causality test developed by Dumitrescu and Hurlin (2012). The test takes into account heterogeneity of the regression model as well as that of the causal relationships. The test also deals with the issue of cross-sectional dependence using a block bootstrap procedure to correct the empirical critical values of panel Granger causality. It is actually a simple Granger (1969) non causality test in heterogeneous panel data models with fixed coefficients (in time). The Dumitrescu and Hurlin panel causality test based on linear Vector Autoregressive model is specified in equation 33 below as;

$$y_{it} = \alpha_i + \sum_{k=1}^{K} \gamma_i^{(k)} y_{i,t-k} + \sum_{k=1}^{K} \beta_i^{(k)} x_{i,t-k} + \varepsilon_{it} \qquad (33)$$

where i = 1, 2, 3, ...,N is the number of cross-sectional units; t = 1, 2, 3,.....,T represent time periods; x and y are two stationary variables observed for N cross-sectional units in T periods; α_i denotes the country-specific intercept and it is assumed to be fixed in time dimension; $\gamma_i^{(k)}$ and $\beta_i^{(k)}$ represent the autoregressive parameters and the regression slope coefficients respectively and they are all allowed to differ across groups; K is the lag order which is assumed to be identical for all cross-sectional units of the balanced panel. Besides, this panel causality test was designed to test the null hypothesis of Homogeneous Non Causality (HNC) implying that there is no causal relationship for any of the cross-section units of the panel. Thus, the null hypothesis is defined as:

$$H_0 : \beta_i = 0 \text{ for all } i = 1, \ldots \text{N}.$$

On the other hand, the alternative hypothesis is that there is Heterogenous Non Causality (HENC) implying that under the alternative hypothesis there are two subgroups of cross-section units: first subgroup characterised by no causal relationship from *x* to *y* and the second subgroup characterised by causal relationships from *x* to *y*, although the regression model is not necessarily the same. Thus, the alternative hypothesis is defined as:

$$H_1 : \beta_i = 0 \qquad \text{for all } \quad i = 1, \ldots \text{N}_1$$

$$\text{and} \qquad \beta_i \neq 0 \qquad \text{for all } i = 1, \ldots, \text{N}_1 + 1, \text{N}_1 + 2, \ldots, \text{N}$$

where it is assumed under the alternative hypothesis that there are $N_1 < N$ individual processes with no causal relation from *x* to *y*. Also, it is assumed that N_1 is unknown but satisfies the condition $0 \leq \frac{N_1}{N} < 1$. It is, therefore, imperative to note that this panel causality test is based on averaging individual Wald statistics associated with the null hypothesis of HNC, denoted as $\mathrm{W}_{\mathrm{N,T}}^{HNC}$. This average statistic is defined as follows:

$$W_{N,T}^{HNC} = \sum_{i=1}^{N} W_{i,T} \tag{34}$$

where $W_{i,T}$ denotes the individual Wald statistics for the i^{th} cross-section unit corresponding to the individual test $H_0 : \beta_i = 0$. The individual Wald statistic converges to a chi-squared distribution. The $W_{N,T}^{HNC}$ statistic is then standardized using mean and variance of $W_{i,T}$ denoted as $Z_{N,T}^{HNC}$, which is specified as;

$$Z_{N,T}^{HNC} = \sqrt{\frac{N}{2K}}\left(W_{N,T}^{HNC} - \text{K}\right) \rightarrow \text{N}\,(0, 1) \tag{35}$$

Where T,N $\rightarrow \infty$ denoting the fact that $T \rightarrow \infty$ first and then $N \rightarrow \infty$. Also, the average statistic $Z_{N,T}^{HNC}$ sequentially converges in standard normal distribution. The Dumitrescu Hurlin panel causality test has several advantages. First, it is very simple to implement, as it is evident in the computation of the standardized average Wald statistics. Secondly, the test has very good properties even in samples with very small values of T and N. Lastly, the method can also be used in unbalanced panels or panels with different lag order K for each individual. Although there several advantages of this testing procedure, it has some disadvantages. One of the drawbacks of this test is that the rejection of the null hypothesis of Homogeneous Non Causality does not provide any guidance with respect to the number or the identity of the particular panel units for which the null of non-causality is rejected.

Data Analysis

The study employed both descriptive and quantitative analysis. Charts such as graph and tables were employed to aid in the descriptive analysis. Cross-sectional dependence was first tested using Pesaran (2004) CD test. Panel unit root test was carried out on the variables to obtain their order of integration to help avoid the problem of spurious regression. Additionally, the study tested for cointegration using Westerlund (2007) panel cointegration test. Besides, once cointegration was established, long run and short run parameters were estimated using Panel ARDL approach with its MG and PMG estimation techniques as well as test for the validity of the Bon curve.

Also, selecting the estimator which is efficient and consistent for discussion, the Hausman test was used to test whether there is a significant difference between the MG and PMG estimator. Finally, the causal relationship between construction expenditure and economic growth in SSA was examined using Dumitrescu and Hurlin panel causality test. Stata version 13 and E-Views 9 software was used to carry out all estimations in this study.

Summary and Conclusion.

This chapter developed and presented the methodology framework suitable for conducting the study. The model used in this study had its theoretical underpinnings from the neoclassical growth model. Panel data consisting of annual time series data covering 1990 to 2014 for 33 sub-Saharan African countries was employed for the study. The study employed the following variables: share of construction expenditure in GDP, real GDP per capita growth, savings, trade openness, inflation, labour force and polity2 (political regime and transition variable).

The study first tested for cross-sectional dependence using Pesaran (2004) cross-sectional dependence (CD) test to know the right panel unit root and cointegration test to use since some of the panel unit root and cointegration test assume cross-sectional independence and others assume cross-sectional dependence. Panel unit root test such as IPS, CADF and CIPS was conducted to ensure that the variables are not integrated in higher order than one to avoid spurious regression. Cointegration test was done to establish long run relationship among variables. The main estimation technique used was the Panel ARDL approach with its PMG and MG estimators to estimate both long run and short run parameters. In order to test for validity of the Bon curve, a quadratic term was included in the model specification. Post-estimation such as Hausman specification test was conducted to choose between the two estimation techniques which provides efficient and consistent estimates. Finally, the causal relationship between construction expenditure and economic growth in SSA was examined using Dumitrescu and Hurlin panel causality test. The systematic framework of this chapter now establishes the relationship between construction expenditure and economic growth that helps in estimation, this has a link with our models as well as guiding us to interpret our estimation results in the subsequent chapters and make policy recommendations based on the outcome of findings.

CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

The results of the study are presented and discussed in this chapter. The aim is to empirically analyse relationship between construction expenditure and economic growth in SSA. The results of the descriptive statistics of all variables, cross-sectional dependence test, panel unit root tests, Westerlund cointegration test, Panel ARDL regression, Hausman test and Dumitrescu Hurlin panel causality test are presented and discussed. These results are discussed in relation to the hypotheses of the study.

Descriptive Statistics

The study conducted descriptive statistics of all the variables used in the study among 33 countries in sub-Saharan Africa from 1990 to 2014. The descriptive statistics under consideration are the mean, standard deviation, minimum and maximum values of the variables. These statistics are shown in Table 1

Table 1*: Descriptive Statistics*

	Mean	Std. Dev	Min	Max	Obs
Real GDP per capita growth	1.80	8.11	-47.72	141.64	792
Construction	4.29	2.29	0.27	15.35	792
Labour	72.73	10.96	48.6	91	792
Savings	12.00	18.24	-125.68	86.27	792
Openness	71.63	46.11	20.96	531.74	792
Inflation	10.02	15.55	-31.57	128.76	792
Polity2	1.47	5.24	-9	10	792

Notes: Std. Dev. denotes Standard deviation; Min denotes Minimum; Max represent Maximum. Obs denotes Observations

Source: Author’s Estimation, 2017

Table 1 presents the descriptive statistics for all the variables used in the estimation. The total number of observations used for the estimation was 792 and it was realised that all the variables have positive means. Over the period of 1990-2014, the average level of real GDP per capita growth is 1.80%, while the minimum and maximum real per capita GDP growth rates are -47.72% and 141.64% respectively. This is an indication of a wide spread in growth among countries in SSA. Again, the standard deviation for real GDP per capita growth is 8.11%, suggesting that real GDP per capita growth rate deviates from its mean by 8.11%. This gives further indication that there is high fluctuation of the variable among sample countries over the period.

Similarly, the share of construction expenditure in GDP ranges from a minimum value of 0.27% to a maximum value of 15.35%, with a mean value of 4.29% which is greater than the real GDP per capita growth rate. Its standard deviation is also 2.29% showing how the share of construction expenditure in GDP deviates from its mean.

Moreover, the mean value of gross domestic saving as a share of GDP is 12%. The mean value of savings is not quite impressive due to relatively high incidence of poverty in SSA. There is also a wide spread among the values of gross domestic saving as a share of GDP since the minimum value is -125.68 % and the maximum value is 86.27%.

Furthermore, although the minimum value (-31.57%) and maximum value (128.76%) of inflation indicates a wide variations for various countries in SSA, the mean value of inflation (10%) show relative macroeconomic stability over sample time period covered for the study. The standard deviation of inflation rate is 15.55%.

Trade Openness, which is the sum of exports and imports of goods and services measured as a share of GDP, has a very large average value of 71.63% indicating the significance of export and import activities to the economies of SSA. Again, the minimum value (20.96 %) and the maximum value (531.74 %) clearly shows that while some countries in SSA are less open to trade, others are more open to trade. Thus, trade openness varies widely among countries in SSA for the study period.

The mean level of labour force participation rate is 72.73%, with some countries recording a minimum labour force participation rate of 48.6% and a maximum of 91% per annum. The mean labour force participation rate is quite large suggesting that more people on average aged between 15 and 64 are in the labour force.

Finally, the low mean score (1.47%) of Polity2 clearly indicate that on average political regime and transition effects in SSA ,which is derived by simply subtracting the autocracy (AUTOC) value from the democracy (DEMOC) value, is not the best. This implies that more needs to be done as a region to deepen our democratic principles to make the system better. It is also worth noting that the polity2 score actually ranges from +10 (full democracy) to -10 (full autocracy) but for SSA the minimum polity2 score is -9, close to full autocracy and the maximum polity2 score is +10 (full democracy).

Cross-sectional Dependence Test Results

As a pre-estimation test, the study first used Pesaran (2004) cross-sectional dependence (CD) test to determine whether cross-sectional dependence exist among the variables used for the study. This was done to choose the right panel unit root and cointegration tests since some of the panel unit root and cointegration test assume cross-sectional independence while others assume cross-sectional dependence. The CD test is designed to test the null hypothesis of no dependence across the panel members against the alternate hypothesis of cross-sectional dependence among panel members. Table 2 reports the results of the cross-sectional dependence test.

Table 2: *Results of Cross-sectional Dependence Test*

	CD-test	p-value	corr	abs(corr)
Real GDP per capita growth	12.40***	0.000	0.108	0.194
Construction	14.66***	0.000	0.128	0.401
Labour	7.84***	0.000	0.068	0.622
Savings	-0.35	0.725	-0.003	0.339
Openness	20.55***	0.000	0.179	0.373
Inflation	19.81***	0.000	0.172	0.258

Notes: ******* indicate significance at 1% level. CD ~ N (0, 1) under H_o: cross-sectional independence among panel units against H_1: cross-sectional dependence among dependence among panel units.

Source: Author's Estimation, 2017

Table 2 highlights the results of the cross-sectional dependence test. The CD test shows that the probability value (p-value) of all the variables except savings are highly significant, meaning that the null hypothesis of cross-sectional independence is rejected at 1% level of significance for all the variables except savings. This strongly suggest that countries used in this study share common developments for all variables except savings. The presence of cross-sectional dependence might possibly be as a result of spatial effects among cross-section of countries in SSA or global common shocks such global financial crisis which had same impact on economies. The absence of cross-sectional dependence for savings clearly indicate that countries in SSA reacts independently with regards to savings.

Panel Unit Root Test Results

The study proceeded to examine the unit root status of all the variables used in the study after identifying the cross-sectional dependence status of all the variables. The results obtained for the CD test require the use of both first and second generational unit root tests. First generational unit root test such IPS specifically for savings variable which is cross-sectionally independent and second generational unit tests such as CADF and CIPS for the other variables which are cross-sectionally dependent. These panel unit root test would help to determine the order of integration of the variables which is essential in applying panel ARDL model. It is important to note that these test are conducted to be sure that none of the variables are integrated of order two I (2).

Table 3: *Results of Panel Unit Root Tests at Level*

Variables	Constant			Constant & Trend		
	IPS (W-t-bar)	CADF (Z-t-bar)	CIPS	IPS (W-t-bar)	CADF (Z-t-bar)	CIPS
Real GDP per-capita growth	-10.933***	-8.194***	-4.474***	-9.037***	-8.116***	-4.800***
Construction	-0.929	-2.367***	-2.138*	-0.731	-0.660	-2.402
Labour	0.144	1.225	-1.213	2.638	2.566	-1.520
Savings	-1.855**	-2.216**	-2.451***	-1.857**	-0.248	-2.694**
Openness	-1.314*	0.748	-2.085*	-0.418	-1.245	-2.800**
Inflation	-13.094***	-10.532 ***	-4.268***	-11.515***	-7.749***	-4.433***
Polity2	-2.705***	-2.205**	-2.232**	-4.794***	-0.262	-2.665*

Notes: *, **, and *** indicate significance at 10 %, 5% and 1% respectively. IPS, CADF & CIPS test the H_o: All panels contain unit root

Source: Author's Estimation, 2017

Table 4: *Results of Panel Unit Root Tests at First Difference*

Variables	Constant			Constant & Trend		
	IPS (W-t-bar)	CADF (Z-t-bar)	CIPS	IPS (W-t-bar)	CADF (Z-t-bar)	CIPS
Real GDP per-capita growth	-24.977***	-21.107 ***	-6.118***	-21.368**	-18.556***	-6.275***
Construction	-12.937***	-9.638***	-4.721***	-10.992***	-8.003***	-4.933***
Labour	-3.481***	-2.354***	-2.822***	-1.848**	-1.048	-3.111***
Savings	-17.694***	-13.048***	-5.195***	-14.987***	-10.67***	-5.256***
Openness	-14.440***	-11.714***	-4.964***	-11.788***	-9.536 ***	-5.077***
Inflation	-23.680***	-19.332 ***	-6.068***	-20.378***	-16.984***	-6.211***
Polity2	-16.882***	-9.885***	-4.316***	-13.236***	-8.268***	-4.434***

Notes: *, **, and *** indicate significance at 10 %, 5% and 1% respectively. IPS, CADF & CIPS test the H_o: All panels contain unit root against H_1: Some panels are stationary.

Source: Author's Estimation, 2017

Table 3 and 4 reports IPS, CADF and CIPS unit root test results with constant only and constant and trend, both examined at levels and first difference respectively. The results clearly indicate that almost all the variables are stationary at levels except the labour variable which is non-stationary. This suggest that the labour variable has unit root. However, when the first difference of all the variables were examined using the same panel unit root tests, it was shown that the null hypothesis of non-stationarity was rejected at both 1% and 5% significance level respectively. On the basis of the panel unit root tests, the study concluded that real GDP per capita growth rate, construction expenditure, savings, trade openness, inflation and polity2 variables are all stationary at levels (i.e. I (0)) but the labour variable is stationary at first difference (i.e. I (1)). Thus, there are mixture of I(0) and I(1) variables to be used for the study, none of the variables are I(2).

Panel Cointegration Test Results

In order to analyse relationship between construction expenditure and economic growth in SSA, the study further tested for the cointegration status of the variables using Westerlund (2007) panel cointegration test. As indicated in the previous chapter, the test used four different test statistics to analyse cointegration among variables. These statistics are the group mean statistics (G_τ and G_α) and panel statistics (P_τ and P_α). For the group mean statistics, it test the null hypothesis of no cointegration against the alternative hypothesis of cointegration for at least one cross-sectional unit in the panel. The panel statistics, on the other hand, test the null hypothesis of no cointegration against the alternative hypothesis of cointegration for whole cross-sectional unit in the panel. This test was used because it allows for heterogeneous vectors and hence, do not impose a common-restriction factor. It is also normally distributed and generally accommodate unit specific short run dynamics, trend, slope parameters and cross-sectional dependence. Table 5 reports the results of the Westerlund panel cointegration test.

Table 5: *Results of Westerlund Panel Cointegration Test*

Cointegration Statistics	Values	Robust P-values
G_τ	-3.594***	0.001
G_α	-1.454	0.971
P_τ	-21.952**	0.014
P_α	-2.162	0.336

Notes: ** and *** indicate significance at 5 % and 1% respectively. Robust p-values are computed using 700 bootstrap replications.

Source: Author's Estimation, 2017

Looking closely at the robust p-value which is the p-value obtained through bootstrapping to deal with cross-sectional dependence, it shows that two of the cointegration test statistics (G_τ , P_τ) rejects the null hypothesis of no cointegration at 1% and 5% level of significance respectively. The remaining statistics(G_α , P_α) were statistically insignificant. On a whole, it can be concluded that there is cointegration among the variables of interest and hence, the study can now proceed to estimate both long run and short run parameters.

Panel ARDL Regression Results

Once cointegration has been established, the study proceeded to estimate long run and short run parameters using both the MG and PMG estimation techniques respectively. The results of MG and PMG estimation techniques highlighting both long run and short run coefficients as well as the Hausman test are presented and discussed in this section.

Table 6 highlights the results of both long run and short run coefficients of MG and PMG estimation techniques as well as the Hausman test. Overall, the PMG estimation technique produced more significant coefficients with the a prior expected signs than the MG estimation technique. As a post estimation test, the Hausman test was used to test the systematic difference in these estimators to decide on the preferred specification. The results from the Hausman test indicate that the null hypothesis of no systematic difference between MG and PMG cannot be rejected since the probability value (p-value) is highly insignificant. This implies that the PMG estimation technique is efficient (and consistent) than MG estimation technique. There is, therefore, no reason to doubt the assumption on which the efficient estimator was based. Hence, the long run and short run coefficients of PMG is discussed below.

Table 6: *Results of Panel ARDL Regression (MG and PMG)*

Dependent Variable: Real GDP per capita growth rate

	Mean Group (MG)		Pooled Mean Group (PMG)	
Variables	Coefficient	P-value	Coefficient	P-value
Long Run Estimates				
Construction (CON)	-0.220 (0.516)	0.670	0.181** (0.090)	0.045
Labour (L)	0.903 (1.960)	0.645	0.114* (0.067)	0.088
Savings (SAV)	-0.028 (0.118)	0.816	0.009 (0.020)	0.641
Openness	0.059* (0.033)	0.074	0.020* (0.012)	0.092
Inflation (INF)	0.009 (0.061)	0.885	-0.038*** (0.012)	0.002
Polity2	1.565 (1.263)	0.215	0.181*** (0.040)	0.000
Short Run Estimates				
Error Correction Term (ECT)	-1.194*** (0.063)	0.000	-0.859*** (0.047)	0.000
Δ Construction (CON)	0.941* (0.554)	0.090	0.403 (0.481)	0.402
Δ Labour (L)	-1.070 (4.811)	0.824	-3.313* (1.836)	0.071
Δ Savings (SAV)	0.068 (0.101)	0.498	0.204*** (0.066)	0.002
Δ Openness	-0.040 (0.037)	0.283	0.007 (0.033)	0.830
Δ Inflation (L)	-0.019 (0.038)	0.611	-0.054** (0.026)	0.039
Δ Polity2	-1.121 (0.832)	0.178	-0.541 (0.333)	0.105
Constant	-40.352 (111.182)	0.717	-7.240*** (0.607)	0.000
Number of countries	33		33	
Number of observations	792		792	
	Chi-square(6) value			P-value
Hausman Test (MG vs. PMG)	0.82			0.9915

Note: *, **, and *** indicate significance at 10 %, 5% and 1% respectively. Standard errors are in parenthesis. Hausman Test: H_o: No systematic difference between MG and PMG (PMG is efficient and consistent than MG under the null hypothesis).

Source: Author's Estimations, 2017

Consistent with expectation, construction expenditure has a positive and significant relationship with real GDP per capita growth in the long run. The coefficient indicate that at 5% level of significance, a percentage increase in construction expenditure will increase real GDP per capita growth by 0.181% in the long run, all other things being equal. This implies that the construction industry which is labour intensive increases employment that makes people better off in terms of disposable income and consumption, leading to an increase aggregate demand and GDP. Thus, construction investments drives economic growth in sub-Saharan Africa in the long run. This result is consistent with the empirical studies by Alagidede and Mensah (2016) in SSA, and other earlier empirical studies such as Ofori (1990); Lopes, Ruddock and Ribeiro (2002).

Similarly, the coefficient of labour force is positive and statistically significant at 10% significance level. This means that, all other things being equal, if labour force is increased by one percent, real GDP per capita growth will increase by 0.114% in the long run. This implies that in the long run as labour force increases, labour supply increases and translates into higher output growth. This result supports existing growth theories which postulate that labour inputs impact positively on economic growth. It can, therefore, be concluded that labour force impacts positively on economic growth in SSA. This empirical finding is consistent with earlier studies like Biyase and Zwane (2011), and Shahid (2014) which found a positive relationship between labour force and economic growth in the long run. However, studies such as Ababio (2015) contradicts the findings of this study as his study found in the long run, a negative but insignificant relationship between labour force and real per capita GDP growth in SSA.

Additionally, the coefficient of savings is positive in the long run but statistically insignificant. This gives an indication of inadequate or low savings and can be attributed to high incidence of poverty, low interest rate and high inflation. However, the positive coefficient is an indication that further increase in savings will contribute to economic growth in SSA.

As anticipated, trade openness which is the sum of exports and imports of goods and services measured as a share of GDP shows a positive sign and is significant at 10% level of significance. The coefficient is 0.02 and it means that a one percent increase in trade openness will increase real GDP per capita growth by 0.02%. This may suggests that in the long run increased trade openness leads to higher exports which increases real output. Again increased trade openness drives economic growth via other channels such as technology transfer, product diversity, increasing economies of scale, efficient allocation and distribution of resources, amongst others. This empirical finding is in line with earlier works such as Brucker and Lederman (2012), Keho (2017), Zohonogo (2017).

Furthermore, the long run relationship between inflation and real GDP per capita growth is shown to be negative and is statistically significant at 1% significance level. The sign and magnitude of the inflation coefficient indicate that in the long run, a percentage increase in inflation will decrease real GDP per capita growth by 0.038% all other things being equal. This may imply that increased inflation in the long run reduces the level of investment which adversely affect economic growth. It, therefore, suggests that inflation has a negative impact on economic growth in SSA in the long run. This empirical evidence is consistent with the findings of Ahiakpor and Akapare (2014); Ababio (2015); Bitterncourt (2012); Zhu and Pollin (2005), who also confirm the negative relationship between inflation and economic growth.

Lastly, at one percent level of significance, political regime and transition effects (Polity2) positively affect real per capita GDP growth in the long run. Specifically, it was found out that a one-point increase in the Polity2 score will increase real GDP per capita growth by 0.181% in the long run. The positive relationship supports the study by Masaki and Van de Walle (2014) in sub-Saharan Africa. This result suggest the existence of democracy which is associated with lower political instability which tends to provide stable environment for increased investment leading to economic growth. It can, therefore, be concluded that political regime and transition effects in SSA positively affects economic growth in the long run.

With regards to short run estimates, Table 6 again shows the results of short run coefficients to help explain relationship between construction expenditure and economic growth in SSA. Engle and Granger (1987) argued that when variables are cointegrated their dynamic relationship can be specified by an error correction representation in which an error correction term (ECT) computed from the long run equation must be incorporated in order to capture both the short run and long run relationships. The error correction term indicates the speed of adjustment to restore equilibrium in the dynamic model after a disturbance.

From table 6, the coefficient of the error correction term or the convergence coefficient is negative and statistically significant at 1% significance level. This actually confirms the existence of a cointegration relationship among variables in the model. The coefficient of the error correction term is -0.859, and this means that approximately 86% of the deviations from the long-term output growth caused by previous year's shocks converges back to the long run equilibrium in the current year. This clearly indicates a very high speed of adjustment in the model, suggesting that the variables will equilibrate faster in the long run when shocked.

The coefficient of construction expenditure in the short run is positive and statistically insignificant. This finding is consistent with the long run results, although statistically insignificant. The positive insignificant coefficient of construction expenditure in the short run suggest that investment in construction activities do not have contemporaneous effect on economic growth but it will actually take some time before it will fully contribute to economic growth. It can be concluded that construction expenditure do not significantly have short run impact on economic growth in SSA.

Unlike the long run coefficient of labour force which is positive, the short run result shows negative coefficient for labour force and is statistically significant at 10% level of significance. The coefficient of labour force is very huge, and suggests that a percentage increase in labour force will reduce real GDP per capita growth by 3.313% in the short run. This is an indication that most people in the labour force bracket in SSA are unemployed or working at a job that do not use labour best skills and hence, in the short run negatively impacts on economic growth. This confirms the study of Shahid (2014), who also found a negative short run relationship between labour force and economic growth.

Again, results from Table 6 also indicate that savings has a positive effect on real GDP per capita growth in the short run. At one percent level of significance, it was realised that a percentage increase in savings will increase real GDP per capita growth by 0.204% in the short run. This suggests that, in the short run, savings positively affects economic growth in SSA. But this impact on economic growth is relatively larger than the impact in the long run.

Besides, the coefficient of inflation in the short run is negative and significant at 5% level of significance. This indicate that all other things being equal if inflation is increased by one percent, real GDP per capita growth will reduce by 0.054% in the short run. This may imply that increased inflation reduces the level of investment which adversely affect economic growth. This clearly suggest that inflation negatively affect economic growth in the short run. The result is in conformity with the findings obtained by Ahiakpor and Akapare (2014) in Ghana, and Datta and Mukhopadhyay (2011) in Malaysia.

Finally, the remaining control variables such as trade openness and Polity2 are not statistically significant in the short run. Trade openness has a positive coefficient and is consistent with its long run result. However, the coefficient of Polity2 is negative and hence, do not conform to its long run result. The indication here is that both trade openness, and political regime and transition effects do not have significant short run effects on economic growth in SSA.

Inverted U-shaped Relationship between construction expenditure and economic growth

As part of the objective, the study tested for non-linear (inverted U-shaped) relationship between construction expenditure and economic growth. Table 7 shows the findings and hence, much focus will be on the long run estimates. The study followed Samargandi, Fidrmuc and Ghosh (2013) and Zohonogo (2017) to put a quadratic term for construction expenditure in the model to capture non-linearity.

The estimation results in Table 7 indicate a non-linear (inverted U-shaped) relationship between construction expenditure and economic growth, and this shows that the Bon curve holds for sub-Saharan Africa. Consistent with expectation, both the quadratic term of construction expenditure and construction expenditure itself are statistically significant at 10% and 1% level of significance respectively. The coefficient of construction expenditure is 0.880 and this is relatively large compared with the long run coefficient of construction expenditure in Table 6. It can, therefore, be interpreted that a percentage increase in construction expenditure will increase real GDP per capita growth by 0.880%, all other things being equal. Also, the coefficient of the quadratic term of construction expenditure is negative and significant but cannot be interpreted directly unless the net effect is computed. The net effect is 0.54538 (see computation at Appendix B1). It means that if construction expenditure is increased by one percent, real GDP per capita growth will increase approximately by 0.545% all other things being equal.

Table 7: *Results of the test of an Inverted U-shaped Relationship between construction expenditure and economic growth*

Dependent Variable: Real GDP per capita growth rate

	Pooled Mean Group (PMG)	
Variables	Coefficient	P-value
Long Run Estimates		
Construction (CON)	0.880 *** (0.276)	0.001
Construction Squared (CON^2)	-0.039* (0.022)	0.079
Labour (L)	0.043 (0.073)	0.555
Savings (SAV)	-0.009 (0.017)	0.621
Openness	0.001 (0.011)	0.955
Inflation (INF)	-0.041*** (0.012)	0.001
Polity2	0.256 *** (0.043)	0.000
Short Run Estimates		
Error Correction Term (ECT)	-0.853*** (0.045)	0.000
Δ Construction (CON)	-2.259 (4.057)	0.578
Δ Construction Squared (CON^2)	0.582 (0.938)	0.535
Δ Labour (L)	-5.274 *** (2.034)	0.010
Δ Savings (SAV)	0.224*** (0.067)	0.001
Δ Openness	0.013 (0.032)	0.687
Δ Inflation (L)	-0.060** (0.029)	0.041
Δ Polity2	-0.343 ** (0.137)	0.012
Constant	-3.212*** (0.535)	0.000
Number of countries	33	
Number of observations	792	

Note: *, **, and *** indicate significance at 10%, 5% and 1% respectively. Standard errors are in parenthesis.

Source: Author's Estimation, 2017

The explanation of the inverted U-shaped relationship is that construction expenditure has a positive effect on economic growth but only up to a threshold level or turning point, after this threshold additional construction expenditure decreases economic growth. The threshold level or turning point is estimated to be 11.28% (see computation at Appendix B2). This suggests that construction expenditure positively affect economic growth and development until it reaches a turning point of 11.28 % of GDP. After this turning point, additional expenditure on construction activities decreases economic growth. The value of this turning point appears in a meaningful range of values of construction expenditure and hence, the relationship is regarded as non-monotonic. Thus, as construction expenditure increases, economic growth sometimes increases and sometimes decreases. To sum up, this inverted U-shaped relationship found between construction expenditure and economic growth clearly indicate the changing role of the construction industry at various stages of economic growth and development, as highlighted by Bon (1992). The findings suggest the importance of the construction industry in SSA.

Panel Causality Test Results

In order to analyse causal relationship between construction expenditure and economic growth, the study used the heterogeneous panel causality test developed by Dumitrescu and Hurlin (2012). The test is quite sensitive to number of lags included in the specification and as a result of that the optimal lag length was determined to be four (4) using Schwarz Criterion (SC) or Bayesian information criterion (see Appendix C). The SC was used in preference over other lag selection criterion because it has a more parsimonious specification and minimizes the loss of degree of freedom.

Table 8: *Dumitrescu Hurlin Panel Causality Test*

Null Hypotheses	W-Stat.	Zbar-Stat.	Prob.
Construction does not homogeneously cause Real GDP per capita growth	7.42558	3.35920***	0.0008
Real GDP per capita growth does not homogeneously cause Construction	6.11113	1.67748*	0.0934

Note: * and *** indicate significance at 10 % and 1% respectively
Source: Author's Estimation, 2017

The Dumitrescu Hulin panel causality test results in Table 8 suggest that the null hypothesis that construction expenditure does not homogeneously cause real GDP per capita growth is strongly rejected at 1% level of significance. This implies that construction expenditure causes real GDP per capita growth. Similarly, the null hypothesis that real GDP per capita growth does not homogeneously cause construction expenditure is also rejected at 10% level of significance. This suggests that real GDP per capita causes construction expenditure.

From the above, it is clear that there is bidirectional relationship or feedback effect between construction expenditure and real GDP per capita growth across the countries under study. Thus, real GDP per capita growth predicts construction expenditure and construction expenditure as well predicts real GDP per capita growth. This finding is in line with the empirical studies of Chen and Zhu (2008) in China, Kargi (2013) in Turkey and Okoye et al., (2016) in Nigeria. In a nutshell, it can be concluded that there is a bidirectional relationship between construction sector and the aggregate economy of sub-Saharan Africa, at least for a four-year lag period.

Summary on the Findings of the Hypotheses Test of the Study

Hypothesis one tested for long run relationship between construction expenditure and economic growth in SSA. The null hypothesis of no long run relationship between construction expenditure and economic growth was rejected at 5% level of significance and hence, was concluded that there is long run relationship between construction expenditure and economic growth. The coefficient of construction expenditure was positive and this was actually consistent with the a prior expectation. Clearly, the finding of the first hypothesis suggests that construction expenditure drives economic growth in SSA.

Hypothesis two also tested for short run relationship between construction expenditure and economic growth in SSA. The coefficient of construction expenditure was positive but statistically insignificant. This means that the null hypothesis of no short run relationship between construction expenditure and economic growth cannot be rejected. Therefore, it implies that there is no short run relationship between construction expenditure and economic growth in SSA. The positive insignificant coefficient of construction expenditure in the short run suggests that construction activities do not have contemporaneous effect on economic growth but it will actually take some time before investment in construction will fully contribute to economic growth. It can be concluded that construction expenditure do not significantly have short run impact on economic growth in SSA.

Hypothesis three tested for non-linear (inverted U-shaped) relationship between construction expenditure and economic growth in SSA. In other words, it was a test for the validity of the Bon curve. Both the quadratic term of construction expenditure and construction expenditure were statistically significant at 10 % and 1% level of significance respectively. This implies that the null hypothesis of no inverted U-shaped relationship between construction expenditure and economic growth is rejected and hence, can be concluded that there is an inverted U-shaped relationship between construction expenditure and economic growth in SSA, with a turning point or threshold level of 11.28%. The inverted U-shaped relationship suggests that construction expenditure positively affect economic growth until it reaches a turning point of 11.28%. After this turning point, additional expenditure on construction decreases economic growth in SSA. This actually provides empirical evidence in support of the validity of the Bon curve in SSA.

Lastly, hypothesis four tested for causal relationship between construction expenditure and economic growth in SSA. The null hypotheses of the test: construction expenditure does not homogeneously cause economic growth, and economic growth does not homogeneously cause construction expenditure were both rejected at 1% and 10 % levels of significance respectively. This clearly indicates that there is causal relationship between construction expenditure and economic growth in SSA. The nature of the causal relationship is bidirectional, with an optimal lags of 4. Hence, it can be concluded that there is a bidirectional relationship between the construction sector and the aggregate economy of sub-Saharan Africa, at least for a four-year lag period.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

This chapter summarizes and concludes the entire study based on the findings reached. Thereafter, it presents some policy recommendations to various governments and policy makers in the sub-Saharan Africa (SSA). Also, the chapter presents limitations of the study as well as some suggestions for future research.

Summary of the Study

Understanding the nature of relationship between construction expenditure and economic growth in SSA is paramount since it helps to highlight the importance of the construction industry in the region. Specifically, it brings to the fore the significant role the industry plays in the sub-Saharan African economy as to enlighten policy decisions in relation to construction investments.

The study worked with a broad objective to analyse relationship between construction expenditure and economic growth using data from 33 SSA countries covering the period of 1990-2014. Specifically, the study analysed short run, long run, inverted U-shaped and causal relationship between construction expenditure and economic growth in SSA. To be able to get supporting economic theories and empirical evidence for the study, a good literature review was first conducted. The literature review presented an overview of the sub-Saharan African economy; theoretical literature review on the relationship between construction expenditure and economic growth as well as a review of empirical literature with specific focus on the non-linear and causal relationship between construction expenditure and economic growth.

The review identified some methodological flaws which have led to inconclusive findings. Thus, most of the test for the validity of the Bon curve have been rather descriptive. Again, most studies that have tested the Bon curve did not consider the inclusion of control variables in its model specification. Hence, making the robustness of such findings questionable. Also, most studies always stop at non-linear relationship and do not extend the analysis to find the turning point associated with such relationship. The review argued that the Bon curve is a long run phenomenon and needs to be re-examined especially for the case of sub-Saharan Africa using a time period since the only study on the subject in SSA used a shorter time period which may not reflect the true nature of the Bon curve.

The study addressed these gaps above to achieve the main objective of the study using Panel ARDL model with its main estimation techniques such as Mean Group (MG) and Pooled Mean Group (PMG). It employed the following variables: real GDP per capita growth rate, construction expenditure as a percentage share of GDP, gross domestic savings as a percentage of GDP, trade openness, inflation, labour force and Polity2 (political regime and transition effects). The Pesaran cross-sectional dependence (CD) test; IPS, CADF and CIPS panel unit root tests; Westerlund cointegration test; Hausman specification test and Dumitrescu Hurlin panel causality test were used in addition to the main estimation techniques to achieve the objectives of the study.

The CD test revealed the presence of cross-sectional dependence among countries used in the study for all variables except savings. The absence of cross-sectional dependence for savings clearly indicated that countries in SSA reacts independently with regards to gross domestic savings. The study proceeded to analyse the unit root status of all the variables and it was realised that real GDP per capita growth rate, construction expenditure, savings, trade openness, inflation and polity2 variables were all stationary at levels (i.e. I (0)) but the labour variable was stationary at first difference (i.e. I (1)). Thus, there were mixture of I(0) and I(1) variables used for the study, none of the variables were I(2).

Again, by the use of Westerlund panel cointegration approach, cointegration was established among the variables. The study then proceeded to analyse short run and long run relationship between construction expenditure and economic growth using both the Mean group (MG) and Pooled mean group (PMG) estimation techniques respectively. The short run and long run findings of the PMG was discussed because it was the efficient and consistent estimation technique according to the Hausman test. The Hausman test which is a post estimation test was highly insignificant and hence, the null hypothesis that there is no systematic difference between MG and PMG, implying that the PMG is efficient and consistent estimation technique than the MG was failed to be rejected. Also, as part of the specific objectives, the study tested for inverted U-shaped relationship between construction expenditure and economic growth as well as causal relationship between the underlying variables. The main findings from the study have been highlighted below:

The error correction term (ECT) or the convergence coefficient confirmed cointegration among the variables as it was negative and highly significant. The coefficient of the ECT revealed a very high speed of adjustment, suggesting that about 86% of the previous year's disequilibrium was adjusted in the current period.

A positive relationship was found between construction expenditure and real GDP per capita growth in the long run and short run, although the latter was statistically insignificant. This clearly shows that construction expenditure matters more in the long run than in the short run in stimulating economic growth in SSA.

The study also revealed a significant positive relationship between labour force and real GDP per capita growth in the long run. This support existing growth theories which postulate that labour inputs impact positively on economic growth. On the other hand, a significant negative short run relationship was found between labour force and real GDP per capita growth. This confirms the empirical finding of Shahid (2014) who also found a negative short run relationship between labour force and economic growth.

Savings had a positive long run relationship with real GDP per capita growth but it was statistically insignificant. This gives an indication of inadequate or low savings and can be attributed to high incidence of poverty, low interest rate and high inflation. However, the positive coefficient is an indication that further increase in savings will contribute to real GDP per capita growth in SSA. On the other hand, relationship between savings and real GDP per capita growth was found to be highly significant and positive in the short run. This suggest that, in the short run, savings positively affects economic growth in SSA.

Again, the study revealed significant positive relationship between trade openness and real GDP per capita growth in the long run. This suggest that in the long run trade openness matters in driving economic growth in SSA. The short run relationship, on the other hand, between trade openness and real GDP per capita growth was also found to be positive but statistically insignificant.

Both long run and short run relationship between inflation and real GDP per capita growth was found to be negative and statistically significant. This clearly indicate that inflation is detrimental to economic growth in SSA.

In addition to the above, a positive and statistically significant relationship was found between political regime and transition effects (Polity2) and real GDP per capita growth in the long run. But the relationship in the short run showed a statistically insignificant negative relationship. The indication is that the effect of political regime and transition effects of sub-Saharan African countries on economic growth matters only in the long run but not in the short run.

Moreover, the test for inverted U-shaped relationship construction expenditure and real GDP per capita growth revealed that the Bon curve holds for SSA, with a turning point of 11.28%. Both the quadratic term for construction expenditure and construction expenditure were statistically significant with their a prior expected signs. Thus, construction expenditure showed a positive relationship with real GDP per capita growth, whereas a negative relationship was found between construction expenditure squared and real GDP per capita growth. The study then proceeded to compute the turning point or the threshold of the inverted U-shaped relationship found. The turning point found for construction expenditure as a share of GDP was 11.28%. This value appeared in a meaningful range of values of construction expenditure and hence, the relationship was regarded as non-monotonic. Thus, as construction expenditure increases, economic growth sometimes increases and sometimes decreases. The inverted U-shaped relationship suggest that construction expenditure positively affect economic growth until it reaches a turning point of 11.28% of GDP. After this turning point, additional expenditure on construction decreases economic growth in SSA. This actually provides empirical evidence in support of the validity of the Bon curve in SSA.

Finally, the Dumitrescu Hurlin panel causality test revealed a bidirectional relationship between construction expenditure and real GDP per capita growth. Thus, real GDP per capita growth predicts construction expenditure and construction expenditure as well predicts real GDP per capita growth. But the statistical significance level of the test suggests a strong causality running from construction expenditure to real GDP per capita growth. This actually confirms the importance of the construction industry in aggregate economy of SSA.

Conclusions

Construction expenditure contributes positively to the economic growth of SSA in the long run. Thus, the construction industry is a relevant driver of economic growth in SSA. However, there is no significant short run relationship between construction expenditure and economic growth in SSA. This means that investment in construction do not have contemporaneous effect on economic growth but rather it will take some time before construction expenditure will fully contribute to economic growth in SSA.

Besides, other control variables such as labour force, trade openness and, political regime and transition effects (Polity2) impacts positively on growth of the sub-Saharan African economy in the long run. These variables are important determinants of economic growth and hence, matters most when policy makers want to stimulate economic growth in SSA. In the short run, savings cannot be overlooked when policy makers want to achieve economic growth in SSA. It is an important short run determinant of economic growth since it impacts positively on economic growth in sub-Saharan African countries.

Furthermore, inflation contributes negatively to economic growth in SSA. It is actually inimical to economic growth both in the long run and short run respectively. Again, labour force has a negative short run relationship with economic growth. This means that labour force do not impact positively on economic growth in the short run.

In addition to the above, there is non-linear (inverted U-shaped) relationship between construction expenditure and economic growth in SSA, with a turning point of 11.28%. The relationship is non-monotonic and suggest that the Bon Curve holds for SSA. This means that the effect of construction expenditure on economic growth is not always positive. Over time, the effect of construction expenditure on economic growth changes from positive to negative. This clearly indicate that the economic growth effects of construction expenditure differs according the level of construction expenditure in SSA.

Finally, there is a bidirectional relationship between construction expenditure and economic growth in SSA, at least for a four-year lag period.

Recommendations

The study recommends that since investment in construction plays a pivotal role in economic growth, governments needs a construction industry policy that is consistent with broader policies to ensure sustainability of the industry. Sustainability of the industry can only be achieved through the creation of the business friendly environment where both local and foreign partnership can strive leading to technological transfer.

Again, considering the importance of the construction industry to economic growth, various governments or policy makers in SSA should consider the industry as one of the major drivers of economic growth. To achieve that, governments should prioritize investment in construction as well as optimize the use of the industry to increase economic growth.

With regards to the non-linear (inverted U-shaped) relationship between construction expenditure and economic growth found, there is the need for various governments to be circumspect in controlling the level of construction expenditure to be able to effectively and efficiently boost economic growth and development in SSA. Policy makers should be guided by the threshold level or turning point because expansion of construction expenditure beyond the turning point may not bring the desired impact on economic growth and hence, the much anticipated development envisaged by these governments.

Additionally, the study also found a positive long run relationship between labour force and economic growth in SSA. In that regard, various governments in SSA should intensify the empowerment of labour force with special skills and opportunities that will continue to support the productive capacity of the economy especially the construction industry towards economic growth. More sustainable jobs that offer good wages and working conditions needs to be created by governments and private institutions to help labour force in contributing to economic growth in SSA.

Moreover, a positive long run relationship was found between trade openness and economic growth. Exporters in SSA must be encourage to add value to their local raw materials before exporting them. Various governments need to create several export processing zones in their economies with the aim of attracting foreign investors and buyers who can facilitate entry into the world market for some of the economies industrial product. This will generate employment and foreign exchange which may later translate into economic growth.

Furthermore, political regime and transition effects (Polity2) was also found to be an important determinant of economic growth in SSA. This requires that all stakeholders and governments in the region needs to continue to strengthen and deepen our democratic principles to help provide a conducive and stable environment for most productive activities. Specifically, there must be a workable electoral and transitional laws coupled up with free and fair elections to ensure that there is always peace and stability in the region to support economic growth and development.

Finally, development of a strong construction industry require a stable macroeconomy towards achieving accelerated growth and development. Therefore, central banks in SSA should continue to pursue inflation targeting policy as the best monetary policy tool or regulate the excessive money supply growth to keep inflation under control since it was found to be detrimental to economic growth in SSA.

Limitations of the Study

The main limitation of this study had to do with limited availability of data that spans over a longer period of time for the countries under study. Some countries were dropped from the sample simply because there were limited availability of data on certain key variables used for the study. Again, the study could not account for non-construction investment that may impact on economic growth in SSA. This is also as a result of unavailability of data. Finally, several attempt to focus on the disaggregated form of construction expenditure and economic growth was constrained because data on disaggregated form of construction expenditure was not readily available for most countries in SSA under study.

Suggestions for Further Research

An area that is worth studying in the future is to examine relationship between disaggregated form construction expenditure and economic growth in SSA using data spanning over a longer period of time. The disaggregated form of construction could either be public and private construction expenditure or residential and non-residential construction expenditure. A test of the validity of the Bon curve in SSA using data on disaggregated form of construction expenditure and real GDP per capita growth would be good for policy directives towards growth of the construction industry and the aggregate economy at large.

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APPENDIX A

List of thirty–three (33) sub-Saharan African countries used in the study

No.	Name of Country
1	Benin
2	Botswana
3	Burkina Faso
4	Burundi
5	Cameroon
6	Central African Republic
7	Chad
8	Comoros
9	Congo Republic
10	Cote d'Ivoire
11	Equatorial Guinea
12	Gabon
13	Ghana
14	Guinea
15	Guinea-Bissau
16	Kenya
17	Madagascar
18	Malawi
19	Mali
20	Mauritius
21	Mauritania
22	Mozambique
23	Namibia
24	Niger
25	Nigeria
26	Rwanda
27	Senegal
28	Sierra Leone
29	South Africa
30	Tanzania
31	Togo
32	Uganda
33	Zimbabwe

APPENDIX B

1. Computation of Net Effect

From Table 7

To interpret Construction Squared, the study computed net effect for the variable

$$\frac{\partial(\,Real\ GDP\ per\ capita\ growth)}{\partial(CON_{it})} = \psi_1 + 2\psi_2\,\overline{CON_{it}}$$

Where $\overline{CON_{it}}$ = 4.29, denotes the mean value of the share of construction expenditure in GDP; $\psi_1 = 0.880$ and $\psi_2 =$ - 0.039, estimate of CON_{it} and $CON_{it}{}^2$ respectively.

$$\frac{\partial(Real\ GDP\ per\ capita\ growth)}{\partial(CON_{it})} = 0.880 + 2[\,(-0.039)(\,4.29)]$$

$$= 0.54538$$

2. Computation of Turning Point

$$\frac{\partial(Real\ GDP\ per\ capita\ growth)}{\partial(CON_{it})} = \psi_1 + 2\psi_2\,CON_{it} = 0$$

$$\psi_1 + 2\psi_2\,CON_{it} = 0$$

Making CON_{it} the subject

$$CON_{it} = -\frac{\psi_1}{2\psi_2}$$

$$= -\frac{0.880}{2(-0.039)}$$

$$= 11.28\ \%$$

APPENDIX C

Results of Panel VAR Lag Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-3051.281	NA	182.9815	10.88514	10.90057	10.89117
1	-2306.224	1482.147	13.03279	8.243222	8.289530	8.261303
2	-2292.331	27.53832	12.58116	8.207953	8.285132	8.238087
3	-2282.384	19.64523	12.31726	8.186753	8.294803	8.228940
4	-2244.631	74.29581	10.92082	8.066419	**8.205341***	8.120660*
5	-2239.479	10.10200	10.87610	8.062312	8.232105	8.128607
6	-2238.497	1.918547	10.99383	8.073071	8.273736	8.151420
7	-2228.674	19.11988*	10.76807	8.052314	8.283850	8.142715
8	-2224.010	9.045356	10.74273*	8.049946*	8.312354	8.152402

Notes**:** * indicates lag order selected by the criterion

LR: sequential modified LR test statistics (each at 5%level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Source: Author's Estimation, 2017

APPENDIX D

Hausman Test for Mean Group (MG) versus Pooled Mean Group (PMG)

	Coefficients			
	(b)	(B)	(b-B)	sqrt (diag (V_b-V_B)
	MG	PMG	Difference	S.E.
Construction	-.2198593	.1811475	-.4010068	1.16198
Labour	.9030328	.1143362	.7886966	4.430874
Savings	-.0275134	.0093141	-.0368275	.2661745
Openness	.0588643	.0195254	.0393389	.0736802
Inflation	.0088148	-.0381655	.0469803	.1373211
Polity2	1.565075	.1814777	1.383598	2.853693

Notes: b = consistent under Ho and Ha;

B = inconsistent under Ha, efficient under Ho;

Test: Ho: difference in coefficients not systematic

chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 0.82

Prob>chi2 = 0.9915

Source: Author's Estimation, 2017