

**UNIVERSITY OF GHANA  
(COLLEGE OF HUMANITIES)**

**OFFICIAL DEVELOPMENT ASSISTANCE AND AGRICULTURAL  
FIXED CAPITAL FORMATION IN AFRICA: EVIDENCE FROM A  
PANEL OF COUNTRIES**

**BY**

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**THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA,  
LEGON IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE  
AWARD OF MPhil FINANCE DEGREE**

**JULY, 2017**

**DECLARATION**

I hereby declare that this work is the original work of Sylvester Stallone Sadekla under the supervision of Prof. Godfred A. Bokpin and Dr. Edward K. Asiedu and that it has not been submitted in part or in full to this university or any other university for the award of a degree. I further declare that all references and acknowledgement have been given to the scholarly works used.

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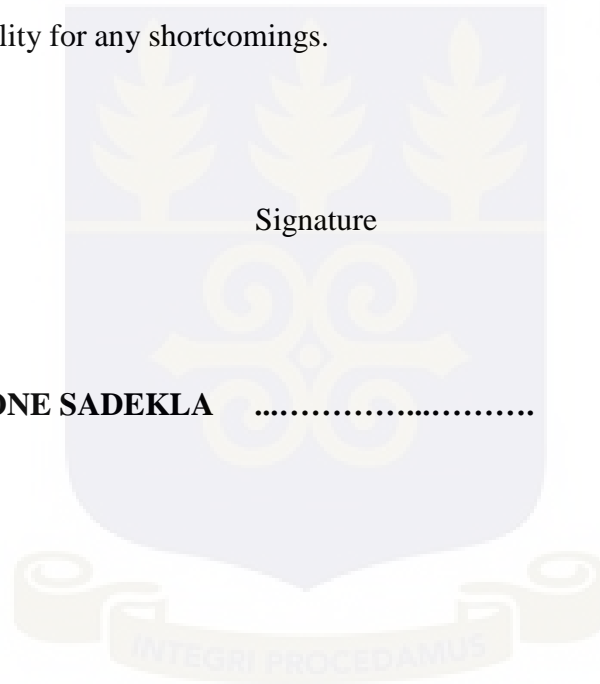
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**CERTIFICATION**

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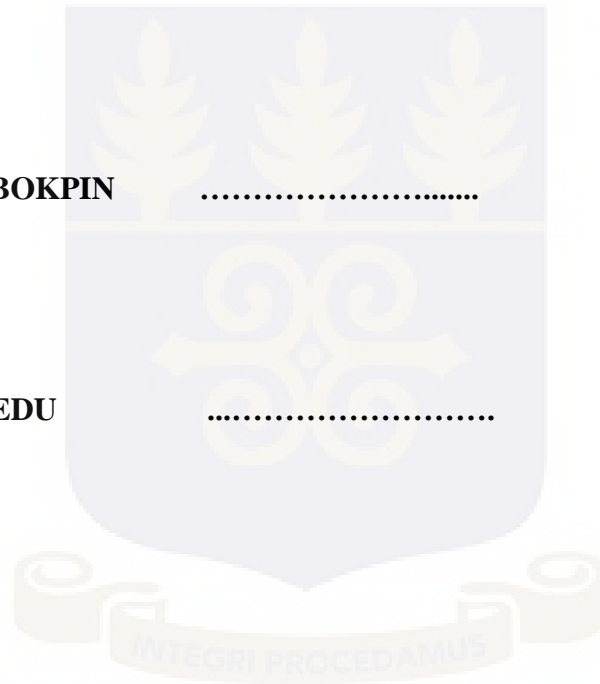
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## DEDICATION

To Sedem and the future he represents



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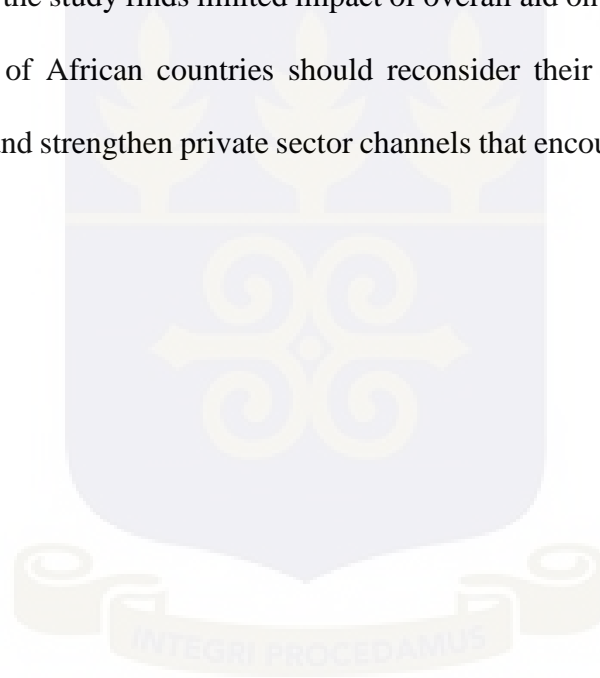
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## ABSTRACT

Sub-Saharan Africa (SSA) has attracted substantial amounts of Official Development Assistance (ODA) over the years. General ODA flows to the continent currently stands at around \$80 billion per annum and the figure is projected to be well above \$125 billion due to the Sustainable Development Goals. Over the last five decades, SSA has received about \$1 trillion in foreign aid for sector-specific (agriculture, health, etc.) development. Even though the impact of aid on economic growth is inconclusive, the question is whether sector-specific aid has led to sector-specific growth. Little is known about the relationship between ODA and agricultural fixed capital formation. In this study we examine how agricultural ODA impacts agricultural fixed capital formation in the short and long-terms in Africa.

ODA has the potential of augmenting scarce domestic resources to form fixed capital in developing countries. Nonetheless, ODA can also be a disincentive to wealth building by depressing governments' motivation for revenue generation; thereby impeding capital formation for economic growth and poverty reduction. For these reasons, this study tests the hypotheses that total ODA and its decomposed forms: bilateral and multilateral, enhances the formation of agricultural fixed capital needed for agricultural growth and employment. Using data on 40 SSA countries over the period 1996 to 2014 and exploiting the instrumental variable two stage least squares (IV-2SLS) in a fixed-effects setting and the generalized method of moment (GMM) estimators, the study finds that in the short-term, total and bilateral ODA have a strong positive and statistically significant impact on fixed capital formation. However, we do not find short-term impacts of multilateral ODA on fixed capital formation. In terms of the growth impacts of total ODA on fixed capital formation, the study finds marginal impact of bilateral ODA on growth in fixed capital formation in Sub-Saharan Africa at the 10% level of significance. Total and multilateral aid do not have

longer-term impact on agricultural fixed capital formation. For this reason, bilateral ODA seem to be more suitable for sustainable rural and agricultural development. The insignificant impact of multilateral ODA at level (short-term) and growth (long-term) could be as a result of free-riding in monitoring. With many donors providing aid in a multilateral arrangement, monitoring could be seen as a public good where individual donors expect others to monitor, and that can result in non-monitoring or under-provision of monitoring. Thus, for policy directions, it is recommended that in the design of multilateral ODA, monitoring by donors should be invigorated to enhance aid effectiveness. Generally, the study finds limited impact of overall aid on agricultural fixed capital. Therefore, governments of African countries should reconsider their over-reliance on official development assistance and strengthen private sector channels that encourage internally generated revenue.



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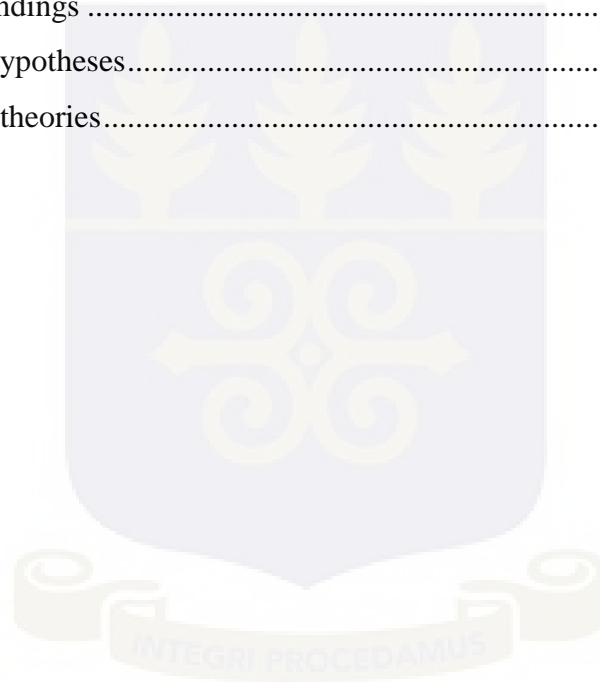
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## LIST OF ABBREVIATIONS

AERC	African Economic Research Consortium
AfDB	African Development Bank
AsDB	Asian Development Bank
BLUE	Best Linear Unbiased Estimator
BODA	Bilateral Official Development Assistance
CGE	Computable General Equilibrium
CLRM	Classical Linear Regression Model
CPI	Consumer Price Index
DAC	Development Assistance Committee
DCs	Developed Countries
DGMM	Difference Generalized Method of Moments
DXR	Dollar Exchange Rate
ECA	Economic Commission of Africa
EDF	European Development Fund
EU	European Union
FAO	Food and Agricultural Organization of the United Nations
FDI	Foreign Direct Investment
FE	Fixed Effects
FPI	Foreign Portfolio Investment
GDN	Global Development Network
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation
GLS	Generalized Least Squares
GMM	Generalized Method of Moments
GNI	Gross National Income
HIPC	Highly Indebted Poor Countries

IDA	International Development Association
IFAD	International Fund for Agricultural Development
IV	Instrumental Variable
LDC	Least Developed Countries
LM	Lagrange-Multiplier
MDGs	Millennium Development Goals
MODA	Multilateral Official Development Assistance
NEPAD	New Partnership for Africa's Development
NGO	Non-Governmental Organization
ODA	Official Development Assistance
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Squares
ROL	Rule of Law
SDGs	Sustainable Development Goals
SES	Socio-Economic Status
SGMM	System Generalized Method of Moments
SNA	System of National Accounts
SSA	Sub-Saharan Africa
SW	Sanderson-Windmeijer
TSLs	Two Stage Least Squares
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNFP	United Nations Fund and Programmes
UNSD	United Nations Statistics Division
US	United States (of America)
WDI	World Development Indicator
WGI	World Governance Indicator
WW II	World War II

## CHAPTER ONE

### INTRODUCTION

#### 1.1 Background

The first, second and eighth objectives of the Sustainable Development Goals (SDGs); “*No poverty*”, “*Zero hunger*” and “*Decent work and economic growth*” respectively can be achieved in Sub-Saharan Africa (SSA) if and only if more attention is given to the agricultural sector. This is because agriculture remains the backbone of most economies in Sub-Saharan Africa (Gabre-Madhin & Haggblade, 2004; FAO, 2005; Godfray, Beddington, Crute, Haddad, Lawrence, Muir, & Toulmin, 2010) and contributes an average of 30%-60% of gross domestic product (GDP) and about 30% of export value (NEPAD, 2003). About 80% of the population in SSA lives in rural areas and 70% of this rural population depend directly on agriculture as an important source of income (Kanu, Salami & Numasawa, 2014). Agriculture in SSA is mostly small-scale and provides employment for 60% of the working population (Obwona & Chirwa, 2006). Diao, Hazell & Thurlow (2010) opined that the growth of the agricultural sector is more pro-poor than any other sector. Thus, investing in physical capital and infrastructure (fixed capital formation) in the agricultural sector of SSA will promote the expansion and productive capacity of the sector; thereby providing available raw material resource needed by industry, creating especially more rural employment opportunities for the burgeoning youthful population of the continent, ensuring food and nutritional security, stimulating and sustaining pro-poor and inclusive growth and raising income levels of the poor and consequently enhancing poverty reduction towards the attainment of the SDGs by the year 2030.

Fixed capital formation represents the total amount of fixed assets such as land improvements, farm machinery, equipment, roads, dams, etc. According to WDI definitions “fixed capital formation is measured as the total value of a producer’s acquisitions, less disposals, of fixed assets during the accounting period plus certain additions to the value of non-produced assets (such as subsoil assets or major improvements in the quantity, quality or productivity of land) realized by the productive activity of individuals or institutional units”. To meet the objective of agricultural growth and development, a nation needs to form fixed capital on a sufficient scale to serve as an engine for productivity and growth (Shuaib & Ndidi, 2015) in the sector. Capital formation is the largest and the most important determining factor of economic development (Shuaib & Ndidi, 2015), not overlooking sound socio-cultural and political conditions, technological and entrepreneurial factors (Jhingan, 2006). However, the economies of SSA on their own have been unable to generate enough capital to bridge the savings and investment gap (Chenery & Strout, 1966; Bacha, 1990; Gomanee, Girma & Morrissey, 2005 ; Afawubo & Mathey, 2017) and so, depend heavily on official development assistance (ODA); a form of foreign aid (Lancaster, 1999; OECD, 2010; De Renzio, 2006). ODA has the potential of augmenting scarce domestic resources for fixed capital formation in developing countries (Morrissey, 2001). Nonetheless, ODA can also be a disincentive to wealth building by depressing governments’ motivation for revenue generation (Gang & Khan, 1991); thereby impeding capital formation for economic growth and poverty reduction.

Morrissey (2001) argues theoretically that “foreign aid increases investment in physical capital; increases the capacity to import capital goods; and is associated with technology transfer that increases the productivity of capital and promotes endogenous technical change”. Even though it is argued theoretically that foreign aid should be economically effective and have a positive

correlation with savings, investment and capital formation in the aggregate economy (Hansen & Tarp, 2001; Clemens, Radelet & Bhavnani, 2004), empirical literature on aid effectiveness is notably far from conclusive (Fischer, 1993; Easterly, 1993; Easterly 1999). Burnside & Dollar (2000) and McGillivray, Feeny, Hermes & Lensink (2006) contend that aid effectiveness is influenced by external and climatic conditions, good policy environments, political conditions and institutional quality.

Mafusire, Anyanwu, Brixiova, & Mubila (2010) reveals that Africa needs \$93 billion per annum to meet demand for adequate infrastructure. Theoretically, it is argued that ODA can have an important role to play in bridging this gap in Sub-Saharan Africa. In this regard, substantial amounts of ODA has been allocated SSA over the years and currently ODA inflows is about \$80 billion every year and the amounts are projected to be well above \$125 billion due to the SDGs.

Considering the importance of agriculture to poverty reduction in SSA, little is known about the relationship between ODA and agricultural fixed capital formation. In this regard, this study examines the level and growth impacts of ODA on agricultural fixed capital formation. The level impact indicates how the flow of ODA may influence the magnitude of fixed capital formation while the growth impact captures the longer-term trajectory fixed capital formation may undergo as a result of ODA flows into recipient countries.

## **1.2 Problem Statement**

Capital formation which comes about as a result of savings, mobilization of savings and investment has been determined by economic theories as the most important determinant of economic growth (Jones & Manuelli, 1990; Shuaib & Ndidi, 2015) but the inability of most economies in Sub-Saharan Africa to form capital remains a fundamental problem (Sidi, Omoruyi, Zhibin, Jun & Pianran, 2016). Due to insufficient savings and investment (Bacha, 1990; Gomanee, Girma &

Morrissey, 2005; Afawubo & Mathey, 2017), most economies of SSA are not able to mobilize enough resources for capital formation and so rely on external finance such as official development assistance (Andrews, 2009; De Renzio, 2006). ODA is considered to play a very crucial function by augmenting savings and investment in the process of capital formation which in essence enhances productivity and develops agriculture in SSA. Among developing countries, Sub-Saharan Africa has received the most aid (Lancaster, 1999; OECD, 2010) and so, *ceteris paribus*, aid is expected to have the largest impact on SSA. However, extant literature on the effectiveness of aid as a catalyst for economic development in general is inconclusive as well as contradictory and most rural dwellers in SSA still wallow in abject poverty. Thus, the savings and investment gap still widens impeding the formation of physical capital. While a number of studies (Levy, 1988; Papanek, 1973; Dowling & Hiemenz, 1983; Gupta & Islam, 1983; Hansen & Tarp, 2000; Hansen & Tarp, 2001; Burnside & Dollar, 2000; Gomanee, Morrissey, Mosley & Verschoor, 2005; Dalgaard *et al.*, 2004; Sachs, *et al.*, 2004; Karras, 2006; Galiani, Knack, Xu & Zou, 2017) find evidence for positive impact of foreign aid on growth indicators and poverty reduction, interestingly, a number of other researchers (Bräutigam & Knack, 2004; Duc, 2006; Javid & Qayyum, 2011; Tracy, 2010; and Uzonwanne & Ezenekwe, 2015) find evidence for negative impact of foreign aid and growth in developing economies. Surprisingly, another set of researchers find neutrality of aid on growth. Notable among these researchers are Mosley (1980), Mosley, Hudson & Horrell, (1987), Boone (1996), and Jensen & Paldam, (2006). Despite agricultural growth being more pro-poor, very little is known about how aid to the agricultural sector impacts fixed capital formation.

A probable problem associated with assessing aid effectiveness using data on the aggregate level is that it may introduce aggregation bias in the data and results (Clark & Avery, 1976). ODA

supports a wide range of sectors such as services (business, industry and employment), governance and enabling environment, manufacturing and mining, health, education, agriculture, water and sanitation, conflict and emergency. Thus, lumping the sectors together in assessing the effectiveness of aid may produce erroneous results because the various sectors operate through different mechanisms. There might actually be a positive or negative effect of official development assistance on development indicators in a particular sector, however considering all sectors put together, the effect in some sectors is likely to cancel out the effect in others and consequently affect regression results and findings of a research. Thus, conclusions from such studies may have the propensity to misrepresent reality.

Against this backdrop, there is the need for a sectoral analysis of aid effectiveness and this study to the best of our knowledge is one of the few studies that examines sectoral ODA in the form of agricultural ODA on gross fixed capital formation in agriculture in Sub-Saharan Africa.

Another problem is that many studies on aid effectiveness do not consider disaggregating ODA into BODA and MODA. This consideration could serve as an effective tool on how ODA can be repackaged to have a bigger and better impact in developing countries agricultural sector.

This empirical work can serve as a tool to enhance the formulation of sustainable policy frameworks that can ensure infrastructural capacity towards agricultural development and food security in the short and long-term. The study covers 40 Sub-Saharan African countries from 1996 to 2014.

### **1.3 Research Objectives**

1. The main objective of this study is to examine the level (short-term) and growth (long-term) impacts of total agricultural official development assistance on agricultural fixed capital formation in Sub-Saharan Africa from 1996 to 2014.

To meet other objectives of finding out which channel is more effective, ODA has been disaggregated into its bilateral and multilateral components. Therefore, the study further seeks to;

2. investigate the level (short-term) and growth (long-term) impacts of agricultural bilateral official development assistance on agricultural fixed capital formation in Sub-Saharan Africa from 1996 to 2014;
3. examine the level (short-term) and growth (long-term) impacts of agricultural multilateral official development assistance on agricultural fixed capital formation in Sub-Saharan Africa from 1996 to 2014.

### **1.4 Research Questions**

With respect to the research objectives, the following specific research questions are raised;

1. What are the level (short-term) and growth (long-term) impacts of agricultural official development assistance on agricultural fixed capital formation in Sub-Saharan Africa from 1996 to 2014?
2. What are the level (short-term) and growth (long-term) impacts of agricultural bilateral official development assistance on agricultural fixed capital formation in Sub-Saharan Africa from 1996 to 2014?

3. What are the level (short-term) and growth (long-term) impacts of agricultural multilateral official development assistance on agricultural fixed capital formation in Sub-Saharan Africa from 1996 to 2014?

### **1.5 Research Hypotheses**

Hypothesis 1: ODA stimulates agricultural fixed capital formation in sub-Saharan Africa.

Hypothesis 2: Bilateral ODA stimulates agricultural fixed capital formation in sub-Saharan Africa.

Hypothesis 3: Multilateral ODA stimulates agricultural fixed capital formation in sub-Saharan Africa.

### **1.6 Significance of the Study**

The evidence and significance of the impact of development assistance is vital for decision makers to choose where to direct resources to make the most impact in reducing poverty. The significance of the study can be viewed along two dimensions; research, policy formulation and practice. Concerning the research significance, this study goes beyond the current debate on aid effectiveness by investigating the impact of official development assistance on agricultural fixed capital formation in Sub-Saharan Africa. To the best of the author's knowledge, there is no study on the issue of such a link.

Concerning significance to policy formulation and practice, the study will serve as a tool to inform on guidelines for best practices for regional bodies and institutions such as Africa Union (AU), Development Assistance Committee (DAC), Economic Community of West African States

(ECOWAS), International Development Association (IDA), International Monetary Fund (IMF), Southern African Development Community (SADC), other development partners and governments of developing countries and provide feedback on policies that strengthen the linkage between official development assistance and investment for Sub-Saharan Africa's agricultural sector in the pursuit of better tools to improve development policy towards the sustainable development goals (SDGs). These contributions to practice and policy will become necessary for the development of innovative and sustainable investment strategies in agriculture and agribusiness to ensure poverty reduction, food security, sufficiency and sustainability in Sub-Saharan Africa.

### **1.7 Motivation of the Study**

High poverty levels continue to plague most rural folks in Sub-Saharan Africa. Since most of Africa's poor are directly engaged in agriculture, it is imperative and prudent to find innovative and sustainable ways to form and maintain physical capital towards agricultural growth and rural development. Investment in infrastructure and other capital goods is particularly crucial in the development of LDCs rural landscape since infrastructure such as roads, dams, farm machineries etc. enhances agricultural productivity. Fixed capital formation in agriculture is therefore imperative for pro-poor growth and poverty reduction.

### **1.8 Scope of Study**

This study covers 40 sub-Saharan African countries from 1996 to 2014. Data was obtained from World Development Indicators (WDI), Worldwide Governance Indicators (WGI) and FAOSTAT databases. The study is limited to the agricultural sector of Sub-Saharan Africa and finds the relationship between capital formation and official development assistance under the period of study. A list of countries included in this research is available in the Appendix section.

### **1.9 Limitations of Study**

The data for this study is purely secondary in nature; hence measurement errors are likely to have a bearing on the results however robust econometrics estimation techniques have been applied to avoid such effects. The limitation in this empirical work has been insufficient data for some countries in certain years. Such countries have been excluded from the research. Nonetheless, these limitations are not strong enough to invalidate this study and its findings with the application of the appropriate methodologies.

### **1.10 Organization of the Study**

This study is structured into five (5) chapters. The introductory chapter gives a general overview of the study and includes the background of the study, statement of the problem, objectives of the study, research questions and hypotheses, justification of the study, methodology, scope and organization of the study among other relevant sectors. Chapter two presents the review of relevant literature with respect to the research topic and relates economic theories to the subject matter of official development and agricultural fixed capital formation. The trends of official development and agricultural investment in fixed assets in Sub-Saharan Africa are considered as well as some empirical findings in the subject area. Chapter three covers the methodology used in the study. It gives a detailed account of the method of analysis and the procedures used for conducting the study. Chapter four covers data analysis and findings. In chapter five, the results of the data analysis are summarized and conclusions drawn. Recommendations for policy and further research are made towards sustainable agricultural and rural development.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Introduction

The role of official development assistance has received a lot of attention in the economic literature. This chapter reviews the various concepts, theories and empirics within the domain of the aid effectiveness literature that are relevant to the study.

#### 2.2 Basic Concepts

##### 2.2.1 Gross fixed capital formation

Gross fixed capital formation represents the total amount of fixed assets owned by both the private and public sectors which collectively promotes the productive capacity of the agricultural sector of a country. According to FAO Capital Stock and Investment in Agriculture database, “Gross fixed capital formation is a flow value and is measured as the total value of a producer’s acquisitions, less disposals, of fixed assets during the accounting period plus certain additions to the value of non- produced assets (such as subsoil assets or major improvements in the quantity, quality or productivity of land) realized by the productive activity of individuals or institutional units”. Uzonwanne & Ezenekwe (2015) contend that the term capital formation involves “variables that foster the postponement of present consumption for future gains in an economy, like investments, savings and gross fixed capital generation and can also be referred to as any method for increasing the amount of capital under one’s control; any method in utilizing or mobilizing capital resources for investment purposes”. According to Butzer, Mundlak & Larson (2010), Gross fixed capital formation (formerly gross domestic fixed investment) includes land improvements (fences, ditches, drains, and so on); livestock (livestock that is used continuously in production

year after year are fixed assets. They include, for example, breeding stock, dairy cattle, sheep reared for wool and draught animals.); treestock (trees that are cultivated in plantations for the products they yield year after year, such as fruit trees, vines, rubber trees, palm trees, cocoa trees are counted as fixed assets), farm machineries such as tillers, fertilizer spreaders, harrows, harvesters, seeders; plants and equipment such as cages for fish farming; and the construction of roads, railways, dams and commercial and industrial buildings for agricultural and agro-processing purposes. According to the 1993 System of National Accounts (SNA) of the United Nations Statistics Division (UNSD), net acquisitions of valuables are also considered capital formation. Economic theories and empirical experience validate the fact that there exist significant contemporaneous differences in the level of economic growth rates and development among different countries or in the same countries over time. To a large extent, these differences in the level of economic growth rates and development are interrelated with the differences that exist in the level and composition of the capital stock. Thus, capital stock builds up by the accumulation of capital formation on regular basis (Saleh, 1997). For simplicity and versatility of text in this study, the terms gross fixed capital formation, fixed capital formation, capital formation, fixed asset, physical asset or investment in fixed asset are assumed to have the same meaning and used interchangeably.

### ***2.2.1.1 The process of Capital formation***

A depreciated real exchange rate increases the domestic saving rate (Montiel & Servén, 2008). This in turn increases the rate of capital formation. Some current consumption has to be given up so as to accumulate physical capital. The higher the propensity to forgo present consumption, the greater the likelihood that individuals will allot more financial resources to form new capital. If society, on the other hand, consumes everything in the present without saving to cater for future

needs, productive capacity of the economy in the future will decline because capital equipment will gradually depreciate in value. In other words, if all of the current productive capacity is used up in the food production process at the detriment of capital goods without proper maintenance and/or replacement and no new capital goods are made, production of consumer goods in the future will fall rapidly. The process of capital formation consists of the following three stages:

(a) **Creation of Savings:** The first-stage requires saving. By way of households, firms and governments increasing the volume of real savings, resources that would have been allocated to the production of consumption goods are released for purposes of capital formation. Capital can also be formed when foreign savings is granted to augment domestic savings. Foreign capital can take the form of: Direct private investment such foreign Direct Investment (FDI) or Foreign Portfolio Investment (FPI) by foreigners; and ODA through loans or grants by foreign governments or loans by international agencies like the World Bank.

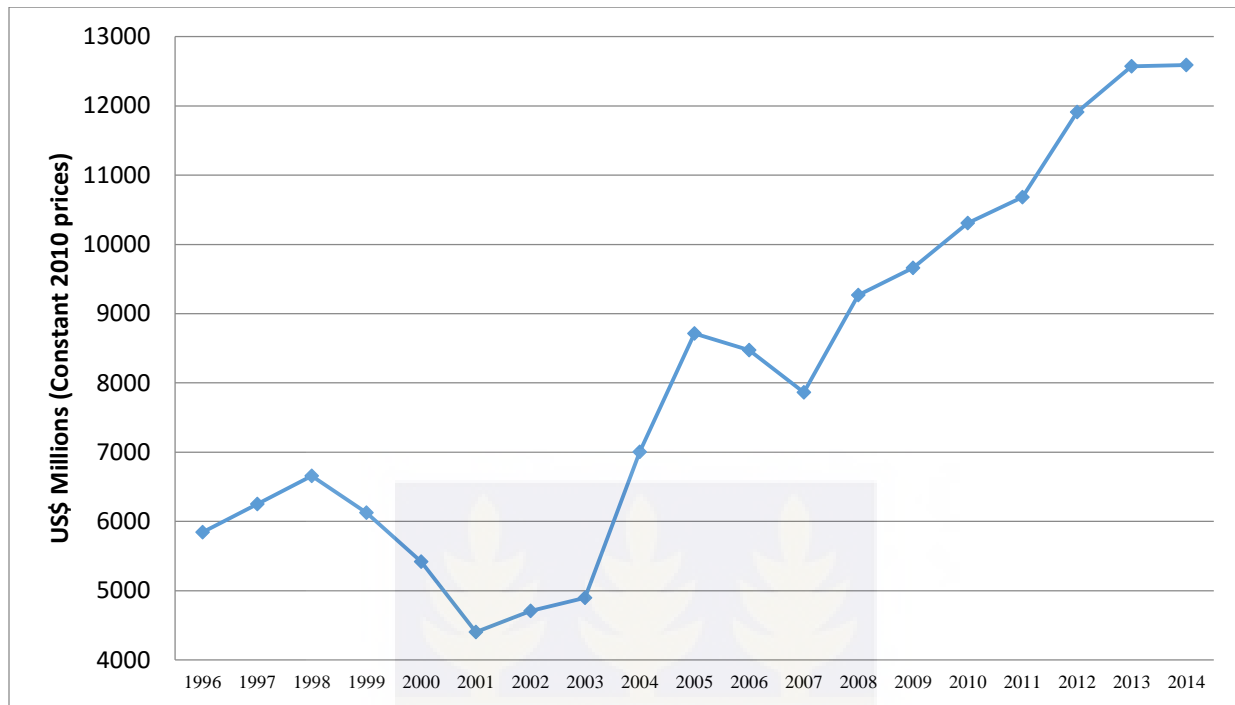
(b) **Mobilization of Savings:** Capital formation requires credible credit or finance facilities (banks, insurance companies, investment trusts, finance corporations etc.) that are capable of allocating available resources efficiently to private investors or government for the purpose of producing capital goods.

(c) **Investment:** The final stage is where the savings must actually be invested. This depends on an entrepreneurs' appetite for risk and requires a risk-taking behaviour. There must also be a sufficient inducement to invest. The marginal efficiency of capital or the prospective rate of profit and interest rate are incentives for capital formation.

### ***2.2.1.2 Trends in Agricultural fixed capital formation in Sub-Saharan Africa***

Gross fixed capital formation has seen a positive trend between 1996 and 2014 even though it has been a little more volatile between 1996 and 2006 than it has been between 2007 and 2014. With a total of US\$ 5.843 billion in 1996, capital formation gently rose to US\$ 6.658 billion in 1998. This is followed by a gradual decline in the amount of physical capital formed until it slumped to a global minimum of US\$ 4.403 billion in 2001 as a result of negligence of the agricultural sector. Almost leveling off between 2001 and 2003, gross fixed capital formation sharply increased from US\$ 4.703 billion to US\$ 8.713 billion in 2003 and 2005 respectively. This doubling of the amount of physical capital can be attributed to donor's revamped interest in development as institutionalized by the Millennium Development Goals (MDGs). After a fall in gross fixed capital formation to a local minimum of US\$ 7.863 billion in 2007, dollar values of physical assets improved more steadily between 2008 and 2014 as a way of government's intervention programs and donor's support to mitigate the impact of the 2007/2008 food crises. On the average, the dollar value of physical capital formed in agriculture in SSA amounted to approximately US\$ 8.070 billion between 1996 and 2014. During this entire period, economies such as Nigeria had the most capital formed (US\$ 38.478 billion), followed by US\$ 22.187 billion from South Africa and US\$ 10.943 billion from Cape Verde. Figure 2.1 shows the trend in gross fixed capital formation over 1996 to 2014.

Figure 1: Trends in Agricultural fixed capital formation

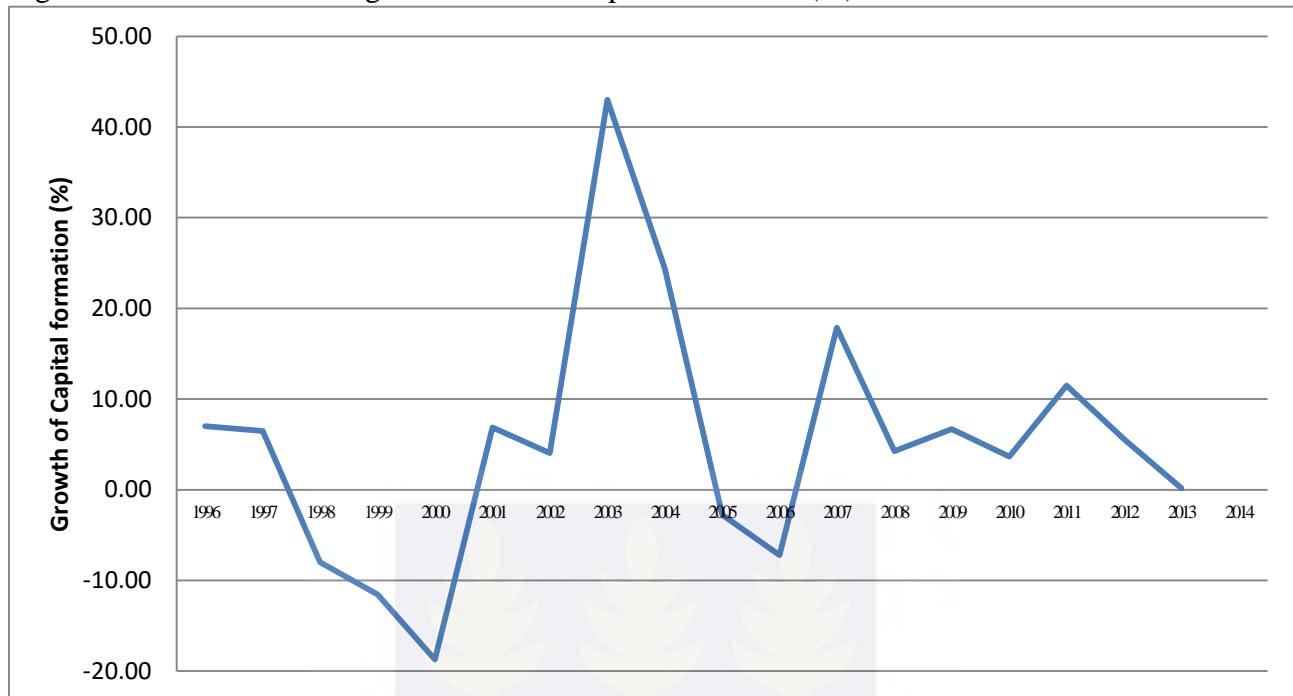


Source: Author's compilation from FAOSTAT data

### 2.2.1.3 Growth rate of Agricultural Capital formation (%) in Sub-Saharan Africa

Growth rates of agricultural capital formation expressed as a percentage are quite erratic. From 1996, there has been a considerable decrease in the year-on-year growth rates of gross fixed capital formation till the lowest growth rate of -18.72% as a result of the low capital stock in 2001 relative to fiscal year 2000. Interestingly, growth rates experienced a remarkable rise to 43% in 2003, being the highest growth rate ever recorded during the period under study. Two years after that, growth rates underwent a rapid drop to -2.75% and further dropped to -7.20% in 2006. Even though growth rates of capital formation or investment in physical assets was less volatile between 2006 and 2014, it had a negative trend. Over the entire study period, investment in fixed assets had a slow-rising positive trend. Figure 2.2 projects a graphical view of the year-on-year growth rates of investment in physical assets in Sub-Saharan Africa's agriculture.

Figure 2: Growth rates of Agricultural fixed capital formation (%)



*Source: Author's compilation from FAOSTAT data*

### 2.2.2 Official Development Assistance

Official Development Assistance is a form of foreign aid and can be defined as all resources; physical goods, skills, technical know-how, financial grants and/or loans (at concessional rates) transferred by donors to recipients governments (Riddell, 2007). The definition of ODA is provided the OECD-DAC. ODA is calculated as the sum of grants and loans to aid recipients and foreign aid qualifies as ODA on these three criteria: (a) “aid flows are undertaken by official agencies (including state and local governments, or by their executive agencies) and have to go to developing country governments (countries and territories on the DAC list of aid recipients) and to multilateral institutions for flows to developing countries”; (b) “aid flows have as the main objective the promotion of economic development and welfare in recipient countries”; and (c) “aid flows are on concessional financial terms (i.e., with a grant element equal to at least 25 per cent of the total at a ten percent discount rate)”. In addition, technical co-operation costs are included as

ODA; but grants, loans and credits for military purposes are excluded. Transfer payments to private individuals, public donations, commercial loans and foreign direct investment (FDI) are not regarded as ODA. It is misleading to treat ODA and foreign aid as the same thing. Assistance given by NGOs are classified as foreign aid but not counted as ODA.

### ***2.2.2.1 A brief history of ODA***

After World War II (WW II), the then world leaders especially those of the United States of America (USA) thought it wise to rebuild Western Europe, especially Germany and the other war-devastated economies through the provision of development assistance based on the Marshall Plan of 1948. Some development assistance from the Marshall Plan came as technical assistance. The U.S. Economic Co-operation's administration arranged for technical aid and advisors from American businesses, banks, farm organizations, and labor unions. Advisory groups worked on improving European production, business organization, and labor-management relations. Most ODA came in the form of cash grants or loans with financial resources of about \$11.8 billion disbursed to rebuild weak economies in the wake of the war. Essentially, Europeans at the time used this money to build infrastructural capacity through the reconstruction of factories and housing. Within a decade on the average, most war-torn European economies including Germany regained resilience towards self-sustenance, re-industrialization, economic growth and development due to the infrastructural capacity which promoted productivity. Trade and exports increased well over what prevailed before the war and industrial production in Western Europe rose by 40% above the pre-war level. Following the successful impact of the Marshall Plan as a development intervention tool coupled with the work of Chenery & Strout (1996) about the two-gap model of investment and savings and the need for global development, official development assistance was extended to governments of least developed countries to facilitate development.

### ***2.2.2.2 Channels and Trends in Official Development Assistance***

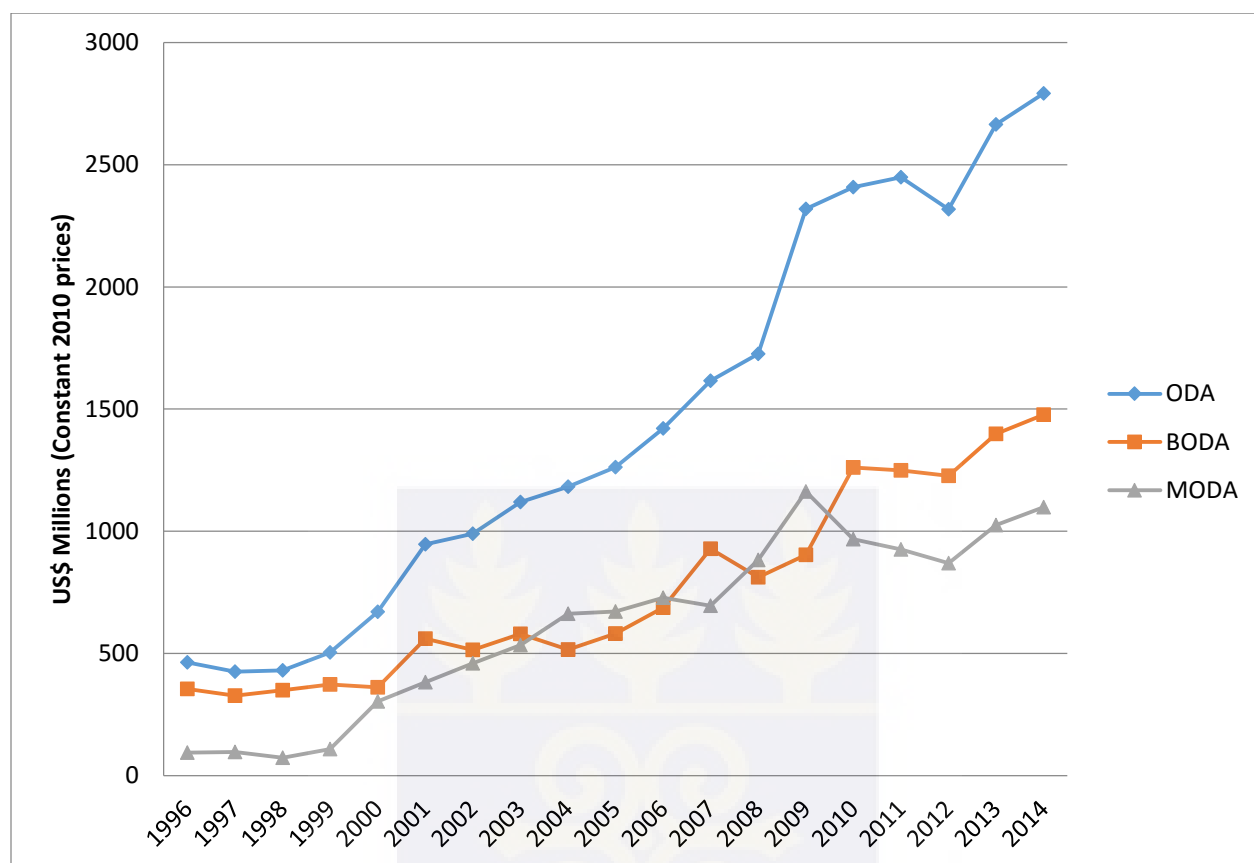
Sub-Saharan Africa has been the largest recipient of ODA. The public sector and multilateral organizations are the primary channels through which most sectoral ODA is disbursed. IDA and Japan are the largest disbursers of agricultural aid. IDA allocates almost 13% of its aid to the sector. With reference to OECD-DAC reports, general ODA to developing countries grew from US\$91.8 billion to US\$128 billion in 1991 and 2011 respectively. In 2010, 35% of the US\$131 billion ODA to developing countries was allocated to Sub-Saharan Africa. Since the mid-1980s, agricultural ODA has fallen by 43%. Quite recently however, there has been an indication of a slowdown in the decline and the inception of a positive trend. The fraction of agricultural aid in DAC member countries has even declined more rapidly: from 17% in the late 1980s to 6% in the mid-1990s. This clearly reveals the relative neglect of the agricultural sector. Over the period of 2003 to 2008, ODA flows to agriculture in SSA represents 31% making it the highest recipient among developing countries. The International Monetary Fund (2004) reports that official grants to SSA rose to 3% of GDP in 2003 and countries such as Ethiopia and Uganda receive grants exceeding 6% of GDP.

### ***2.2.2.3 Bilateral vs. Multilateral ODA***

ODA is made up of mainly two components; bilateral and multilateral. According to OECD-DAC definitions, “bilateral aid refers to flows from official (government) sources directly to official sources in the recipient country while multilateral aid represents core contributions from official (government) sources to multilateral agencies where it is then used to fund the multilateral agencies’ own programmes in recipient countries”. In some cases, donors contract multilateral agencies to deliver programmes or projects on its behalf in a recipient country. Such cases are

typically counted as bilateral flows. About 70% of ODA flows have been provided through bilateral organizations and 30% through multilateral organizations. The share of bilateral ODA has remained relatively stable at 70% of total aid flows since the mid-1970s, with the exception of 2005 when bilateral ODA reached 78% of the total. However, there is a great deal of donor-by-donor variance in terms of bilateral versus multilateral contributions: the shares of multilateral contributions in total ODA flows for the 2000-2005 period range from 9% to 64%. Development partners face growing demands to explain and justify the allocation choice between multilateral and bilateral aid channels. Among other reasons, Annen & Knack (2015) are of the view that “aid disbursements of multilateral agencies looks, in many cases, quite similar to the disbursements of bilateral donors, offering aid on similar terms, within the same countries and to the same sectors and the possibility of substitution across these two channels creates a strategic opportunity for donors to direct funding through either bilateral or multilateral institutions”. This begs the question of which channel (bilateral or multilateral) is better in terms of aid effectiveness. According to (OECD, 2010) “a number of trends in the aid landscape are pushing donors to think carefully about the nature of this choice as there are options to consider because official aid organizations exist in a crowded marketplace”. There are over 210 multilateral channels of major organizations and funds (OECD, 2010). In the meantime, there are 28 bilateral donor members within the OECD-DAC, and an emerging group of non-DAC donors made up of at least 28 countries.

Figure 3: Trends in Total Agricultural ODA, Bilateral (BODA) and Multilateral (MODA)

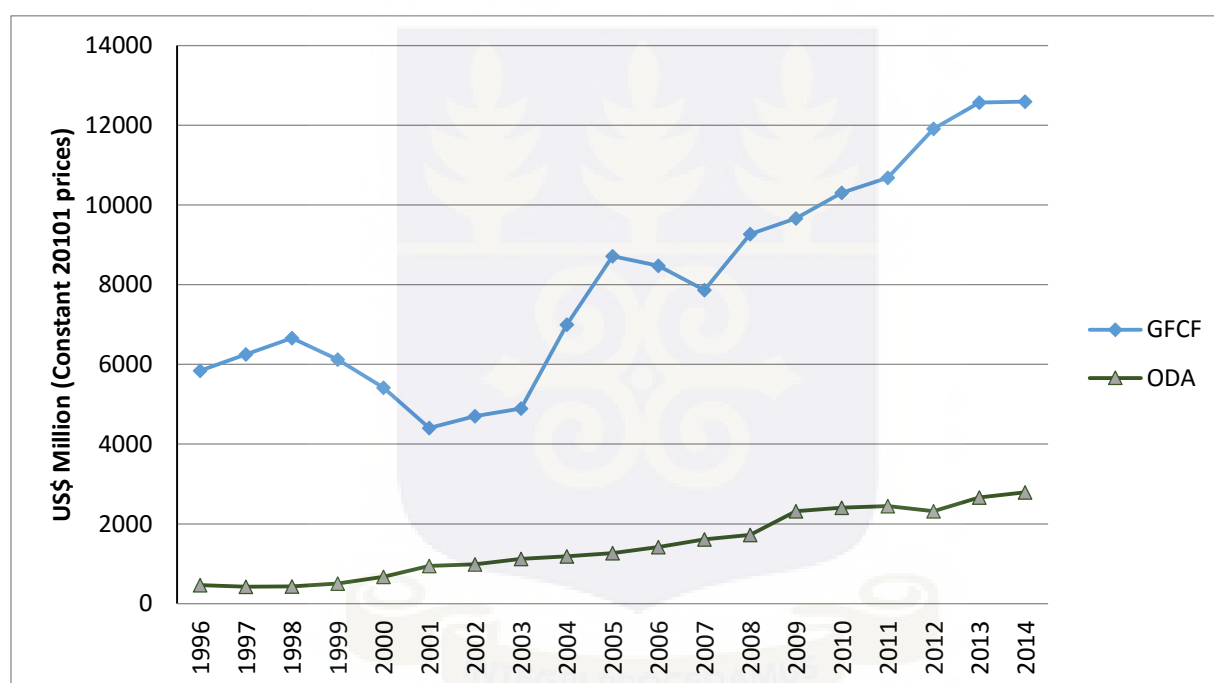


Source: Author's compilation from FAOSTAT data

Due to the widespread inconclusiveness of aid effectiveness in the literature among other economic factors, ODA to the agriculture and productive sectors declined progressively between 1995 and 2007 and has started to increase subsequently. According to OECD-DAC (2010) reports, ODA allocations to agriculture reduced from about 10% of total ODA in 1995 to 3.8% in 2005. However, recent years have recorded small increments in official development assistance to agriculture. In 2009, ODA to the agriculture sector got to 6.4% of total ODA (OECD-DAC, 2010). However, this still remains well below the levels seen in 1995 and relatively further away from the United Nations target of 10% of ODA to agriculture. Meanwhile, economic infrastructure such as roads, ports, etc. declined from 23% of total ODA in 1995 to as low as 12.3% in 2003. In 2008 and 2009, ODA

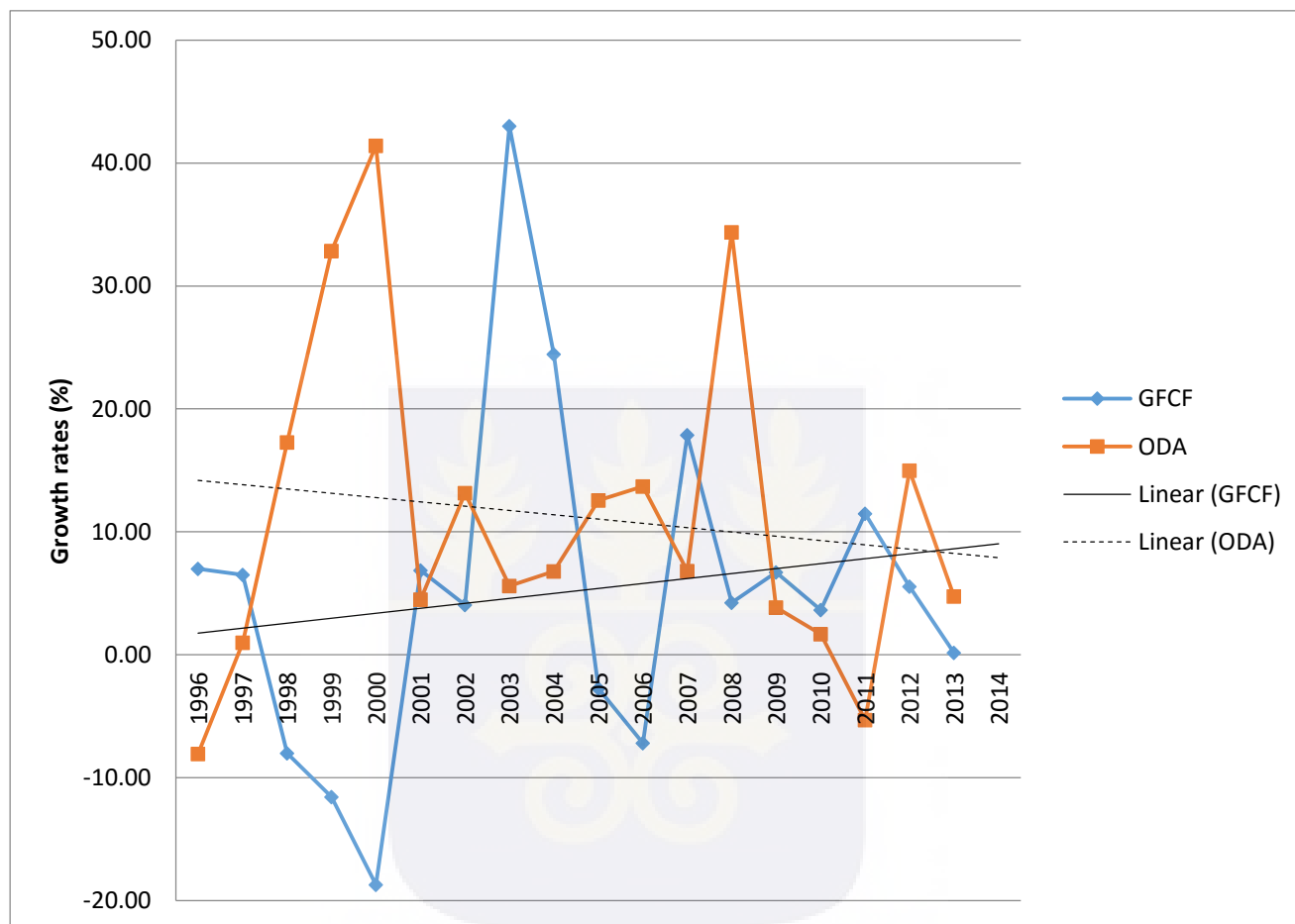
allocations to economic infrastructure improved to about 17%, but aid to infrastructure has only just regained the fraction it held a decade ago (OECD-DAC, 2010). The rate at which capital is formed seeks to be growing faster than the rate at which ODA is allocated. Evidence on this statement is depicted in Figures 2.4 and 2.5 below. The situation can be attributed to other external sources of agricultural financing such FDI, government expenditures and other non-DAC inflows into Africa’s agriculture.

Figure 4: Trends in Capital formation & Official Development Assistance



Source: Author’s compilation from FAOSTAT data

Figure 5: Growth rates of Capital formation & Official Development Assistance

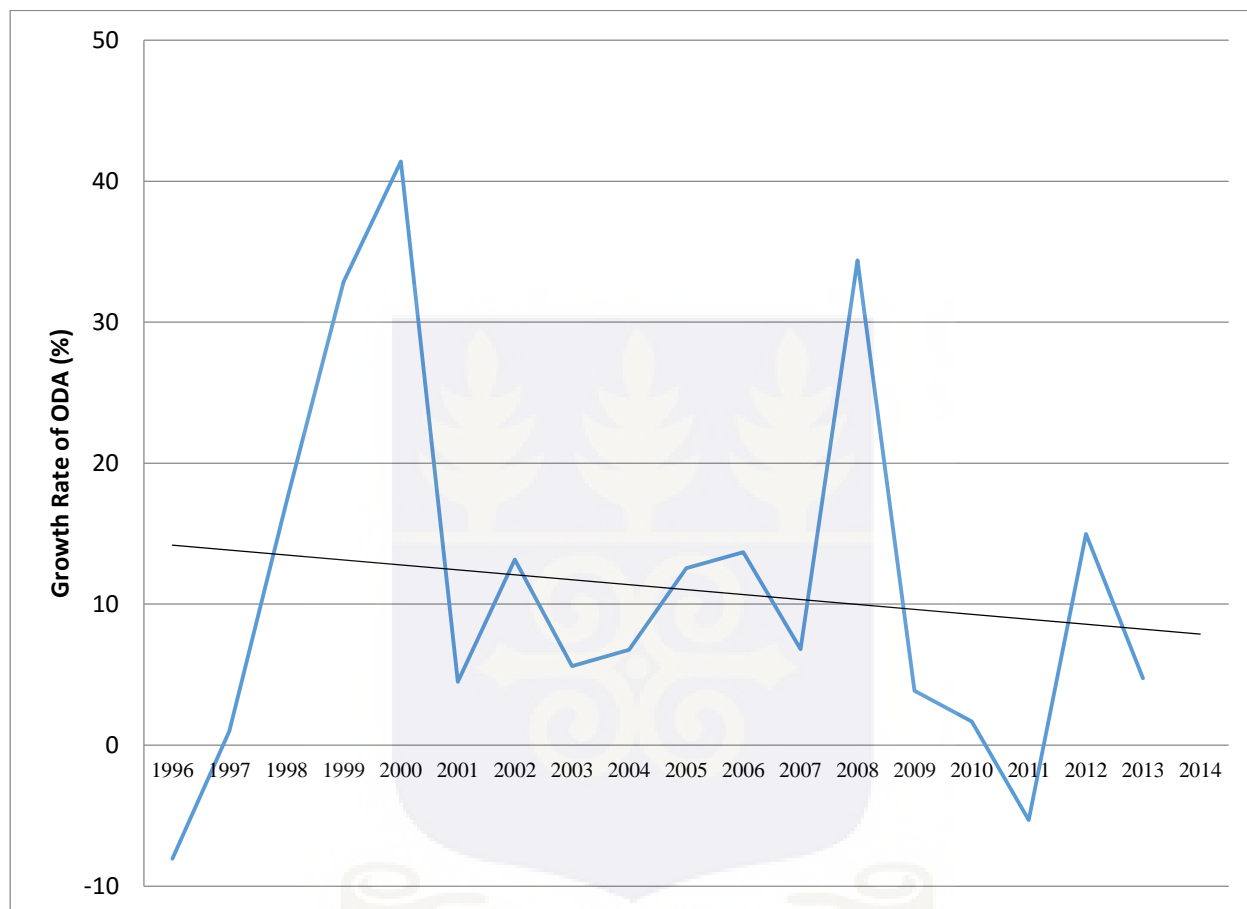


Source: Author's compilation from FAOSTAT data

Between 1996 and 2014, there has been a general downward trend in the growth rates of agricultural official development assistance. After a moderate increment from its lowest rate of -8.07% in 1996, growth rates increased sharply between 1997 and 1999. Peak performance of 41.40% in growth rates was recorded in fiscal year 2000 as a result of donor's heightened interest to implement the MDGs. Year-on-year growth rates fell drastically in 2001 and was relatively stable till 2007 when it shot up again to 34.38% a year after. This short-lived increment was followed by a strong reduction to 3.85% in 2009 and consistently fell to -5.32% in 2011. Quite

recently growth in ODA has started registering positive rates. Figure 2.6 gives a pictorial account of the growth rates recorded.

Figure 6: Growth rate of Official Development Assistance (%)



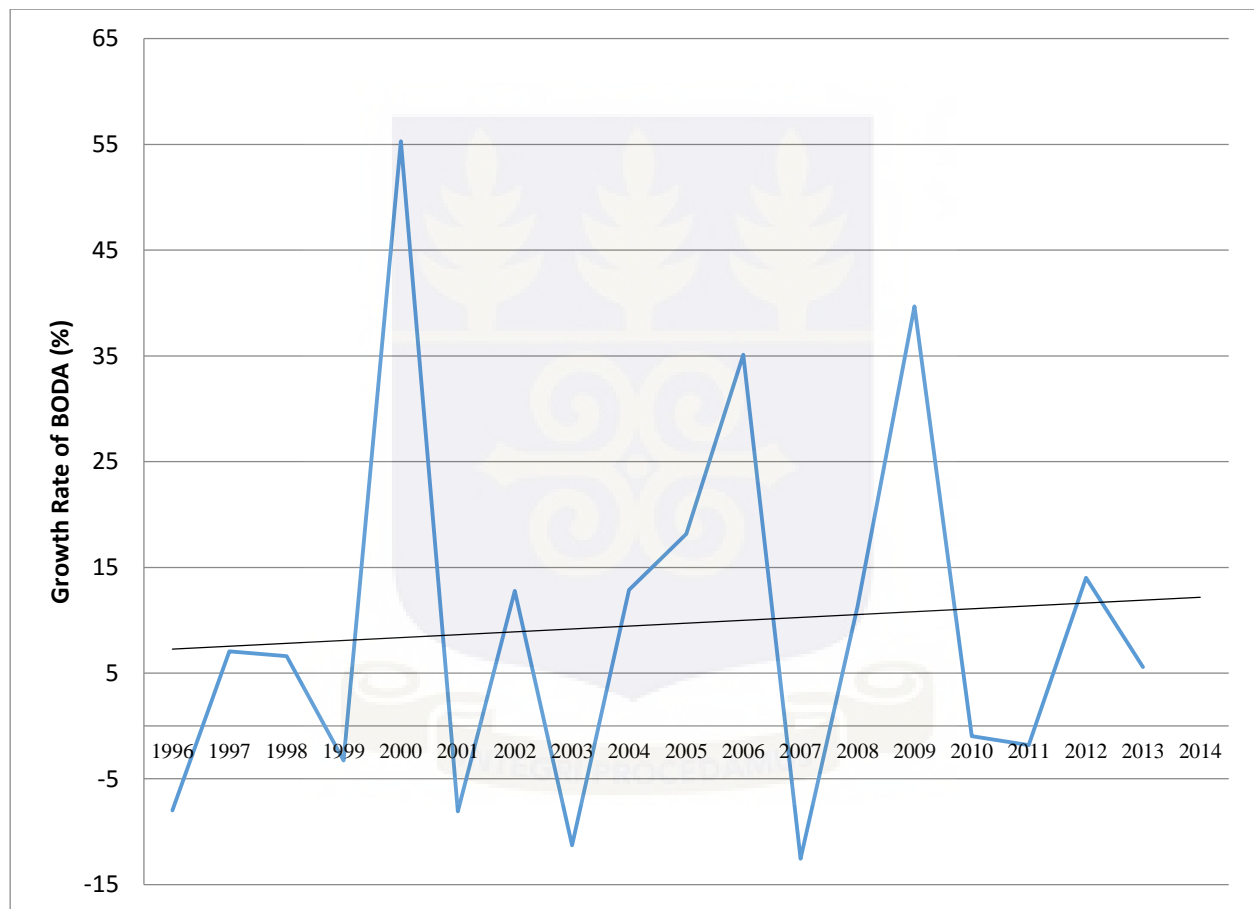
Source: Author's compilation from FAOSTAT data

#### 2.2.2.4 Bilateral Official Development Assistance (BODA)

Growth in BODA has been very unpredictable even though it generally had a trend that rises gradually. From one of its lowest in 1996 at about -8.0%, rates in growth of bilateral official assistance suddenly escalated to 55.30% in fiscal year 2000. This effect was also evident with growth rates in ODA in the same year. This happening is one of the features that buttress the fact that ODA is mostly driven by BODA or that BODA has a larger proportion of ODA. Surprisingly,

growth rates declined severely by -63.0% in 2001 and it was followed by a further decline to -11.27% in 2003. Rates improved steadily to 35.10% in 2006 before it surprisingly deteriorated to -12.44% a year later. Fiscal year 2009 recorded the second highest growth rate of 39.67%. On the average, bilateral ODA grew by 9.58% during the study period.

Figure 7: Growth rate of Bilateral Official Development Assistance (%)



Source: Author's compilation from FAOSTAT data

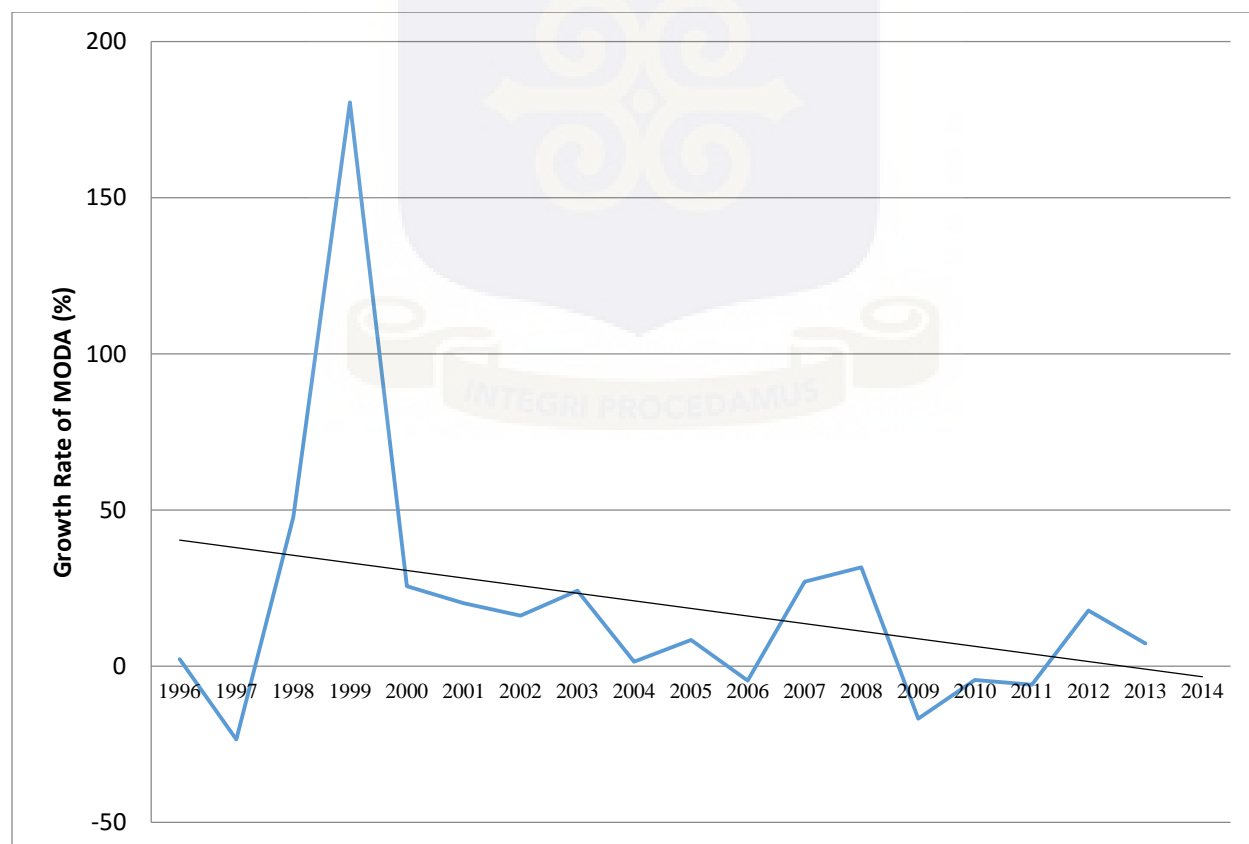
### 2.2.2.5 Multilateral Official Development Assistance (MODA)

Multilateral aid is concentrated in five main clusters. Over the past years, there has been a very little change in the way DAC members allocate multilateral aid. Member countries provide most

of their multilateral aid (81% from 2006-2010) to five clusters of multilateral agencies namely: the European Development Fund (EDF), financed by extra-budgetary contributions of the EU member states and the budget of the European Union (EDF-plus-EU, 36%), the World Bank’s International Development Association (IDA, 22%), United Nations Funds and Programmes (UNFP, 9%), the African Development Bank and Asian Development Bank: 5% and 3% respectively.

Unlike bilateral ODA, growth in multilateral ODA had a negative trend. From its lowest of -23.50% in 1997, growth rates shot up continuously to at a whopping 180.53% in the 1999 fiscal year and subsequently fell to 25.65% a year later. After this period, growth rates of multilateral ODA became relatively stable even though it continued its downward trend with relatively small increments in 2008 and 2012.

Figure 8: Growth Rates of Multilateral Official Development Assistance (%)



Source: Author’s compilation from FAOSTAT data

### ***2.2.2.6 Advantages of official development assistance***

The main problems of developing countries according to the early growth theories of the 1950s and the 1960s was capital formation. These theories were of the opinion that development assistance was greatly needed as an ingredient for capital formation because it had a very important role to play in economic growth and development. The reasons given for these arguments were that developing countries have insufficient savings to finance large-scale investments such as the development of economic and social infrastructure (Bacha, 1990). Also, developing countries have less foreign exchange for the importation of farm machinery, spare parts and other capital goods. As such, foreign aid was needed to fill the savings-investment gaps and the trade gaps by increasing the level of investment towards economic growth and poverty reduction. From 1980, there have been diverse objectives of providing ODA with the expected returns in the form of economic growth, investment, poverty reduction and public expenditure in terms of services in the developing countries. ODA in the form of technical assistance provides technical skills which have a positive effect on development and this is done by improving human capital quality and filling the skills gap.

Additionally, ODA helps governments to meet their budgetary targets by augmenting expenditure. Thus, ODA used for investment in education, health and other sectors contributes to economic growth and overall economic development. Programme Aid- an import support tool helps to increase the production efficiency of both public and private enterprises resulting in higher output and increases the availability of goods and services.

### ***2.2.2.7 Disadvantages of official development assistance***

While official development assistance is noted to have a positive impact on the economy of recipient countries, the literature on aid effectiveness has also outlined some negative effects of ODA. Project aid, which allows donors or development partners to partake directly in the design and implementation of a developmental project, is noticed to distort spending patterns since governments of recipient countries are supposed to cover the “recurrent costs” of project. Since many countries have limited capacity to absorb aid, an increase in the number of projects puts pressure on recipient country institutions. In their studies, Lane and Tornell (1996,1999) suggests that in economies where there exist strong groups but weak public institutional characteristics such as those in SSA “the heightened lobbying and rent-seeking activity that follows a resource windfall causes a more than proportional increase in redistribution”. This aggressive effect, according to Lane & Tornell (1999), “encourages the inefficient allocation and use of resources thus yielding a lower rate of return on investment and hence fostering a net social loss”.

According to Riddell (2007), tying project aid to certain conditions causes the economic exploitation of the developing countries because they are usually restricted to purchase items as such machines, equipment, spare parts etc. from the donor country.

Additionally, ODA is also a potential cause of real exchange rate appreciation in developing countries and this creates a rising domestic inflation. This phenomenon is known as the “*Dutch Disease* and it mounts an upward pressure on the of the recipient country’s real exchange rate as a result of an inflow of foreign exchange through ODA” (Bandara, 1991; Benjamin, Devarajan & Weiner, 1989; Corden, 1984). Consequently, the *Dutch Disease* acts as a mechanism for the inflow of ODA to reduce the competitiveness of the export sector of the recipient country.

Debt extensions or debt overhang is also a major problem of concern in developing countries. Despite the Highly Indebted Poor Countries (HIPC) initiative and other structural reforms and debt relief programs, countries in Sub-Saharan Africa still come under enormous debt burdens. To a large extent, this is attributed to the consumption or inefficient use of such loans and particularly, the exorbitant interest rates paid on loans for which a lion's share of budgets is used to service debt (Gang & Khan, 1991; Gang & Khan, 1986; Please, 1967; Papanek, 1973; Weisskoff, 1972). Considering the disadvantages of official development assistance, there is also the issue of agricultural aid fungibility in developing countries (Feyzioglu, Swaroop & Zhu, 1998) and this brings about a limited effect of ODA on growth and poverty reduction (Pack & Pack, 1993). Aid fungibility refers to the situation where donors provide and earmark funding for certain purposes based on the donor's perspective of the needs of a recipient country for which the recipient country's government has already allocated financial resources from its own budget. The external fund is then diverted and spent on different projects or even different sectors. In certain cases, the recipient country's government diverts resources into different sectors while allocating minimal or no resources to the sector being funded by the external donor. Thus, the inflow of ODA makes resources available for governments of recipient economies to lessen the amounts that ought to be allocated a certain sector and redistribute it to different sectors.

Pack & Pack (1993) posit that "aid fungibility in itself is not necessarily detrimental, especially if the extra funds are reallocated for productive uses within the economy but aid fungibility creates a problem by increasing the possibility of corruption and rent-seeking". Additionally, ODA also creates a *moral hazard* problem in the recipient country by serving as a permanent soft budget constraint. The incessant influx of easy foreign money creates the impression that the recipient government would be bailed out when things go wrong and this in a way fosters the relaxation of

government in its taxation and revenue mobilization (Gang & Khan, 1991). ODA inflows also enables resources to be used for other purposes where the recipient governments channel local taxes and other sources of income into the purchase of military weapons and build arsenals for extended oppressions through wars and luxury consumptions (Degnbol & Pedersen, 2003) which spurs the growth of poverty.

### **2.3 The endogeneity of ODA and GFCF**

Theoretically, ODA is supposed to augment savings, which consequently creates the opportunity to invest or form physical capital (Hansen & Tarp, 2001; Clemens, Radelet, & Bhavnani, 2004; Bazoumana, 2007). Thus, ODA correlates or is supposed to correlate with investment in fixed assets such as machines or equipment through savings. Similarly, in practice, capital formation is linked to ODA through (per capita) GDP. Capital formation has a strong positive and statistically significant association with GDP (Shuaib & Ndidi, 2015). As (per capita) GDP increases after a certain point, the economic status of a beneficiary country changes and donors assume that economic agents in recipient countries are capable of saving and investing to generate capital, therefore donors or development partners relax the volume of aid disbursed to such countries. The converse also holds true: as per capita GDP decreases, more ODA is allocated to support government budgets and development projects (Dowling & Hiemenz, 1985).

### **2.4 Theoretical Review**

The study follows a deductive research approach and considers the following relevant theories; Dependency Theory of Underdevelopment, Idealist Theory, Realist Theory, Neo-realist Theory

### ***2.4.1 Dependency Theory of Underdevelopment***

The dependency theory states that “the reliance of least developed countries (LDCs) on developed countries (DCs) is a major cause for the underdevelopment of LDCs” (Uzonwanne & Ezenekwe, 2015). Dependency theory was developed in the late 1950s under the guidance of Raul Prebisch. Prebisch and his colleagues were disheartened by the fact that economic growth in the advanced industrialized countries did not necessarily lead to growth in the poorer countries. Indeed, they suggested that “economic activity in the richer countries often led to serious economic problems in the poorer countries adding that such a possibility was not predicted by the neo-classical theory, which had assumed that economic growth was beneficial to all even if the benefits were not always equally shared”. A number of Latin American economists have contributed immensely to the dependency theory of underdevelopment. Noticeable writers include Frank, Sunkel, Furtardo, Santos, Emmanuel and Amin (Frank, 1979). The explanation given by the various writers differ subtly. Each writer tries to determine and specify certain factors which have been responsible for the underdevelopment of LDCs by DCs. For this reason, there is a variety of dependency views; different meaning accorded the concept of dependency and different analyses are offered to explain underdevelopment as a result of the interaction between internal and external structures. Due to the varied nature of dependency theory, the one that best suites this work shall be discussed briefly. Based on the views of Santos (1970), Frank (1979) and Sunkel (1969), “dependency is a situation whereby the economy of certain countries is conditioned by the development and expansion of another economy to which the former is subjected”. The authors further elaborated that, “a dependent relationship between two or more economies is one where some countries (the dominant ones) can expand and be self-sustaining, while other countries (the dependent ones) can do this only as a reflection of that expansion, which can have either a positive or (mostly) a negative effect

on the immediate development of the dependent countries”. Thus, surrounding LDCs become heavily reliant on the dominant economies for external capital. This brings about an excessive orientation of LDCs through the exportation of raw materials and the importation of manufactured goods. The situation contributes to the industrialization of foreign economies at the detriment of local ones. In these sequence of events, agriculture could be stagnated through price control policies by foreign economic agents. With a high concentration of primary commodities for exports when prices are dictated by foreign buyers, a growing fiscal deficit is encouraged in the peripheral countries and this necessitates further foreign financing. It can also lead to a phenomenon in which the extra resources created in the dominated economy is successfully drawn off by the dominant economy because external investors insist on the choice of projects, price decisions, equipment supply, technical know-how and personnel. As a result, dominated economies are impoverished and the dominant ones grow rich. Sunkel (1969) claims that this is the point where a recipient country actually becomes dependent on the donor country. With this subjective rich-poor country relationship, the dominant country exerts to a larger extent some form of control over the natural resources in the recipient country which is likely to affect commodity prices. The phenomenon can result in the over-exploitation of the agriculture sector amidst population growth such as in Sub-Saharan Africa and further creates food insecurity.

Todaro (1994) calls it “the neo-classical dependency model which attributes the existence and continuity of third world underdevelopment primarily to the historical evolution of a highly unequal international capitalist system of rich-poor country relationships”.

Furthermore, the dependency of LDCs on DCs leads to a greater outflow of declared profits as in *capital flight*. Also the repayment of debt created by these loans further drains capital formation of LDCs; stunting the growth of agriculture which contributes more to the per capita GDP of

countries in SSA. The relationship promotes trade. Thus, foreign investment through ODA becomes a means of exploitation of LDCS by DCs.

Therefore, this study considers dependency theory more relevant and realistic in examining the impact of ODA on fixed capital formation in the agricultural sector of Sub-Saharan Africa. The theory has it that “once LDCs continue to depend on DCs for their sustenance, especially through budget support, their level of poverty and laxity will continue to increase due to complacency effect as many human resources will remain dormant and unproductive both in the in short run and the long-run” (Uzonwanne & Ezenekwe, 2015).

#### ***2.4.2 Idealist Theory***

This theory suggests that a government gives aid because of its altruistic motives (Fuller, 2002) and hence aid is given to promote the welfare of others, especially countries in the so-called Third World such as those in Sub-Saharan Africa. The idealist theory also contends that donor governments give official development assistance in order to impose their form of governance, especially democracy and human rights policies on recipient countries. Thus, countries with lower per capita income receive more development assistance (Dowling & Hiemenz, 1985)

#### ***2.4.3 Realist Theory***

Realist theorists on the contrary posit that donors give aid on condition that it agrees with their national interest instead of recipient country humanitarian needs. This theory became widely accepted towards the end of the cold war (Fuller, 2002). Realists suggest that policies for the allocation of official development assistance are formulated based on political strategy. Thus, donors give aid provided that recipient countries can give military support to promote donor’s national security and self-preservation (Schraeder, Hook & Taylor, 1998)

#### **2.4.4 Neo-realist Theory**

This is an advanced form of the realist theory. National interests still serve as a motivation to give ODA, but the most crucial factor has moved from national security and self-preservation to economic interests (Fuller, 2002). Neo-realists support the view that donor countries use aid to enhance their economic development (Tuman, Emmert & Sterken, 2001) and do not really care whether or not recipient countries benefit from aid. For this reason, donors allot more aid to LDCs that have more to offer them through exports, access to raw materials, and industrial competitiveness. Donors, per strategy give ODA so as to set-up FDI's to tap into the raw material resource base of the aid recipient country. Schraeder et al. (1998) claimed that economic motivation dominated Japan's allocation strategy, with the top recipients of Japanese ODA serving as a potential source of raw materials for Japanese industry or a marketplace for Japanese goods and services. In short, donor countries give ODA to set-up export and investment linkages mainly in more populated countries offering larger available markets to the companies of donor countries (Fuller, 2002).

#### **2.5 Empirical Review**

Over the last five decades, governments of Sub-Saharan African countries have received about \$1 trillion in foreign aid (Ogundipe, Ojeaga & Ogundipe, 2014). Oddly enough, over the same period, GDP per capita growth in SSA actually recorded a remarkable fall and in some years was even negative (Uzonwanne & Ezenekwe, 2015). A typical example is that World Bank calculations in 1960 predicted based on theories that aid transfers to Zambia should by now raise income per capita to more than \$20,000. However, stagnation of income per capita has been around \$600 for years (Abuzeid, 2009; Ogundipe, Ojeaga & Ogundipe, 2014; Sidi et al, 2016) and is less than \$2,000 as at 2014. World Development Indicator (WDI) data indicates that ODA to SSA as a

percentage of total world's ODA has increased and yet economic growth rate has not increased over the years. For example, 23.39% of total world ODA was received by SSA in 1980 but economic growth was just 1.14% in that year. ODA to SSA as a percentage of world ODA rose to 28.58% in 1985 but interestingly enough, economic growth rate fell to -1.16% in that same year depicting a negative growth rate. ODA further increased to 29.33% of total world percentage but there was still no positive growth rate as the economic growth rate still was at a negative of -1.57%. This was not the case for other developing countries such as China at the time. Even though ODA to China was less than that of SSA economic growth rate of China was higher than that of Sub-Saharan Africa. As the percentage of ODA increased from 0.190% in 1980 to 2.919% in 1985, economic growth rate doubled from about 6% in 1980 to 12% in 1985 (Uzonwanne & Ezenekwe, 2015). This shows that ODA was successful in realizing growth. On the other hand, as ODA reduced to 27.53% of total world percentage in Sub-Saharan Africa, economic growth rate became positive and grew to 1.09% (Uzonwanne & Ezenekwe, 2015). Considering these interesting statistics, it is argued that ODA can form capital in certain environments and can also discourage capital formation and cause poverty in other environments such as countries in Sub-Saharan Africa.

It should be noted however, that the aid effectiveness literature is predominately on the link between foreign aid and economic growth. Scanty work has been done on the intermediate relationship such as between ODA and capital formation even though numerous debates exist about the impact of official development assistance on economic development. One side of the argument posits that there is a positive and statistically significant relationship between foreign aid or ODA and economic growth and development indicators (Arndt, Jones & Tarp, 2010; Whitaker, 2006; Burnside & Dollar, 2000) while the other side opines an inverse relationship

between ODA and economic development (Brautigam & Knack, 2004; Duc, 2006; Tracy, 2010; Javid & Quayyum, 2011; Uzonwanne & Ezenekwe, 2015). Interestingly, a third side contends that there is no relationship whatsoever between foreign aid and economic development in developing countries (Mosley, 1980; Mosley et al., (1987); Boone, 1996; Jensen & Paldam, 2006) such as those in SSA. Thus, it is evident that generally, there is a lack of consensus on aid effectiveness in SSA.

Studies on the effectiveness of ODA is a matter of politics in recent times. Examining the nexus between aid, policy, and growth, Burnside & Dollar (2000) found that “foreign aid has a positive impact on growth in developing countries with good fiscal, monetary and trade policies but has little effect in the presence of poor policies”. These results largely inform policy and lend themselves to new strategies in the design and allocation of ODA and its effectiveness for that matter. Reassessing whether or not aid enhances growth in a good policy environment, Easterly, Levine & Roodman (2004) used an updated version of Burnside & Dollar’s (2000) data and concluded that new data casts doubts on Burnside & Dollar’s (2000) conclusion. According to Easterly (2003), “achieving a beneficial aggregate impact of foreign aid remains a mystery”. In his research, Ram (2004) considered the effect of ODA in reducing poverty by assessing the policy environment of recipient countries. His findings disagrees with the popular view that aid to countries with better policies results in higher growth and poverty alleviation. Therefore, Ram (2004) concluded that “evidence is lacking to support the leading belief that directing foreign assistance to countries with good policy will increase the impact on growth or poverty reduction in developing countries”. Chenery & Strout (1966), who pioneered the Investment-Savings and Import-Export model (the two-gap model), found a significantly positive relationship between official development assistance (foreign aid as it was referred to) and economic growth using

regression analysis for a sample of 50 developing countries. Their study further showed that an increase in investment helps boost economic growth by increasing output and per capita income. However, investment required to increase output depends on domestic savings and in a case where there is a financing gap, foreign assistance would be needed to fill it. In the Import-Export model, Chenery & Strout (1966) elaborated that any economy that wishes to increase output should import mainly capital goods and export the goods produced to realize higher export earnings than import and that in case export earnings become lower than imports, foreign assistance would be needed to balance the account.

Using time series data on India, Gang & Khan (1991) tests the foreign aid-public investment hypothesis with the help of behavioral equations derived from an estimated maximization framework. Their results confirm a negative relationship between taxes and government investment in the presence of foreign aid. Gang & Khan (1991) found that “grants and loans generally go into development projects with no leakages into consumption”. Additionally they contend that bilateral aid draws resources out of consumption and makes them available for development projects.

Investigating the relationship between capital accumulation and ODA from 1980 to 2013, Uzonwanne & Ezenekwe, (2015) applies OLS and concluded that foreign aid had a negative and a statistically significant impact on capital formation. From their study, a 10% increase in foreign aid decreased capital formation by 0.2% at the 1% level of significance in Nigeria.

Boone (1996) gained insight into aid recipient country’s political regimes as a way of analyzing aid effectiveness. Using an analytical framework involving three stylized political-economic regimes labeled egalitarian, elitist and laissez-faire coupled with reduced form equations and data on non-military aid flows to 96 developing countries, Boone found that models of elitist political

regimes best predict the impact of foreign aid and added that aid does not significantly increase investment and growth.

Still on the effectiveness of aid, McGillivray, Feeny, hermes & Lensink (2006) shows that ODA to Africa countries does not only spur growth but serves as relevant instrument for poverty reduction with data from 1968 to 1999. More importantly, McGillivray et al. (2006) noted that the continuous growing poverty in SSA compromises the MDGs number one objective of halving the number of people living in extreme poverty by 2015 with respect to 1990 level. McGillivray et al. (2006) concluded that “inflation and trade openness influence the amounts of aid received”.

Examining how foreign aid influences macroeconomic variables such as import, investment and consumption expenditure of the Ethiopian government, Yohannes, Hudson & Horrell (2011) employed the Johansson maximum likelihood approach on a times series data from 1970 to 2008. Results revealed that in the long-run, there is a positive and significant impact of foreign aid on growth through import and investment. Nevertheless, Yohannes, Hudson & Horrell (2011) concluded that in the short-term, for foreign aid to have a substantial effect on growth, it must to be supported by a good fiscal, trade and monetary policy environment. Furthermore, the authors concluded that “foreign aid has a significant impact on government consumption expenditure in the short run, which confirms the existence of aid fungibility”.

Focusing on the effect of foreign aid inflows on fiscal variables in Senegal, Quattara (2006) uses time series data from 1970 to 2000 and finds that “a large portion of aid flows, approximately 41%, is used to finance Senegal’s debt and 20% of the government’s resources are devoted to debt servicing”. The author also found an insignificant impact of foreign aid on domestic expenditures and a significant negative effect of debt servicing on domestic expenditure. As a result, Quattara

suggests that “debt reduction could become a more successful policy tool than obtaining additional loans”.

Examining how effective aid is, Javid & Quayyum (2011) applies the OLS technique to a time series data. Main findings were that “foreign aid and real GDP are inversely related, but the interaction of aid-policy has a positive and significant impact on real GDP growth in Zimbabwe from 1990-2010”.

Addressing the mechanisms through which ODA affects growth such as savings and investment, Gomanee, Girma & Morrissay (2005) concluded that ODA had a positive and statistically significant effect on economic growth in 25 SSA countries from 1970 to 1997. Furthermore, investment was identified as the most significant transmission mechanism through which ODA affects growth. Gomanee et al. (2005) elaborated that on the average, a 1% increase in the aid/GNP ratio contributes 0.25% to the growth rate. As a result, they suggested that Africa’s poor growth record needs to be attributed to factors other than aid ineffectiveness.

Using panel data from 1975 to 2000, Duc (2006) investigated the effect of foreign aid on economic in 39 developing countries. Results revealed that foreign aid had a negative and statistically significant relationship with economic growth in most SSA countries. On the other hand, Duc (2006) found that from 1992 to 2000, foreign aid to South Asian countries correlated positively and significantly with economic growth.

With focus on the importance of institutional quality, Afawubo & Mathey (2017) investigated the impact of aid volatility on both savings and investment; the mechanisms through which aid affects growth. Using aggregate data from 1960 to 2013 on 45 countries in Sub-Saharan Africa and applying the GMM estimation technique, it was found that even though aid had a positive

association with savings and investment, aid volatility had a negative relationship with both savings and investment. Additional findings suggest that in the presence of high-quality institutions, the volatility of aid had a less harmful effect on savings and investment.

Karras (2006) is also another contributor of the aid effectiveness literature. Using annual aggregate data from 1960 to 1997, Georgios Karras examined the relationship between aid and per capita GDP growth in 71 aid-receiving countries. The study found that the impact of aid on economic growth is “positive, permanent, statistically significant and sizeable”. Karras (2006) concluded that “raising foreign aid by \$20 per person of the receiving country results in a permanent increase in the growth rate of real GDP per capita by approximately 0.16%”.

## **2.6 Conclusion**

Studying the effectiveness of aid using aggregate data on the whole economy has generated a lot of controversies in the literature. There are three sides to the issue of aid effectiveness; the optimist, the pessimist and the neutral views. The optimist approach finds a strong positive and statistically significant association between official development assistance and economic growth indicators. The pessimist view however contends that official development assistance and economic growth indicators have a strong negative and statistically significant relationship. Studies that find no impact of official development assistance and economic growth indicators fall under the neutral approach. With such a large volume of studies on aid effective and still no single concrete solution, the impact of ODA on GFCF is worth considering. Given the gaps mentioned in Chapter One, this study situates itself in the agricultural aid effectiveness literature and particularly examines how ODA at level and growth impacts changes in fixed capital formation.

## CHAPTER THREE

### METHODOLOGY

#### 3.1 Introduction

This chapter provides a detailed account of the methods used in the study, justifications for the chosen methods, the data type and sources, models and the econometric techniques employed to analyze the data towards the achievement of the objectives of the study.

#### 3.2 Research Design

Following a quantitative approach, this study investigates the impact of official development assistance on agricultural investment in Sub-Saharan Africa with regards to available data from 1996 to 2014. The assumption behind the positivist paradigm is that there exist an objective truth in the world and this truth can be measured accurately or by proxy and explained scientifically. The main concerns of the quantitative paradigm are that measurement is reliable, valid, and can be generalized in its clear prediction of cause and effect (Cassell & Symon, 2004).

#### 3.3 Estimation Strategy

Considering a possible endogenous relationship between official development assistance and gross fixed capital formation, the following two-stage equation model is specified as a starting point;

$$\ln GFCE_{it} = \beta_0 + \beta_1 \ln ODA_{it} + \sum_{j=2}^k \beta_j X_{it} + v_i + \varepsilon_{it} \quad (1)$$

$\ln GFCE_{it}$  is the natural logarithm of agricultural gross fixed capital formation in country  $i$  at time  $t$ ,  $\ln ODA_{it}$  is the natural logarithm of official development assistance in country  $i$  at time  $t$   $X_{it}$  is a vector of control variables in country  $i$  at time  $t$  that include the natural logarithm of dollar

exchange rate, the natural logarithm of inflation, the natural logarithm of gross domestic product, the natural logarithm of population and real interest rate.  $\nu_i$  are unobserved, time-invariant country fixed effects such as geography, climate, gender, ethnic fractionalization and other demographic characteristics.  $\varepsilon_{it}$  is the stochastic error term that captures all possible omitted variables.  $E(\varepsilon_{it}) = 0$  for all  $i$  and  $t$ .  $\beta_0, \beta_1, \beta_2, \dots, \beta_k$  are parameters to be estimated. Variables are converted into logarithmic form to minimize large variations in the values.

Given the specification in equation (1) above, the relationship between  $\ln GFCF_{it}$  and  $\ln ODA_{it}$  could be endogenous due to the non-random nature of ODA. Thus, receiving ODA is usually not random. Sources of this endogeneity are omitted variables. Thus, the effect of ODA on GFCF could be driven by other factors that are not captured by the model (i.e. omitted variable problem). To estimate the causal effect of ODA, the study uses fixed-effects instrumental variable (IV) regressions and the fixed effect two stage least squares (2SLS) estimations among other estimation techniques.

### ***3.3.1 Fixed-effects instrumental variable two stage least squares***

The long panel data set on agricultural ODA in Africa allows us to empirically examine the extent to which ODA impacts GFCF and also allows us to control for time-invariant unobserved characteristics that could impact the relationship between ODA and GFCF. The fixed-effects method of panel estimation is considered over the random-effect due to the possible correlation between the independent variables and the country-specific effects. Given that the instruments are more than one, the 2SLS estimator is employed. The 2SLS estimator requires that the number of instruments are more than the number of regressors. The objective of the 2SLS is to estimate  $\ln ODA_{it}$  in a first-stage regression using instruments that are uncorrelated with  $\lambda_{it}$  as stated in

equation (2) below. In a second-stage regression as specified by equation (3), the predicted values of  $\ln ODA_{it}$ , denoted as  $\ln \hat{ODA}_{it}$  are then used to estimate the impact of official development assistance on fixed capital formation.

The 2SLS equations are specified below;

$$\ln ODA_{it} = \alpha_0 + \sum_{j=2}^k \alpha_j X_{it} + \gamma Z_{it} + \mu_i + \lambda_{it} \quad (2)$$

$$\ln GFCE_{it} = \beta_0 + \beta_1 \ln \hat{ODA}_{it} + \sum_{j=2}^k \beta_j X_{it} + \nu_i + \varepsilon_{it} \quad (3)$$

$Z_{it}$  is a vector of instrumental variables that include deviations in rainfall, rule of law and a set of dummy variables on social economic status of recipient countries classified by World Bank standards as low, low-middle, upper-middle or high income.  $\gamma$  is a vector of parameters for the set of external instruments.  $\mu_i$  are unobserved, time-invariant country fixed effects such as geography, climate, gender, ethnic fractionalization among others.  $\lambda_{it}$  is the stochastic error term that captures all omitted variables and  $E(\lambda_{it}) = 0$  for all  $i$  and  $t$ .  $\alpha_0, \alpha_1, \alpha_2, \dots, \alpha_k$  are parameters to be estimated.

### 3.3.2 Fixed-effects instrumental variable regression

The fixed-effects instrumental variable regression serves as a robustness check for the two stage least squares estimates. Under the IV estimation approach, the idea is to find an instrument that correlates with ODA but does not correlate with GFCE. To ensure that the selected instruments are good, the Kleibergen-Paap rank LM test (Kleibergen & Paap, 2006) and the Sanderson-Windmeijer test, a modification of the Angrist & Pischke test (Angrist & Pischke, 2009; Sanderson & Windmeijer, 2015) are performed to test for instrument relevance, while the F-test and the

Hansen's J test (Hansen, 1982) are performed to check for weak identification and instrument validity respectively. Both the Kleibergen & Paap and the Sanderson-Windmeijer tests are chi-squared distributed under the null hypothesis that the endogenous regressor,  $\ln ODA_{it}$  is underidentified. When the number of instruments is less than the number of endogenous regressors, the endogenous regressors are said to be underidentified and so, the reduced form of the equation cannot be solved and so are the structural coefficients. The Hansen's J test, also chi-squared distributed works under the null hypothesis that the instrument is valid. Thus, a rejection of the null hypothesis cast doubts on the instrument's validity. According to Steiger and Stock, (1997), an F-test statistic of at least 10 in the first stage regression shows that the endogenous regressor is not weakly identified. In other words, the instrument is good enough to estimate  $\ln ODA_{it}$  unbiasedly.

### ***3.3.3 Path-Dependency***

Now, we examine whether the types of ODA have a growth effect on fixed capital formation. As noted by Mogues & Benin (2012), this investigation is more indicative of the longer-term trajectory fixed capital formation may undergo as a result of the inflows of official development assistance into the agricultural sectors of the various countries in Sub-Saharan Africa. Hence, a growth model is estimated as specified by equation (4).

In the growth model, a possible path-dependency of growth in fixed capital formation due to the slow-changing nature of country's tax bases and the fragmented disbursement of aid over time are accounted for by including countries' past growth in fixed capital formation as an independent variable. Allowance is also made for the possibility that low income countries may have a different growth trajectory than high income countries by including the lagged level of fixed capital formation; this variable clarifies the nature of convergence or divergence of countries' fixed capital

formation over time. Thus, the model estimates growth or changes in agricultural fixed capital formation  $\Delta(\ln GF_{it})$  as a function of changes in the first lag of agricultural fixed capital formation  $\Delta(\ln GF_{it-1})$  by following the lagged-investment in fixed capital concept of Eberly, Rebelo & Vincent (2012) and Mogues & Benin (2012). The model of growth in fixed capital formation is then given as:

$$\Delta(\ln GF_{it}) = \beta_0 + \beta_1 \Delta(\ln GF_{it-1}) + \beta_2 \ln GF_{it-1} + \beta_3 \Delta(\ln ODA_{it}) + \sum_{j=4}^k \beta_j \Delta(X_{it}) + \nu_i + \varepsilon_{it} \quad (4)$$

### 3.3.4 Estimation of Growth Path-dependency Model

In equation (4) above, although the objective of the study is to estimate  $\beta_3$ , the difficulty is to estimate  $\beta_1$  accurately because the lagged growth term of fixed capital formation correlate with the stochastic error term.

For simplicity, rewriting equation (4) as;

$\Delta(\ln GF_{it}) = \beta_0 + \beta_1 \Delta(\ln GF_{it-1}) + \pi_{it}$  (5), where  $\pi_{it} = \nu_i + \varepsilon_{it}$ , it is evident that both  $\Delta(\ln GF_{it})$  and  $\Delta(\ln GF_{it-1})$  depend on the time-invariant effects,  $\nu_i$ . Thus, the introduction of the lagged dependent variable makes OLS estimation inconsistent and bias (Nickel, 1981; Jones & Tarp, 2016). The OLS estimate of  $\beta_1$  is upward-biased, because  $\Delta(\ln GF_{it-1})$  is positively correlated with  $\pi_{it} = \nu_i + \varepsilon_{it}$ .

To avoid the inconsistent estimates of the pooled OLS estimation of an AR (1) process caused by endogeneity, the difference and system-GMM estimation techniques are used. The techniques remove the unobservable, time-invariant country fixed effect  $\nu_i$  among other corrections, so as to eliminate the inconsistency caused by the dependence of  $\Delta(\ln GF_{it-1})$  on  $\nu_i$  as shown below.

$$[\Delta(\ln GFCE_{it}) - \Delta(\ln GFCE_{it-1})] = \beta_1[\Delta(\ln GFCE_{it-1}) - \Delta(\ln GFCE_{it-2})] + (v_i - v_i) + (\varepsilon_{it} - \varepsilon_{it-1}) \quad (6)$$

Now, to construct internal instruments for the GMM estimation of  $\beta_1$ , consider period  $t = 3$ , the period in which equation (6) is observed for the first time results in the equation below;

$$[\Delta(\ln GFCE_{i3}) - \Delta(\ln GFCE_{i2})] = \beta_1[\Delta(\ln GFCE_{i2}) - \Delta(\ln GFCE_{i1})] + (\varepsilon_{i3} - \varepsilon_{i2}) \quad (7)$$

In the first difference equation above,  $\Delta(\ln GFCE_{i1})$  is a valid and a strong internal instrument for  $[\Delta(\ln GFCE_{i2}) - \Delta(\ln GFCE_{i1})]$  because it is highly correlated with  $[\Delta(\ln GFCE_{i2}) - \Delta(\ln GFCE_{i1})]$  but orthogonal to  $(\varepsilon_{i3} - \varepsilon_{i2})$ . Therefore, changes in fixed capital formation at  $t = 1$  is a good instrument for the difference between changes in fixed capital formation at  $t = 2$  and  $t = 3$ . Further considering period  $t = 4$ ;

$$[\Delta(\ln GFCE_{i4}) - \Delta(\ln GFCE_{i3})] = \beta_1[\Delta(\ln GFCE_{i3}) - \Delta(\ln GFCE_{i2})] + (\varepsilon_{i4} - \varepsilon_{i3}) \quad (8)$$

In equation (8), both  $\Delta(\ln GFCE_{i1})$  and  $\Delta(\ln GFCE_{i2})$  are highly correlated with  $[\Delta(\ln GFCE_{i3}) - \Delta(\ln GFCE_{i2})]$  and as such are good internal instruments. Subsequent internal instruments are generated in a similar fashion.

The difference and system-GMM estimators are designed for dynamic panel analysis and embody the following assumptions about the data-generating process (Roodman, 2006):

1. There may be arbitrarily distributed fixed individual effects. This argues in favor of a panel set-up, where variation over time can be used to identify parameters.
2. The process may be dynamic, with current realizations of the dependent variable influenced by past ones.

3. Some independent variables may be endogenous.
4. The idiosyncratic disturbances (those apart from the fixed effects) may have individual-specific patterns of heteroskedasticity and autocorrelation.
5. The idiosyncratic disturbances are orthogonal across individuals.
6. Some predicted variables may be predetermined but not strictly exogenous: even if independent of current disturbances, still influenced by past ones. The lagged dependent variable is an example.
7. The time span of available data,  $T$ , may be small. (The panel is “small  $T$ , large  $N$ .”) Finally, since the estimators are designed for general use, they do not assume that good instruments are available outside the immediate data set. In effect, it is assumed that the only available instruments are *internal* based on lags of the instrumented variables.

Heid, Langer & Larch (2012) and Grohmann (2015) argues that if the data-generating process follows an autoregressive function and shows a high persistence between the autoregressive explanatory variable and the dependent variable, then SGMM should be chosen over Difference Generalized Method of Moments (DGMM). According to Blundell & Bond (2000), the persistence in these variables introduces bias and imprecision on the DGMM estimator. This bias and imprecision comes about as a result of the double-lagged level instruments used in the difference equations. The instruments are actually weak instruments because they become less informative as the value of the autoregressive parameter increases towards unity and as the variance of the country-specific effects  $v_i$  increases relative to the variance of the transitory shocks,  $\varepsilon_{it}$  (Blundell, Bond & Windmeijer, 2001). Thus, the model is estimated using Arrelano & Bond (Difference GMM) and Blundell & Bond (System GMM). Even though the variables of interest are stationary at level, results of both estimators are presented.

### 3.3.5 Post-estimation Tests

#### a) *Heteroskedasticity*

OLS assumes that  $\text{var}(\varepsilon_t) = \sigma^2 < \infty, \forall t$ . That is, the variance of the error term is constant. This is referred to as homoskedasticity (Brooks, 2008). If the error terms do not have constant variance, they are said to be heteroskedastic. In context, countries with low incomes will spend relatively less on investments, and the variations in investments across such low income countries will be small as compared to countries with high income levels; where the amount of discretionary income is higher. Accordingly, the average amount spent on investment will be higher and there will also be greater variability among such high income countries. This results in heteroskedasticity and infringes on the ability of the estimator as a relatively efficient estimator using OLS. Therefore, there is the need to investigate the presence of heteroskedasticity of the error terms. To do this, the Breusch-Pagan / Cook-Weisberg test for heteroskedasticity is used. The null hypothesis assumes constant variance or homoskedasticity, while the alternative is that the variance of the error term is not constant or heteroskedastic (Pagan & Hall, 1983; Johnson, Johnson & Buse, 1987; Koenker, 1981; Waldman, 1983; Baum, Schaffer & Stillman, 2003).

The solution to the problem of heteroskedasticity of unknown form has been provided by the GMM technique, which, by itself, brings the advantage of the efficiency and consistency in the presence of arbitrary heteroskedasticity. Nevertheless, this is delivered at a cost of possibly poor finite sample performance, and therefore, if heteroskedasticity is in fact not present, standard instrumental variable regression may be preferable over GMM (Pagan & Hall, 1983).

#### b) *Multicollinearity*

OLS estimation method implicitly assumes that the explanatory variables are not correlated with one another (Brooks, 2008). Multicollinearity comes about when at least two independent

variables are highly correlated. This makes it difficult to separate the effect of the individual variables (Westerlund, 2005). A simple way to get a fair idea whether or not multicollinearity is a problem is to generate a correlation matrix and look for pair-wise variables that have a very strong correlation with each other. This matrix gives an indication of the association and/or strength and direction of the variables.

### **3.4 Data Sources**

Secondary data on the World Bank website, WDI and FAOSTAT databases covering the period 1996 to 2014 was used for the study on 40 sub-Saharan African countries. The period (1996-2014) was chosen mainly due to availability of data.

### **3.5 Variable definitions and measurement**

This section defines the variables, especially control and instrumental variables for the study and how they are measured. Variables can be dichotomized as dependent and independent (Harris, 1995). In data analysis, a dependent variable is predicted to change when independent variables change. The natural logarithm of these variables are taken so as to: (1), interpret coefficients as elasticities (2), interpret the first difference as growth rates and (3) scale down the values and induce normality

#### ***3.5.1 Agricultural gross fixed capital formation***

Agricultural gross fixed capital formation is the dependent variable. Agriculture; as used in this study refers to the agriculture, fishing and forestry sectors. According to WDI “GFCF is measured as the total value of a producer’s acquisitions, less disposals, of fixed assets during the accounting period plus certain specified expenditure on services that adds to the value of non-produced assets”. GFCF measures investment in fixed assets in agriculture as measured by the System of

National Accounts (SNA) concept. Data on agricultural investment was obtained from FAOSTAT database.

### ***3.5.2 Official Development Assistance***

Official development assistance flows in millions of dollar values are purposely for the provision and promotion of investments in fixed assets or for the purposes of infrastructural development in developing countries' agriculture sector. The term agriculture as used in this study refers to the agriculture, fishing and forestry sectors. ODA can be categorized as bilateral or multilateral. According to Boone (1995), aggregate aid flows does not significantly increase investment. However, Arndt, Jones & Tarp (2010) claim that aid remains a key tool for enhancing the development prospects of poor countries due to its positive and statistically significant causal effect on factors of growth. Given the ambiguous nature of the aid effectiveness literature, this study expects ODA to have a negative, neutral or positive impact on agricultural investment.

### ***3.5.3 Inflation***

Inflation, expressed in percent and measured by the consumer price index (CPI) reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, mainly yearly. Inflation could be thought of as the rate at which wealth is losing its value. The Laspeyres formula is used in computing the consumer price index (CPI). The source is the World Bank database. High levels of inflation cause firms and households to reduce investment because the actual prices of capital goods increase. Consequently, firms need money to buy capital goods and a reduction in firms' real balances will increase the effective cost of buying new capital. Due to the corrosive effect of higher inflation, a

negative relationship between inflation and investment in fixed asset is expected (De Gregorio, 1993; Dornbusch & Frenkel, 1973; Fischer, 1993).

#### ***3.5.4 Dollar exchange rate***

Dollar exchange rate refers to the real exchange rate determined by national authorities or the rate determined in the legally sanctioned exchange market relative to the dollar. The real exchange rate between two currencies is the product of the nominal exchange rate (the dollar cost of a local currency, for example) and the ratio of prices between the two countries using the Purchasing Power Parity approach. It is calculated as an annual average based on monthly averages of local currency units relative to the U.S. dollar. Data was obtained from The International Monetary Fund. Fixed capital formation is negatively affected by real exchange rate instability (Bleaney & Greenaway, 2001) when the economy is mainly import-based. However, when an economy is export-based, a high exchange rate will be an incentive to form fixed capital. Thus, the study expects a negative or positive effect of exchange rate on investment in fixed capital.

#### ***3.5.5 Gross Domestic Product per capita***

GDP per capita is gross domestic product divided by midyear population. GDP is defined by WDI as “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. Data are in constant 2010 U.S. dollars. Dollar figures for GDP are converted from domestic currencies using 2010 official exchange rates. For a few countries where the official exchange rate does not reflect the rate effectively applied to actual foreign exchange transactions, an alternative conversion factor is used. Data source is the World Bank. Investment in fixed assets has a positive and strong relationship with economic growth using GDP per capita as an indicator

(Ilegbinosa, Micheal & Watson, 2015). Increase in income provides an incentive for more saving. Thus, the higher the income level, the greater the amount investment through savings; thus GDP per capita causing investment. Also, with increase in GDP, governments allocate and spend more on capital goods such as infrastructure. This increases the marginal productivity of capital and labor in the private sector and leads to more investment which in turn also leads to higher GDP per capita as a measure for economic growth. Empirical studies (Khan & Reinhart, 1990; Ghura & Hadjimichael, 1996; Ben-David, 1998; Collier, 1999; Collier & Gunning, 1999; Hernandez-Cata, 2000; Ndikumana, 2000; Shaib & Ndidi, 2015) considering investment as capital formation and economic development, conducted in Africa, Asia and Latin America have established, beyond reasonable doubt the critical connection between capital formation and the rate of economic growth measured as GDP per capita growth. Against this empirical backdrop, GDP per capita has a positive and a strong relation with investment. GDP per capita is in thousands of dollars and the natural logarithm was computed for the study as a way of scaling down and normalizing the data series. The study expects a strong positive relationship between GDP per capita and fixed capital formation.

### ***3.5.6 Real Interest Rate***

Real interest rate is the lending interest rate adjusted for inflation as measured by the GDP deflator. Applying the Fisher equation, the real interest rate is approximately the nominal interest rate minus the inflation rate. According to Khurshid (2015) and Bader & Malawi (2010), when interest rates increase, the cost of investment also increases contemporaneously and causes lower-income investors to eventually withdraw from the area of investment; this phenomenon reduces the demand for investment. Conversely, when interest rates fall, investment costs decline. This fall in interest rates stimulates investment and the total social investments increase. However, higher

income and risk-loving investors take chances to form capital. With high interest rates both lower and higher income investors have a better opportunity to lend to the government through the purchase of treasury bills and other instruments. The government can then allocate portions of such resources for infrastructural purposes which lead to fixed capital formation. Thus, interest rate can have either a negative or positive impact on capital formation.

### ***3.5.7 Population***

Population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship. The values are midyear estimates in millions of people. According to the literature, investment is affected negatively by population growth (Yoon, Kim & Lee, 2014). Savings that households deposit in banks are a source of investments in the private sector. Thus, as population grows, the propensity to consume increases, decreasing saving and hence investment. Empirical works support the fact that declining fertility does indeed stimulate savings for physical capital accumulation and investment (Coale & Hoover, 2015; Sinn, 2000; Kelley, 1988; Coale & Hoover, 1958). On the other hand, it is argued that increase in population creates higher demand which attracts market-seeking FDI and thereby resulting in higher investment flows (Alsan, Bloom & Canning, 2006; Buch, Kleinert & Toubal, 2006). Given this mixed results about direction of the link between investment and population; this study expects a negative or positive sign *a priori*.

### ***3.5.8 Rule of law***

Rule of law (ROL) measures “the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, the police, and the courts, as well as the likelihood of crime and violence”. The ROL index is a “quantitative assessment tool

designed to offer a comprehensive picture of the extent to which countries adhere to the rule of law” (Agrast, Botero & Ponce, 2010). The measure hinges on four key principles: (1) Accountable government, (2) Good laws, (3) Good process, and (4) Access to justice. Following Alesina & Dollar (2000), Burnside & Dollar (2000) and Bräutigam & Knack (2004), the rule of law as a governance indicator is considered as an instrument for ODA. Since ODA is said to be more effective in a good policy environment (Dollar & Levin, 2006), donors are more likely to allocate higher amounts to recipient countries with a higher rule of law index. Rule of law ensures macroeconomic policy formulation and implementation and the enhancement of institutional quality (Herzer & Grimm, 2012). Data was obtained from WGI database.

### ***3.5.9 Rainfall Deviations***

Following Brückner (2013), this study uses rainfall variability as another instrument for ODA. Sub-Saharan Africa’s economy is dominated by the agricultural sector and agricultural in SSA is predominantly rain-fed. Thus, it is imperative to incorporate rainfall shocks into the ODA equation. Rainfall shocks may have important implications for the effectiveness of ODA. Drought has the power to offset any positive contribution made by ODA. According to Tadesse (2011), years of drought are mostly followed by an increase in the volume of aid flow to Ethiopia. Therefore, *a priori*, the effect of rainfall on ODA could be negative or positive based on its intensity from drought to flood. Rainfall data was obtained from *Weatherbase* database for Africa. Deviations in rainfall was calculated as  $RMD = RF_{it} - \overline{RF}$ , where  $RF_{it}$  is the annual average rainfall in country  $i$  at period  $t$  and  $\overline{RF}$  is the long-term annual average rainfall of all countries considered.

### 3.5.10 Socio-Economic Status

Lastly, the socio-economic status (SES) of recipient countries as a dummy instrument is considered as a determinant of official development assistance. In the development trajectory of developing countries, they progress from low income status, through low-middle income and upper-middle income to high income status. Intuitively, the volume of ODA inflow is expected to reduce as recipient countries develop. Countries are categorized as low income, lower-middle income, upper-middle income and high income according to their GNI per capita using the World Bank's Atlas method. According to 2015 estimates, a low income country has  $\$0 \leq pcGNI \leq \$1,025$ , lower-middle-  $\$1,026 \leq pcGNI \leq \$4,035$ , upper-middle-  $\$4,036 \leq pcGNI \leq \$12,475$  and high income-  $pcGNI \geq \$12,476$ . SES data was obtained from the World Bank's database. A dummy variable was generated from the SES, where 1 indicates the presence of a desired characteristic and 0, otherwise.

Note: For the socio-economic status categories, s1=high income countries, s2=low income countries, s3=lower-middle income countries and s4=upper-middle income countries. In 2014, Seychelles attained a high income socio-economic status.

Table 3.1: Variable View

No.	Variables	Definition	Expected signs	Citation
1	ODA	Official Development Assistance	-/+ or =	Boone (1996), Arndt, Jones & Tarp (2010)
2	BODA	Bilateral Official Development Assistance	-/+ or =	Duc (2006) Uzonwanne & Ezenekwe (2015)
3	MODA	Multilateral Official Development Assistance	-/+ or =	Dalgaard et al. (2004) Burnside & Dollar (2000); Sachs et al. (2004); Easterly et al. (2004); Gomanee, Girma & Morrissey (2005); Tracy (2010)
4	INF	Inflation	-	Dornbusch & Frenkel (1973), De Gregorio (1993)
5	pcGDP	Per capita Gross Domestic Product	+	Ilegbinosa, Micheal & Watson (2015); Shuaib & Ndidi (2015)
6	DXR	Dollar Exchange Rate	-	Bleaney & Greenaway (2001)
7	INT	Real Interest Rate	-/+	Khurshid (2015), Bader & Malawi (2010)
8	ROL	Rule of law	+	Burnside & Dollar (2000), Dollar & Levin (2006).
9	RMD	Rainfall Deviations	-/+	Tadesse (2011) Brückner (2013)
10	SES	Socio-economic status		

**Note:** -/+ or = implies negative/positive or neutral effect.

### **3.6 Data Analysis**

The data shall be analyzed within the framework of instrumental variable 2SLS and the GMM estimators using Stata 13.0 package. To ensure that the appropriate model is specified, diagnostic tests and post-estimation tests shall be explored.

### **3.7 Conclusion**

Regression results are imperative for policy formulation in the right direction. The method used to arrive at a certain regression parameter is crucial, hence a multiplicity of the estimation techniques well suited to the circumstances of this study are employed to allow for flexibility and robustness in the behaviour of the parameters of interest while controlling for the accurate estimate of other independent variable. ODA is treated as endogenous and instrumented using population, rule of law, rainfall deviations and socio-economic status. Robust 2SLS and IV (for robustness check) regressions that control for fixed effects and GMM-type estimators have been used for parameter estimates as well as their standard errors. This is because pooled OLS and FE OLS will produce inconsistent and bias estimates in the presence of the possible endogenous covariates included in the model specifications.

## CHAPTER FOUR

### RESULTS AND DISCUSSION

#### 4.1 Introduction

The objective of this study is to investigate the level and growth impacts of official development assistance (total, bilateral and multilateral ODA) on gross fixed capital formation in the agricultural sector of Sub-Saharan Africa from 1996 to 2014. With respect to these objectives, a detailed account of the results and discussions are provided in this chapter. The chapter presents descriptive statistics of variables, pre-estimation and post-estimation tests and answers the research questions raised in Chapter One with regards to the hypotheses of the study. In examining the link between gross fixed capital formation and official development assistance at level, the estimation techniques employed include the instrumental variable 2SLS by Theil (1953) and Basmann (1957). Examining the growth impact of official development assistance on fixed capital formation in agriculture, the study estimates the growth model using the Arellano-Bond (1991) and the Arellano-Bover (1995)/Blundell-Bond (1998) dynamic difference and system-GMM estimators respectively.

#### 4.2 Descriptive Analysis

This section provides a statistical summary of both dependent and independent variables of the various countries over the time frame and shows the features of the variables in the models.

Table 4.1: Descriptive Statistics

VARIABLES	(1) N	(2) Mean	(3) SD	(4) Min	(5) Max
lnGFCF	759	4.190	1.493	1.386	8.260
lnODA	760	2.571	1.729	-4.605	6.059
lnBODA	733	1.936	1.749	-4.605	5.421
lnMODA	692	1.546	2.001	-4.605	5.844
lnpcGDP	760	7.000	1.108	5.231	9.581
lnDXR	756	4.807	2.158	-2.040	8.856
lnINF	674	1.729	1.141	-2.303	8.330
INT	596	9.096	11.55	-94.22	52.26
lnPOP	760	1.914	1.563	-2.526	5.179
ROL	640	-0.622	0.630	-2.205	1.060
RMD	760	0.0646	28.72	-60.05	63.17
s1	760	0.00132	0.0363	0	1
s2	760	0.675	0.469	0	1
s3	760	0.192	0.394	0	1
s4	760	0.132	0.338	0	1
Number of Countries	40	40	40	40	40

*Source: Author's compilation using Stata 13.0*

From Table 4.1 above, N represents the total number of observations recorded per variable. Due to some missing values,  $596 \leq N \leq 760$ . SD represents the standard deviations or spread associated with the means or average values of the variables. Minimum (Min) and maximum (Max) observation are also indicated. The negative values recorded under column (4) of Table 4.1 are due to the data-generating process of the natural logarithm operator of values less than 1. For example, in 1996, total agricultural ODA allocated for the acquisition of physical capital amounted to US\$ 0.02 million, taking the natural logarithm of such a figure yields a negative value because it is less than US\$ 1.00 million. Natural logarithm of gross fixed capital formation recorded the minimum value of 1.386 which represents US\$ 4 million in Seychelles in fiscal year (FY) 2004. The highest natural logarithm of gross fixed capital formation of 8.260 (US\$ 3.865 billion) was observed in Nigeria in FY2004. The average value of agricultural physical capital investment was

about US\$ 206.90 million. Official development assistance recorded an average of US\$ 37.36 million with Ethiopia receiving the most aid of 6.059 in term of natural logarithms (US\$ 427.94 million) in FY2009. The lowest value (-4.605 corresponding to US\$ 0.01 million) of agricultural ODA was recorded by the Democratic Republic of Congo (formerly Zaire) in 1996.

Similarly, bilateral official development assistance recorded an average of US\$20.15 million with Ethiopia still receiving the most aid of 5.421 in terms of natural logarithms (US\$ 226.01 million) in FY2014. In 1996, there was no inflow of multilateral ODA recorded hence total ODA was solely bilateral. Thus, the lowest value of -4.605 corresponding to US\$ 0.01 million of agricultural ODA (made up of only bilateral) was recorded by the Democratic Republic of Congo in 1996.

Considering multilateral ODA, the average value in dollar terms was US\$ 17.32 million, while the minimum dollar value was US\$ 0.01 million (-4.605 in log terms) recorded in Gabon for FY1997 and the maximum dollar value of US\$ 345.02 million (5.844 in log terms) was allocated to Ethiopia in 2009, making Ethiopia the largest recipient of agricultural ODA considering both bilateral and multilateral sources within the study period. On the average, there have been more bilateral flows towards the formation of physical capital in agriculture in Sub-Saharan Africa than multilateral flows from 1996 to 2014. This is evident from the higher frequency of bilateral inflows ( $N = 733$ ) as compared to multilateral inflows ( $N = 692$ ) and their average dollar values. There are more observations for total ODA ( $N = 760$ ) than bilateral ODA ( $N = 733$ ) and multilateral ODA ( $N = 692$ ) because in some years, some countries have received bilateral ODA but no multilateral ODA and vice versa. For example, between 1996 and 2000, Mauritania received no bilateral ODA and in 1999 Nigeria received no multilateral ODA.

Real interest rate assumed the lowest rate of -94.22% in fiscal year 1996 in Angola while in Madagascar; it was as high as 52.26% in fiscal year 2013.

### **4.3 Econometric Analysis**

#### ***4.3.1 Test of Endogeneity***

The endogeneity of aid has been discussed extensively in recent studies of the aid effectiveness (Arndt, Jones & Tarp, 2010; Knack, 2001; Wright, 2009; Djankov, Montalvo & Reynal-Querol, 2008). In line with previous empirical work, this study tests for endogeneity of agricultural ODA using the Durbin-Wu-Hansen test under the null hypothesis that the specified endogenous regressor (ODA) can actually be treated as exogenous. The test statistic is distributed as chi-squared with degrees of freedom equal to the number of regressors tested; in this case, one regressor (ODA). The test statistic equals 6.429 with a p-value of 0.0112 suggesting that the null hypothesis of exogeneity can be rejected at 5%. Due to the endogeneity of agricultural ODA, the study resorts to the use of IV-2SLS and GMM estimators.

#### ***4.3.2 Test of heteroscedasticity***

Testing for the presence of heteroscedasticity, the Breusch-Pagan / Cook-Weisberg test distributed as chi-squared was used under the null hypothesis of constant variance. With a p-value of 0.5550, the test fails to reject the null hypothesis and hence concludes the presence of homoscedasticity (Cook & Weisberg, 1983).

#### ***4.3.3 Tests of stationarity***

Both fixed capital formation and official development assistance follow a stationary process. This was evident from panel unit root tests. With the exception of the Hadri Lagrange-Multiplier (LM) stationarity test which work under the null hypothesis that all panels are stationary, all other unit root tests- Levin-Lin-Chu, Harris-Tzavalis, Breitung, Im-Pesaran-Shin and the Fisher's Type work

under the null hypothesis that all panels contain unit root. In all cases, the various tests provide consistent results. With a probability of 0.0000 (and 0.9962 as in the case of the Hadri LM stationarity test), the null hypothesis that all panels contain unit roots was rejected, hence the variables series are stationary at level (Im, Pesaran & Shin, 2003). Below are the tables for test statistics and results. Stationarity results for bilateral and multilateral ODA are reported in the Appendix.

Table 4.2: Summary of Unit root tests for GFCF

Test	Levin-Lin-Chu	Harris-Tzavalis	Breitung	Im-Pesaran-Shin	Fisher's Type	Hadri LM Stationarity
Null Hypothesis	Panels contain unit roots	Panels contain unit roots	Panels contain unit roots	All panels contain unit roots	All panels contain unit roots	All panels are stationary
Statistic	Adjusted t* -8.0747	Rho 0.2341 Z -23.5883	Lambda -11.72	Z-t-tilde-bar -11.92	Modified inv. chi-squared Pm 41.4484	z -2.6659
p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.9962
Remark	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary

Source: Author's compilation using Stata 13.0

Table 4.3: Summary of Unit root test for ODA

Test	Levin-Lin-Chu	Harris-Tzavalis	Breitung	Im-Pesaran-Shin	Fisher's Type	Hadri LM Stationarity
Null Hypothesis	Panels contain unit roots	Panels contain unit roots	Panels contain unit roots	All panels contain unit roots	All panels contain unit roots	All panels are stationary
Statistic	Adjusted t* -13.3144	Rho -0.3466 Z -46.1139	Lambda -16.3617	Z-t-tilde-bar - 14.7295	Modified inv. chi-squared Pm 75.0794	z 3.4920 -
p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.9998
Remark	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary

Source: Author's compilation using Stata 13.0

#### 4.4 Empirical Results

Empirical analyses of the level (short-term) and growth (long-term) impacts of the various forms of official development assistance on fixed capital formation were conducted. This section presents the estimated results.

From Table 4.4 below, the generalized least squares (GLS), fixed effects ordinary least squares (FE) and the random-effects instrumental variable two stage least squares are presented as alternative estimation techniques to justify the use of the fixed-effects instrumental variable two stage least squares. The Hausman's test rejects the null hypothesis suggesting the use of the fixed-effects estimations (Hausman, 1978). Results of the Hausman's test are reported in Table 6 of the Appendix section. For robustness checks of the 2SLS estimates, results of the IV regressions are presented in tables 3-5 in the Appendix section. The 2SLS-lnGFCF columns present the 2<sup>nd</sup> stage regression results while the 2SLS-lnODA columns provide the 1<sup>st</sup> stage regression results of the fixed and random effects instrumental variable two stage least squares estimations.

Table 4.4: Level (short-term) impact of ODA on GFCF

	2SLS-FE		2SLS-RE		FE	GLS
	lnGFCF	lnODA	lnGFCF	lnODA	lnGFCF	lnGFCF
lnODA	0.160*** (0.0511)		0.158** (0.0613)		0.0357** (0.0162)	0.0653*** (0.0176)
lnpcGDP	0.734** (0.309)	0.148 (0.742)	0.612*** (0.160)	0.423** (0.212)	0.778** (0.311)	0.884*** (0.129)
lnPOP	1.547*** (0.410)	3.802*** (0.737)	1.213*** (0.0876)	1.040*** (0.135)	1.982*** (0.335)	1.136*** (0.0792)
lnDXR	-0.283*** (0.0354)	0.357*** (0.119)	-0.185*** (0.0608)	0.421*** (0.110)	-0.232*** (0.0340)	-0.127*** (0.0480)
lnINF	0.0324 (0.0210)	-0.00627 (0.0419)	0.0242 (0.0231)	-0.0162 (0.0575)	0.0308 (0.0203)	0.0228 (0.0229)
INT	0.00356** (0.00164)	0.00129 (0.00675)	0.00215 (0.00201)	0.00221 (0.00608)	0.00259 (0.00183)	0.00104 (0.00195)
RMD		0.0146** (0.00568)		0.00540 (0.00392)		
ROL		1.030*** (0.236)		1.287*** (0.246)		
s1		-		-1.275*** (0.112)		
s2		2.447*** (0.466)		0.600 (0.377)		
s3		2.140*** (0.318)		0.632*** (0.171)		
s4		1.448*** (0.195)		-		
Constant	-3.125* (1.684)	-8.907* (4.674)	-2.026* (1.114)	-3.989** (1.671)	-4.155** (1.746)	-3.809*** (0.979)
Observations	466	466	466	466	535	535
R-squared	0.569	0.418			0.560	
Number of ID	39	39	39	39	39	39
Country FE	YES	YES			YES	
Country RE			YES	YES		YES

Robust standard errors in parentheses \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

.From Table 4.4, the estimates show that there exists a positive and statistically significant relationship between total agricultural ODA and fixed capital formation in agriculture across all

three estimation techniques. From the 2SLS estimation, *ceteris paribus*, a 1% increase in ODA yields on the average a 0.160% increase in fixed capital formation in agriculture. Hence, total agricultural ODA has a level effect on the magnitude of fixed capital formation in Sub-Saharan Africa. This optimistic view of ODA is supported by Arndt, Jones & Tarp (2001), Gomanee, Girma & Morrissay (2005), Sachs et al. (2004), Dalgaard et al. (2004) and McGilivray (2005).

Per capita GDP is a significant determinant of agricultural fixed capital formation at the 5% level of significance in the 2SLS estimation. On the average, when all other variables are held constant, a 1% increase in per capita GDP is associated with a 0.73% increase in gross fixed capital formation in agriculture. This finding conforms to the findings of Ndidi & Shuaib (2015). However, per capita GDP has an insignificant but positive relationship with total ODA (Boone, 1996).

The estimated results also show that there exists a positive and 1% statistically significant relationship between population and fixed capital formation in agriculture across all three estimation techniques. From the 2SLS estimation, a 1% increase in population yields on the average a 1.55% increase in fixed capital formation in agriculture. As population increases, extra demand is created. The demand is likely to stimulate investment towards fixed capital formation. In the same way, population has positive and statistically significant relationship with official development assistance in the first stage regression. A 10% increase in population brings about a 38% increase in ODA at the 1% level of significance.

Dollar exchange rate has a negative and statistically significant impact at the 1% level on fixed capital formation in agriculture. A 1% increase in the dollar exchange rate reduces investment in fixed capital by 0.28%. This finding is supported by Bleaney & Greenaway (2001) and agrees with macroeconomic theory; if the cost of a dollar increases relative to the currencies of SSA countries,

these SSA countries will need more money to import capital goods which will discourage investment in capital goods. The finding suggests a high import of capital goods by recipient countries from donor countries and resonates with the concepts of *Dutch Disease* and *Tied Aid*.

Interest rate impacts gross fixed capital formation positively and the link is statistically significant at the 5% level of significance. On the average, if interest rate increases by 1%, fixed capital formation increases as a result by about 0.004%. This finding disagrees with the works of Khurshid (2015) and Bader & Malawi (2010) who found a negative relationship between investment and interest rates. The magnitude of this effect is nevertheless small. In principle, as interest rate increases, it creates an incentive to save and this saving may translate into investment or capital formation. When interest rates increase, the cost of borrowing from banks increases as well. This may discourage private sector investment in capital goods by risk averse lower-income investors such as smallholder farmers but investors with a higher risk appetite will still go for loans with high interest charges to form agricultural fixed capital. Furthermore, high interest rates create an incentive for governments to make money through the issuance of risk-free securities such as treasury bills. Thus, government can afford to provide infrastructure thereby forming fixed capital. Since the dependent variable is the total value of fixed capital formed by both the private and public sectors, the finding that real interest rates has a positive correction with GFCF is an indication that a larger proportion of the GFCF data is fixed capital formed by the public sector.

Rainfall deviations, rule of law and socio-economic status of countries classified as high income (s1), low income (s2), lower-middle income (s3) and upper-middle income (s4) used as instruments in the first-stage regressions are all statistically significant. Deviation in annual average amount of rainfall from the long-term mean annual rainfall is positive and statistically significant at the 5% significance level as a determinant of total agricultural ODA. As rainfall

deviations increase by 1%, total agricultural ODA improves by 0.015%. The long-term mean annual rainfall was calculated as 62.527mm. Considering rule of law as an instrument for ODA, there is a strong positive and statistically significant relationship between the two variables. Per the results, a 1% improvement in the rule of law index increases agricultural ODA by 1.03%. The socio-economic status of a recipient country is also another major determinant of ODA. The results indicate that agricultural ODA to low income countries will increase by 2.45% more than agricultural ODA to high income countries at the 1% level of significance. Also, agricultural ODA to lower middle income countries will increase by 2.14% more than agricultural ODA to high income countries. Lastly, the estimates also reveal that agricultural ODA to low income countries will increase by 1.45% more than agricultural ODA to high income countries. These findings confirm the fact that development partners consider the socio-economic status (measured as GNI per capita) of recipient countries in allocating ODA. The findings further support the Idealist theory that development partners give ODA on humanitarian grounds (Fuller, 2002).

On the relevance and validity conditions of the instruments, the Sanderson-Windmeijer (SW) first-stage chi-squared and F statistics as tests of under-identification and weak identification respectively, of the endogenous regressor-ODA, under the null hypotheses that ODA is unidentified and weakly identified (Sanderson-Windmeijer, 2015) are employed. The null hypotheses are rejected at the 1% significance level. These rejections both confirm the relevance and validity of the excluded instruments used to identify ODA in the first stage. This conclusion conforms to the Kleibergen-Paap rank LM statistic of under-identification and rejects the null hypothesis. The Sargan-Hansen test is a test of over-identifying restrictions or validity of instruments. The joint null hypothesis is that the instruments are valid instruments, implying that they are uncorrelated with the stochastic error term, and that the excluded instruments are correctly

excluded from the second-stage estimated equation. Under the null, the test statistic is distributed as chi-squared. Since robust estimates are reported, Hansen's J statistic is provided instead of the Sargan's statistic and the test fails to reject the null hypothesis. Alternatively, the F-statistic is used for the same purpose. According to Staiger & Stock (1997), as a rule of thumb, an F statistic of at least 10 is used to conclude with confidence that the selected instruments are indeed valid (Results are provided in Tables 3-5 of the Appendix section).

Concerning the level impact of bilateral ODA on fixed capital formation, Table 4.5 below presents estimates. The 2SLS-lnGFCF columns present the 2<sup>nd</sup> stage regression results while the 2SLS-lnBODA columns provide the 1<sup>st</sup> stage regression results of the fixed and random effects instrumental variable two stage least squares estimations.

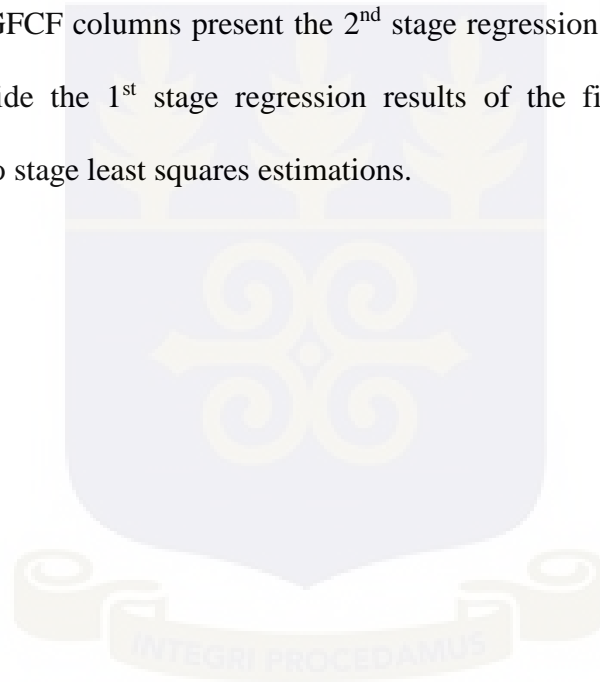


Table 4.5: Level (short-term) impact of BODA on GFCF

	2SLS-FE		2SLS-RE		FE	GLS
	lnGFCF	lnBODA	lnGFCF	lnBODA	lnGFCF	lnGFCF
lnBODA	0.166*** (0.0546)		0.173*** (0.0630)		0.0271 (0.0201)	0.0520** (0.0220)
lnpcGDP	0.736** (0.309)	0.0155 (0.922)	0.912*** (0.118)	0.320 (0.235)	0.786** (0.321)	0.911*** (0.135)
lnPOP	1.584*** (0.401)	3.448*** (1.169)	0.632*** (0.224)	1.043*** (0.145)	2.033*** (0.329)	1.159*** (0.0880)
lnDXR	-0.263*** (0.0336)	0.213** (0.0935)	-0.127** (0.0607)	0.325*** (0.0971)	-0.224*** (0.0355)	-0.109** (0.0519)
lnINF	0.0354 (0.0212)	-0.0171 (0.0368)	0.0279 (0.0232)	-0.0323 (0.0444)	0.0343* (0.0190)	0.0271 (0.0215)
INT	0.00280 (0.00173)	0.00586 (0.00623)	0.00128 (0.00215)	0.00584 (0.00550)	0.00233 (0.00186)	0.000626 (0.00203)
RMD		0.0125* (0.00669)		0.00631 (0.00423)		
ROL		1.115*** (0.346)		1.305*** (0.253)		
s1		-2.069*** (0.586)		-1.428*** (0.106)		
s2		-		0.305 (0.395)		
s3		-0.278 (0.239)		0.247 (0.261)		
s4		-0.543 (0.441)		-		
Constant	-3.179* (1.715)	-5.091 (5.005)	-3.191*** (0.970)	-3.284* (1.803)	-4.354** (1.829)	-4.058*** (1.051)
Observations	466	453	466	453	517	517
R-squared	0.569	0.330			0.552	
Number of ID	39	38	39	38	39	39
Country FE	YES	YES			YES	
Country RE			YES	YES		YES

Robust standard errors and p-values in parentheses \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

From Table 4.5 above, the estimates show that there exists a positive and statistically significant relationship between bilateral agricultural ODA and fixed capital formation in agriculture. The

2SLS estimation indicates that *ceteris paribus*, a 1% increase in bilateral ODA yields on the average a 0.17% increase in fixed capital formation in agriculture. Therefore, bilateral ODA has a level effect on the magnitude of fixed capital formation at the 1% level of significance. This finding conforms to the optimistic view of the literature on aid effectiveness and agrees with Gomanee, Girma & Morrissay (2005), Sachs (2005) and McGilivray (2005) but disagrees with Wako (2011).

In the GFCF-BODA equation, per capita GDP remains a significant determinant of agricultural fixed capital formation across all the estimation. Specifically in the 2SLS estimation, on the average, when all other variables are held constant, a 1% increase in per capita GDP is associated with a 0.74% increase in gross fixed capital formation in agriculture. This finding is in line with the findings of Ndidi & Shuaib (2015). Nonetheless, per capita GDP has an insignificant but positive effect (Boone, 1996) in the first stage estimation. Thus, per capita GDP does not appear to be a significant factor in donor's motivation for allocating bilateral aid.

Just as in the GFCF-ODA equation, dollar exchange rate has a negative and statistically significant impact at the 1% level on fixed capital formation in agriculture. All things being equal, a 1% increase in the dollar exchange rate reduces fixed capital formation by 0.26% on the average. This finding is supported by Bleaney & Greenaway (2001). Inflation and interest rates are both insignificant in the GFCF-BODA equation even though they both have a positive effect.

Furthermore, Table 4.6 below presents estimates for the level impact of multilateral ODA on fixed capital formation. The 2SLS-lnGFCF columns present the 2<sup>nd</sup> stage regression results whiles the 2SLS-lnMODA columns provide the 1<sup>st</sup> stage regression results of the fixed and random effects instrumental variable two stage least squares estimations.

Table 4.6: Level (short-term) impact of MODA on GFCF

	2SLS-FE		2SLS-RE		FE	GLS
	lnGFCF	lnMODA	lnGFCF	lnMODA	lnGFCF	lnGFCF
lnMODA	0.0678 (0.0417)		0.0865 (0.0561)		0.0334 (0.0236)	0.0517** (0.0215)
lnpcGDP	0.805** (0.323)	-0.717 (1.301)	0.995*** (0.135)	-0.0954 (0.214)	0.837** (0.312)	0.927*** (0.110)
lnPOP	1.822*** (0.450)	4.739*** (1.217)	0.807*** (0.281)	0.863*** (0.147)	1.989*** (0.431)	1.155*** (0.0908)
lnDXR	-0.267*** (0.0434)	0.626*** (0.218)	-0.144** (0.0564)	0.430*** (0.120)	-0.244*** (0.0324)	-0.126** (0.0580)
LnINF	0.0296 (0.0213)	0.0636 (0.0945)	0.0204 (0.0238)	0.0649 (0.101)	0.0427** (0.0168)	0.0320* (0.0182)
INT	0.00460** (0.00184)	-0.0135** (0.00644)	0.00341 (0.00222)	-0.00716 (0.00745)	0.00141 (0.00154)	0.000661 (0.00185)
RMD		0.0197** (0.00956)		0.00373 (0.00520)		
ROL		0.845** (0.364)		1.283*** (0.284)		
s1		-1.748 (1.109)		0.334* (0.181)		
s2		- (0.966)		1.033 (0.847)		
s3		0.179 (0.515)		1.647** (0.772)		
s4		-1.482 (0.966)		- (0.966)		
Constant	-3.879** (1.660)	-5.030 (7.892)	-3.827*** (0.877)	-1.704 (1.928)	-4.505*** (1.530)	-4.057*** (0.854)
Observations	466	423	466	423	483	483
R-squared	0.563	0.306			0.578	
Number of ID	39	39	39	39	39	39
Country FE	YES	YES			YES	
Country RE			YES	YES		YES

Robust standard errors and p-values in parentheses \*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

The estimated results of the 2SLS-lnGFCF column of Table 4.6 above indicates that multilateral ODA has no significant impact on agricultural fixed capital formation in the fixed and random effects instrumental variable two stage least squares estimations at level even though there is a positive relationship.

As in the case of the equations containing total ODA and bilateral ODA, per capita GDP still has a positive and statistically significant impact on agricultural fixed capital formation. On the average, a 1% increase in GDP generates an approximate increase of 0.81% in gross fixed capital formation in agriculture. Nevertheless, there is a negative but statistically insignificant association between per capita GDP and multilateral ODA in the first-stage regressions. Thus, development partners are not motivated by per capita GDP in their decision to allocate agricultural multilateral aid.

Dollar exchange rate has a negative and statistically significant impact on fixed capital formation. All things being equal, a 1% appreciation of the dollar relative to the local currency reduces investment in fixed capital by 0.27% on the average. This finding is in line with Bleaney & Greenaway (2001) and agrees with macroeconomic theory.

Real interest rate has a positive effect on agricultural fixed capital formation and the relationship is statistically significant at the 1% level of significance. On the average, a 1% increase in the real interest rate results in a 0.005% increment in fixed capital formation.

The analysis thus far has considered how the inflows of total, bilateral and multilateral official development assistance influence the magnitude of fixed capital formation in the short-term. However, concerning the reasons given in Section 3.3.3, it is useful to examine as well how growth of official development assistance can affect growth or changes in fixed capital formation in the long-term. The results of this set of estimations are presented in Table 4.7 below. Both GMM-type and external instruments are used for the forms of official development assistance and are all treated as endogenous in the estimations.



Table 4.7: Growth (long-term) impact of total, bilateral and multilateral ODA on GFCF

	(1)	(2)	(3)	(4)	(5)	(6)
D.lnGFCF	Arellano-Bond	Blundell-Bond	Arellano-Bond	Blundell-Bond	Arellano-Bond	Blundell-Bond
D.lnODA	0.0633 (0.0412)	0.0411 (0.0336)				
D.lnBODA			0.101* (0.0582)	0.0757* (0.0453)		
D.lnMODA					-0.00502 (0.0308)	0.0271 (0.0288)
LD.lnGFCF	-0.292*** (0.0539)	-0.207 (0.154)	-0.322*** (0.0685)	-0.231 (0.152)	-0.227** (0.0905)	-0.272** (0.132)
L.lnGFCF	-0.908** (0.355)	-0.00494 (0.0190)	-0.684** (0.269)	-0.00740 (0.0229)	-1.089** (0.432)	-0.00257 (0.0220)
D.lnpcGDP	3.694** (1.796)	4.466*** (1.336)	4.169** (1.837)	4.422*** (1.502)	2.914 (2.267)	4.211** (1.926)
D.lnPOP	21.60* (12.96)	3.930 (2.462)	20.23 (22.11)	4.507** (2.248)	13.09 (10.95)	3.839 (2.451)
D.lnDXR	1.061 (1.054)	0.943* (0.555)	1.328 (0.966)	0.981** (0.436)	0.790 (0.661)	0.808** (0.395)
D.lnINF	0.124** (0.0580)	0.0172 (0.0494)	0.130 (0.0791)	0.0351 (0.0658)	0.151** (0.0672)	-0.0408 (0.0412)
D.INT	-0.00140 (0.00954)	-0.00295 (0.00594)	-0.00689 (0.00513)	-0.00491 (0.00458)	0.00617 (0.0102)	-0.0168** (0.00716)
Constant		-0.177 (0.118)		-0.137 (0.137)		-0.134 (0.141)
Observations	296	344	290	336	249	299
Number of ID	38	39	37	38	35	38
Country FE	YES	YES	YES	YES	YES	YES
Hansen test (Overid. res)	17.99 [0.523]	29.46 [0.942]	16.34 [0.634]	27.49 [0.968]	11.31 [0.881]	26.28 [0.979]
AR(1)	-0.85 [0.396]	-3.18 [0.001]	-2.27 [0.023]	-3.28 [0.001]	-1.36 [0.173]	-2.00 [0.045]
AR(2)	-0.95 [0.341]	0.95 [0.342]	-0.53 [0.594]	0.40 [0.693]	-0.45 [0.654]	0.43 [0.670]

Robust standard errors are in parentheses and p-values are in square brackets \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

From the results in column (1) and (2) of Table 4.7 above, it is evident that even though the coefficient of changes in total ODA is positive (0.0633), the value is not statistically significant. The direction of the result is the same using the difference and system-GMM estimators. Thus, changes in total ODA have no growth impact on agricultural fixed capital formation in SSA.

Disaggregating total ODA into its components, it was realized that changes in bilateral ODA had a positive and statistically significant growth impact on agricultural fixed capital formation. With respect to the *ceteris paribus* condition, a 1% increment in the growth of bilateral ODA is associated with about 0.08% to 0.10% increment in the growth of fixed capital formation at the 10% level of significance. This result is consistent using both the difference and system GMM estimators. The finding that bilateral ODA has a growth impact disagrees with the conclusion of Wako (2011) who found no significant impact of general bilateral ODA.

On the contrary to the growth effect of bilateral ODA, changes in multilateral ODA had no growth impact on fixed capital formation using both the difference and system GMM estimators. This finding that multilateral ODA has no growth impact agrees with the conclusion of Wako (2011) who found no significant impact of general multilateral ODA. The lack of growth impact could be due to the fungibility of agricultural aid (Feyzioglu, Swaroop, & Zhu, 1998; Pack & Pack, 1990; Pack & Pack, 1993) among other reasons or that multilateral channels free-ride monitoring or inflows are not consistent and large enough to induce growth in fixed capital formation. It could also be that projects for which these monies are allocated are long-term investments such as land improvement for the cultivation of rubber and as such, their growth impacts will take years to manifest.

Using the difference GMM estimator, the results show that changes in fixed capital formation is path-dependent across all forms of ODA. Thus, growth in past fixed capital formation have a

significant depressing impact on growth in current fixed capital formation. From the model containing total ODA, a 1% growth in past GFCF is associated with a 0.29% reduction in current GFCF growth. On the average, this reduction in current GFCF growth is 0.32% and 0.23% for the models containing bilateral ODA and multilateral ODA respectively.

The lagged level of fixed capital formation also have a depressing effect on changes in current fixed capital formation. Robustly in statistical significance across all forms of ODA, a 1% increase in the lagged level of GFCF reduced the growth rate of current GFCF by 0.68% to 1.09% on the average. This finding could be as a result of depreciation of land improvements due to adverse weather conditions such as flood and land degradation, depreciation of farm machineries and equipment due to lack of maintenance or higher cost of maintenance. Thus, existing fixed assets become less or even counter-productive.

Per capita GDP growth remains a strong determinant of changes in gross fixed capital formation. In columns (1) and (2) of Table 4.7, on the average, a 1% increase in per capita GDP growth is characterized by a 3.69% to 4.47% increment in the growth rate of fixed capital formation. This suggests that per capita GDP growth is strongly positive and statistically significant at the 5% level of significance. This finding agrees with the findings of Shuaib & Ndidi (2015).

Using the system GMM estimator, growth in dollar exchange rate have a positive and statistically significant impact on growth in fixed capital formation at the 10% level of significance in the model containing total ODA. Estimated results show that on the average, a 1% change in dollar exchange rate is accompanied by about 0.94% increment in fixed capital formation. In the bilateral and multilateral ODA models, growth in dollar exchange rates also have a positive and statistically significant impact on growth in GFCF at the 5% level of significance. A 1% change in dollar exchange rates is associated with 0.98% in the bilateral ODA model and 0.81% in the multilateral

ODA model. Growth in dollar exchange rates will have such a positive and significant effect on fixed capital formation through the channel of exports. This finding suggests a high level of trade of agricultural raw materials or farm produce from developing countries to developed countries and indirectly supports the Neo-realist theory that development partners give ODA for economic reasons.

Table 4.8 Summary of findings

No.	Type of ODA	Level	Growth
1	Total ODA	Significant and positive impact	No impact
2	Bilateral ODA	Significant and positive impact	Significant and positive impact
3	Multilateral ODA	No impact	No impact

Table 4.9: Summary of hypotheses

No.	Hypothesis	Conclusion	
		Level	Growth
H <sub>1</sub>	ODA stimulates agricultural fixed capital formation in sub-Saharan Africa	Supported	Not supported
H <sub>2</sub>	Bilateral ODA stimulates agricultural fixed capital formation in sub-Saharan Africa	Supported	Supported
H <sub>3</sub>	Multilateral ODA stimulates agricultural fixed capital formation in sub-Saharan Africa	Not supported	Not supported

Table 4.10: Summary of theories

No.	Theory	Conclusion
T <sub>1</sub>	Idealist Theory	Supported
T <sub>2</sub>	Realist Theory	Not tested
T <sub>3</sub>	Neo-realist Theory	Supported
T <sub>4</sub>	Dependency Theory of underdevelopment	Supported

### **3.5 Further discussions**

The analyses revealed that at level, both total and bilateral ODA have positive and statistically significant impact on fixed capital formation in agriculture, but multilateral ODA has no level impact on fixed capital formation. Considering growth impacts, only bilateral ODA has a statistically significant impact on fixed capital formation. An attempt to explain why (a) total ODA has no growth impact and (b) multilateral ODA has neither level nor growth impacts is provided below;

#### ***4.5.1 Free-riding in Monitoring***

Multilateral ODA comes about as a result of core contributions from many developed countries and institutions. In this regard, there could be some degree of free-riding in terms of monitoring among donors or contributors of multilateral ODA due to their large group size. Ineffective monitoring mechanisms are likely to undermine the effectiveness of multilateral ODA. Within the donor community, only Sweden, Norway, Luxembourg, Denmark and the Netherlands have actually met their long-standing UN target of 0.7% GNI in terms of donor contributions.

#### ***4.5.2 Transaction Cost***

Due to the involvement of relatively numerous institutions along the supply chains of multilateral ODA, a relatively larger portion of cash transfers goes into settling transaction costs within and along the various institutions. This relative increase in the cost of transaction has the tendency of undermining the actual amount of multilateral ODA disbursements and hence its effect on fixed capital formation.

#### **4.6 Conclusion**

This chapter answers the research questions mentioned in Chapter One. It provides empirical analyses of the economic effect of total, bilateral and multilateral ODA, on GFCF in the agricultural sector of Sub-Saharan Africa from 1996 to 2014.

Applying the Durbin-Wu-Hansen endogeneity test, ODA and its forms were found to be endogenous. Therefore, the study uses instrumental variable two stage least squares estimation techniques within a fixed effects and GMM estimators for analyses. Instruments employed include Rule of law, Rainfall deviations and the Socio-economic status of recipient countries. The Sanderson-Windmeijer, Kleibergen-Paap and Hansen's test of under-identification and over-identifying restrictions respectively confirm that the instruments are both relevant and valid in the first-stage regression equations.

At level, total and bilateral ODA have a strong positive and statistically significant relationship with fixed capital formation in the short-term. Nevertheless, at level (short-term), multilateral agricultural ODA have a positive but statistically insignificant relationship with fixed capital formation. Considering the growth (long-term) impact, only bilateral ODA have a positive and statistically significant relationship with fixed capital formation at the 10% level of significance.

## CHAPTER FIVE

### SUMMARY, CONCLUSION AND RECOMMENDATIONS

#### 5.1 Introduction

This chapter has three sections. The first section summarizes the key findings with respect to the research objectives. Conclusions are drawn for each objective in the second section. Lastly, recommendations for policy and future research directions are provided.

#### 5.2 Summary of findings

Regarding the objectives and questions of the research in Chapter One, findings of the study are summarized below;

In response to the first research objective which investigates the impact of total ODA on fixed capital formation, the results show that at level (short-term), total ODA have a strong positive and statistically significant association with fixed capital formation in agriculture. *Ceteris paribus*, a 1% increase in total ODA yields on the average a 0.16% increase in fixed capital formation in agriculture at the 1% significance level. However, total agricultural ODA has no growth (long-term) impact on fixed capital formation.

With regards to the second research objective which investigates the level impact of bilateral ODA on fixed capital formation, the results show that agricultural bilateral ODA encourages agricultural fixed capital formation in Sub-Saharan Africa in the short-term. All things being equal, a 1% increase in bilateral ODA yields on the average a 0.17% increase in fixed capital formation in agriculture at the 1% level of significance. Regarding the growth impact or long-term effect of bilateral ODA, a 1% increment in the growth of bilateral ODA is associated with about 0.08% to

0.10% increment in the growth of fixed capital formation at the 10% level of significance. Thus, bilateral ODA has a stronger impact on fixed capital formation in Sub-Saharan Africa's agriculture than multilateral ODA.

Concerning the third objective which examines the impact of agricultural multilateral ODA on fixed capital formation, the results show that on the average multilateral ODA has neither level (short-term) nor growth (long-term) effect on fixed capital formation.

### **5.3 Conclusion**

For more than five decades now, Sub-Saharan Africa has been the largest recipient of general ODA and still receives more as a result of the SDGs. Even though its impact on economic growth is inconclusive, little is known of the relationship between ODA and fixed capital formation in SSA's agriculture. Therefore, this study examined the hypotheses that ODA and its decomposed forms: bilateral and multilateral, encourage the formation of agricultural fixed capital. Applying fixed-effects instrumental variable two stage least squares, and the generalized method of moment estimators among other estimation techniques to a panel data of 40 Sub-Saharan African countries from 1996 to 2014, the study discovered that at level or in the short-term, both total and bilateral ODA have a strong positive and statistically significant impact on fixed capital formation in Sub-Saharan Africa's agriculture. However, at level, multilateral ODA has no statistically significant impact on gross fixed capital formation even though the direction of the relationship is positive. Regarding growth impacts or long-term effects, only bilateral ODA has a positive and statistically significant impact on gross fixed capital formation at the 10% level of significance.

These findings suggest that besides the amount of ODA, the type of ODA has a significant import on measuring its impact on fixed capital formation in agriculture in Sub-Saharan Africa for the study period.

#### 5.4 Recommendations

From the research conclusions, the following recommendations are made towards policy, practice and further research;

1. Official development assistance has growth potential for fixed capital formation in SSA's agriculture towards poverty reduction. The positive but insignificant growth impacts of total and multilateral ODA suggests that either (a) ODA inflows are fragmented and volatile, (b) amounts to the agriculture sector are not large enough to induce growth or (c) monitoring mechanisms are less effective for capital formation. It is therefore recommended that in the design of aid, monitoring mechanisms along multilateral channels should be restructured and strengthened to enhance ODA effectiveness.
2. In his book, *The End of Poverty*, Sachs (2005) recommends that "rich countries should increase aid and work closely with recipients so as to achieve the Development Goals and eradicate extreme poverty by 2025". This recommendation is still relevant and should be considered closely.
3. Due to the limited impact of ODA disbursements, dependence on it as a budget and project support instrument is more precarious. Hence, there is the need for recipient governments to stimulate private sector investment through good monetary and fiscal policy to encourage local revenue generation and mobilization towards growth and sustainable rural development.

4. Future research on aid effectiveness should focus on sector-specific and country-specific studies due to the vast difference among countries in Sub-Saharan Africa. Such studies could further clarify the issues of aid effectiveness.



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**APPENDIX**

SSA countries used for this research are; Angola, Benin, Botswana, Burkina Faso, Burundi, Cape Verde, Cameroon, Central African Republic, Chad, Comoros, Congo, Côte d'Ivoire, Democratic Republic of the Congo, Djibouti, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Seychelles, South Africa, Swaziland, Tanzania, Togo, Uganda, Zambia.

Note for Graph by ID: Angola = ID 1,... , Zambia =ID 40

**Table 1: Summary of Unit root test for bilateral official development assistance**

<b>Test</b>	<b>Levin-Lin-Chu</b>	<b>Harris-Tzavalis</b>	<b>Breitung</b>	<b>Im-Pesaran-Shin</b>	<b>Fisher's Type</b>	<b>Hadri LM Stationarity</b>
<b>Null Hypothesis</b>	Panels contain unit roots	Panels contain unit roots	Panels contain unit roots	All panels contain unit roots	All panels contain unit roots	All panels are stationary
<b>Statistic</b>	N/A	N/A	N/A	Z-t-tilde-bar - 13.9343	Modified inv. chi-squared Pm 6.9378	N/A
<b>p-value</b>	-	-	-	0.0000	0.0000	-
<b>Remark</b>	-	-	-	Stationary	Stationary	-

*N/A: requires strongly balanced data.*

*Source: Stata 13.0*

**Table 2: Summary of Unit** root test for multilateral official development assistance

Test	Levin-Lin-Chu	Harris-Tzavalis	Breitung	Im-Pesaran-Shin	Fisher's Type	Hadri LM Stationarity
Null Hypothesis	Panels contain unit roots	Panels contain unit roots	Panels contain unit roots	All panels contain unit roots	All panels contain unit roots	All panels are stationary
Statistic	N/A	N/A	N/A	Z-t-tilde-bar -3.8961	Modified inv. chi-squared Pm 8.3274	N/A
p-value	-	-	-	0.0000	0.0000	-
Remark	-	-	-	Stationary	Stationary	-

*N/A: test requires strongly balanced data. Source: Stata 13.0*



**Robustness Checks with instrumental variable regression**

Table 3: Level (short-term) impact of ODA on GFCF using instrumental variable regression

	IV	
	lnGFCF	lnODA
lnODA	0.160*** (0.0582)	
lnpcGDP	0.734*** (0.174)	0.148 (0.4292)
lnPOP	1.547*** (0.269)	3.802*** (0.6565)
lnDXR	-0.283*** (0.0468)	0.3568 (0.2975)
lnINF	0.0324 (0.0202)	-0.0062 (0.0480)
INT	0.00356* (0.00184)	0.0013 (0.0078)
RMD		0.0146*** (0.0056)
ROL		1.0298*** (0.2167)
s1		-1.448*** (0.4027)
s2		0.999*** (0.2907)
s3		0.6919*** (0.1511)
s4		-
Constant		
Observations	466	466
R-squared	0.517	
Number of ID	39	
Country FE	YES	
F test		13.60 [0.0000]
Kleibergen-Paap		28.02
rk LM statistic		[0.0000]
Hansen's J		5.892 [0.2073]

Robust standard errors in parentheses, p-values in square brackets

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

Table 4: Level (short-term) impact of BODA on GFCF using instrumental variable regression

	IV	
	lnGFCF	lnBODA
lnBODA	0.167** (0.0650)	
lnpcGDP	0.737*** (0.182)	0.0155 (0.5159)
lnPOP	1.577*** (0.295)	3.448*** (0.7402)
lnDXR	-0.263*** (0.0439)	0.2134 (0.2795)
lnINF	0.0342 (0.0211)	-0.0171 (0.0506)
INT	0.00278 (0.00190)	0.0059 (0.0078)
RMD		0.0125** (0.0058)
ROL		1.115*** (0.2359)
s1		-1.526*** (0.4476)
s2		0.5432 (0.369)
s3		0.2651 (0.282)
s4		-
Observations	453	
R-squared	0.482	
Number of ID	38	
Country FE	YES	
Country RE		
F test		10.30 [0.0000]
Kleibergen-Paap rk LM statistic		18.86 [0.0020]
Hansen's J		5.313 [0.2566]

Robust standard errors in parentheses, p-values in square brackets

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

Table 5: Level (short-term) impact of MODA on GFCF using instrumental variable regression

	IV	
	lnGFCF	lnMODA
lnMODA	0.0487 (0.0406)	
lnpcGDP	0.742*** (0.170)	-0.7174 (0.7429)
lnPOP	2.004*** (0.277)	4.739*** (0.8449)
lnDXR	-0.259*** (0.0567)	0.626*** (0.2039)
lnINF	0.0391** (0.0184)	0.0636 (0.0834)
INT	0.00190 (0.00176)	-0.0135* (0.0080)
RMD		0.0197** (0.00846)
ROL		0.8451** (0.36895)
s1		-0.2660 (0.7216)
s2		1.482*** (0.5174)
s3		1.661*** (0.4390)
s4		
Constant		
Observations	423	
R-squared	0.572	
Number of ID	39	
Country FE	YES	
Country RE		
F test		10.90 [0.0000]
Kleibergen-Paap rk LM statistic		20.862 [0.0009]
Hansen's J		4.913 [0.3100]

Robust standard errors in parentheses, p-values in square brackets

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

Table 6: Hausman's Test

Level equation	Chi-squared statistic	p-value	Remark
ODA	58.92	0.0000	Choose fixed-effects
BODA	61.02	0.0000	Choose fixed-effects
MODA	53.30	0.0000	Choose fixed-effects

Figure 1: Scatter plot of GFCF and ODA

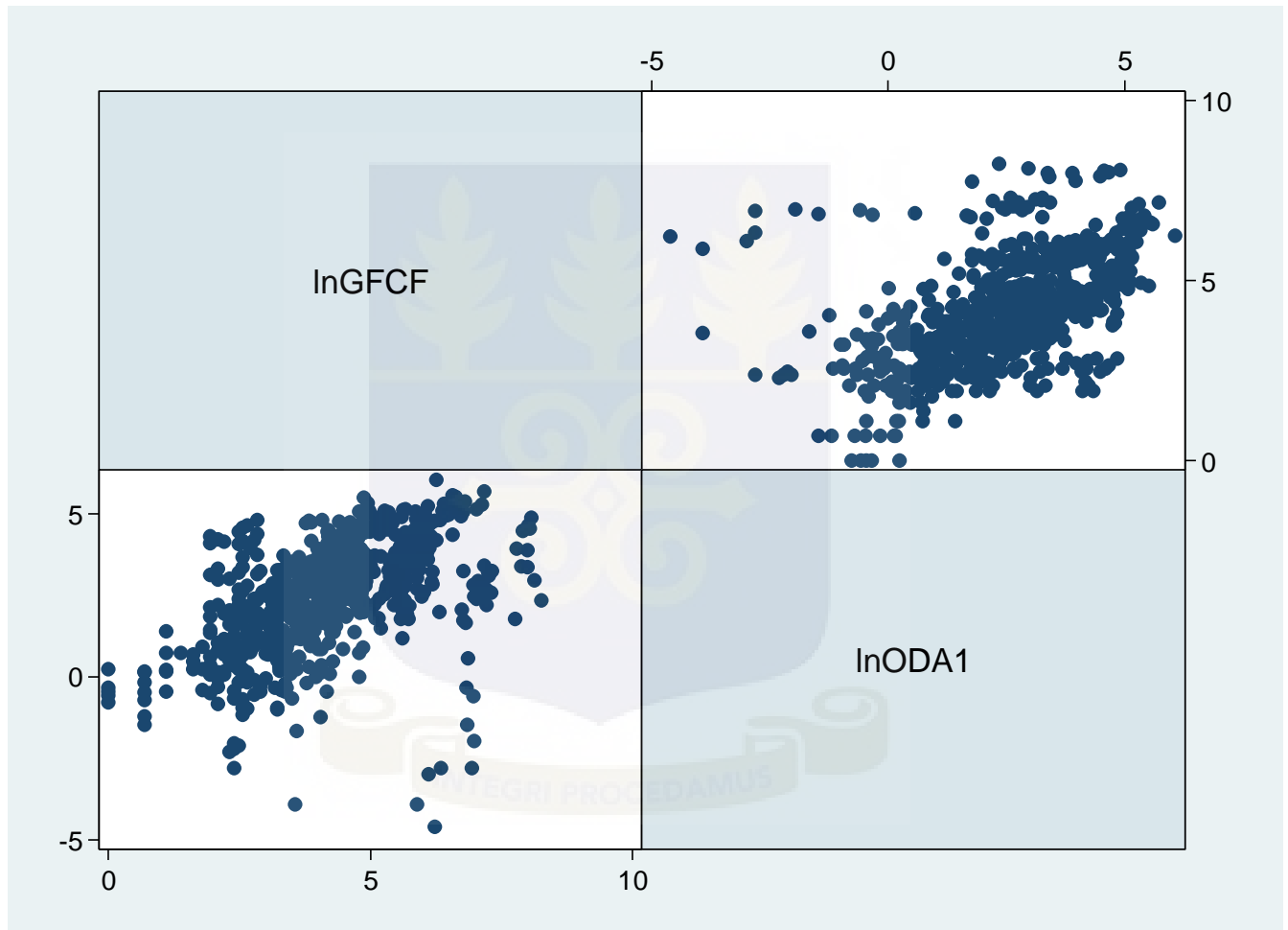


Figure 2: Histogram of GFCF

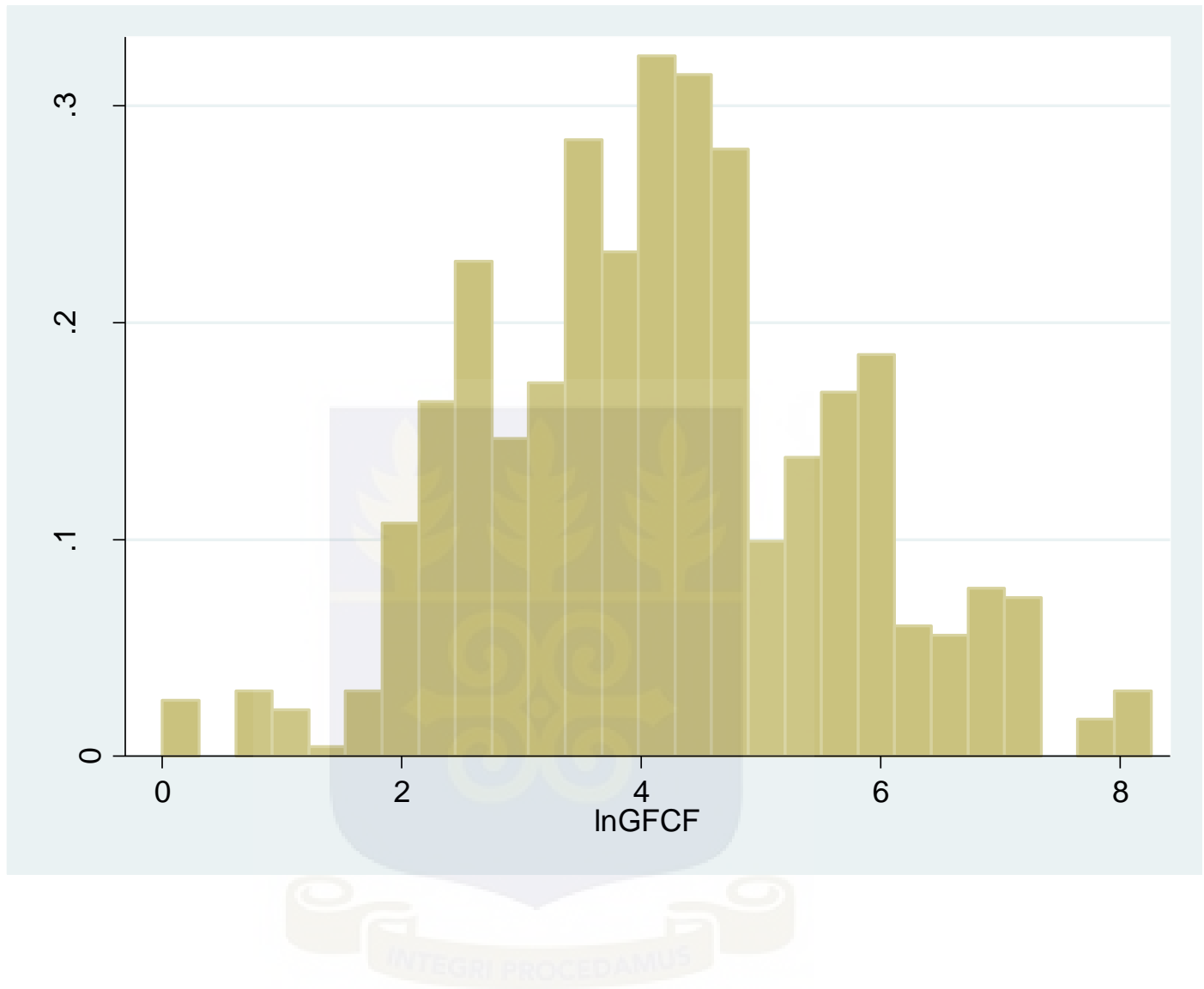


Figure 3: Normality plot of GFCF

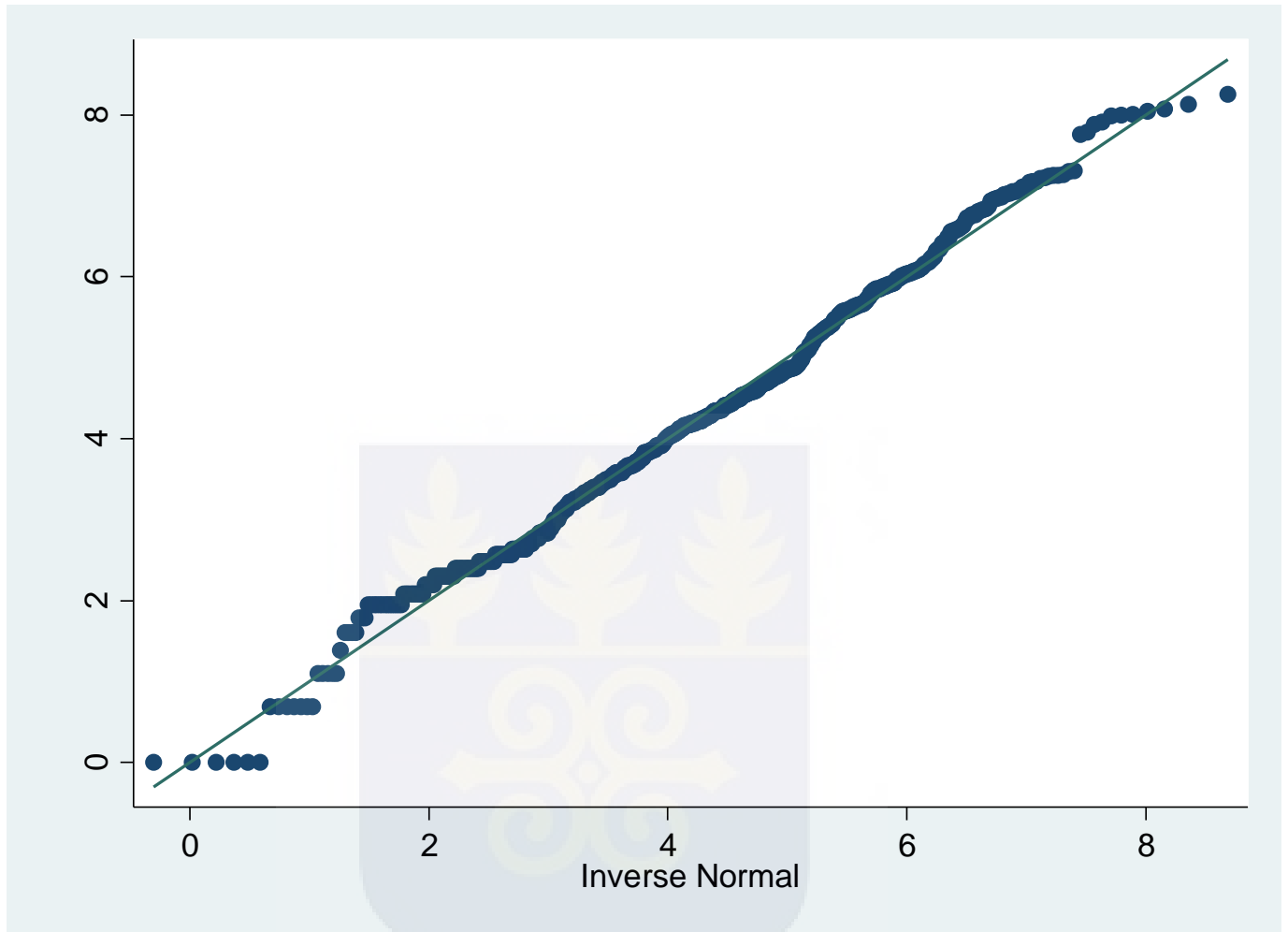


Figure 4: GFCF Graph of SSA countries

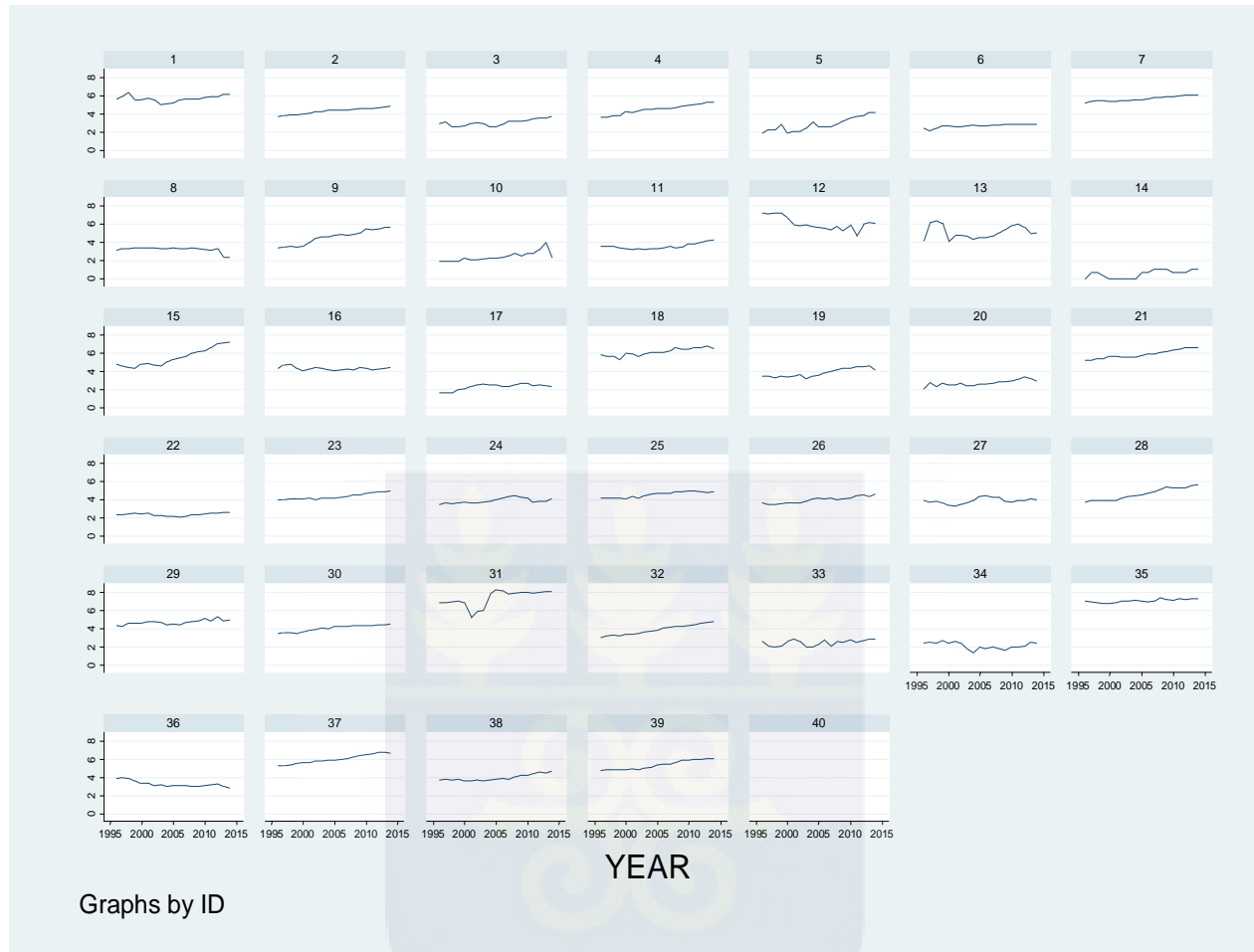
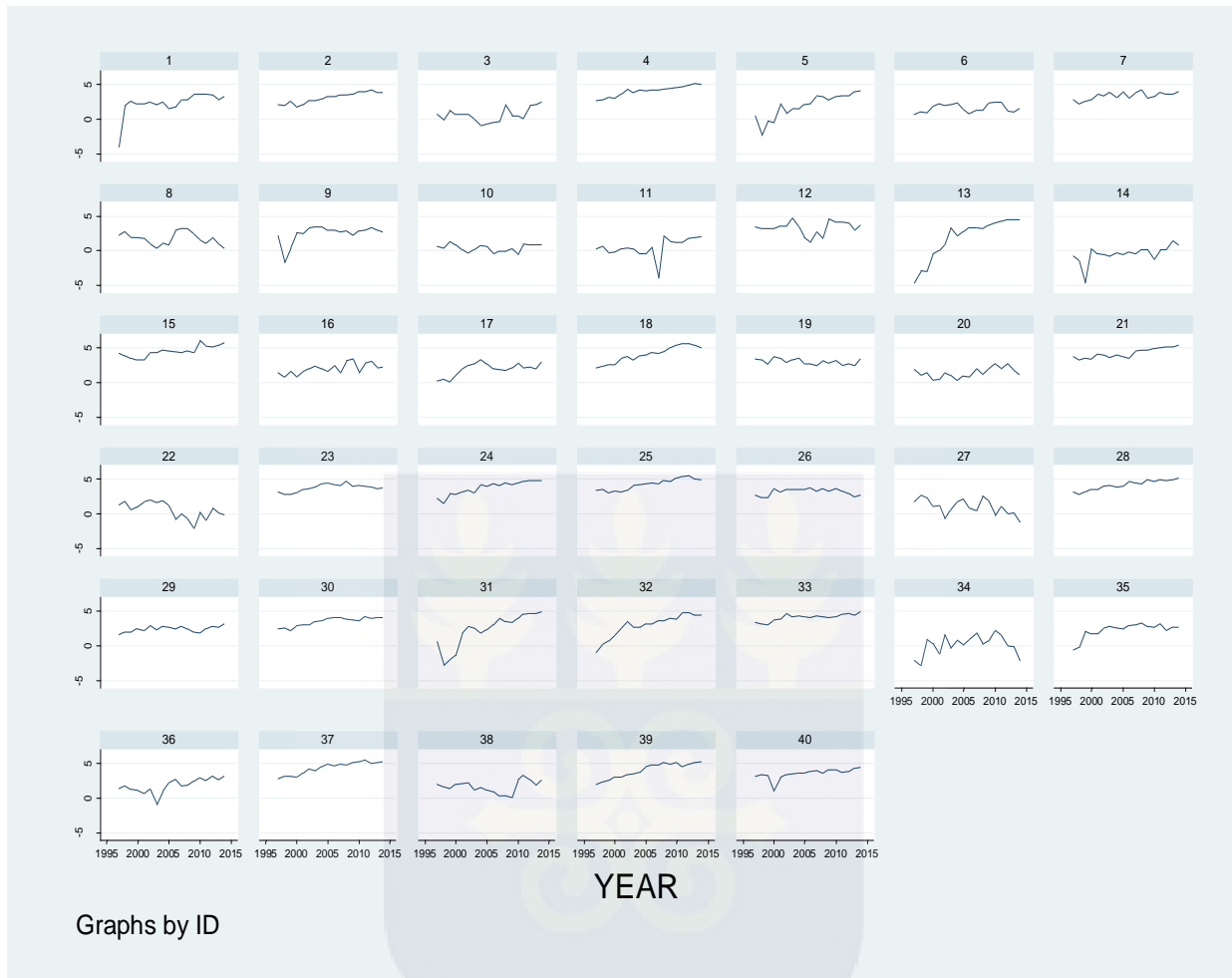


Figure 5: ODA Graph of SSA countries



**Important Equations**

$$\ln GFCE_{it} = \beta_0 + \beta_1 \ln ODA_{it} + \sum_{j=2}^k \beta_j X_{it} + \nu_i + \varepsilon_{it} \quad (1)$$

$$\ln ODA_{it} = \alpha_0 + \sum_{j=2}^k \alpha_j X_{it} + \gamma Z_{it} + \mu_i + \lambda_{it} \quad (2)$$

$$\ln GFCE_{it} = \beta_0 + \beta_1 \ln \hat{ODA}_{it} + \sum_{j=2}^k \beta_j X_{it} + \nu_i + \varepsilon_{it} \quad (3)$$

$$\Delta(\ln GFCE_{it}) = \beta_0 + \beta_1 \Delta(\ln GFCE_{it-1}) + \beta_2 \ln GFCE_{it-1} + \beta_3 \Delta(\ln ODA_{it}) + \sum_{j=4}^k \beta_j \Delta(X_{it}) + \nu_i + \varepsilon_{it} \quad (4)$$



Table 7: Correlation Matrix

	lnGFCF	lnODA	lnBODA	lnMODA	lnpcGDP	lnDXR	lnINF	INT	lnPOP	ROL	RMD	s1	s2	s3	s4
lnGFCF	1.00														
lnODA	0.52	1.00													
lnBODA	0.51	0.91	1.00												
lnMODA	0.45	0.84	0.63	1.00											
lnpcGDP	0.82	0.39	0.39	0.33	1.00										
lnDXR	-0.04	0.23	0.18	0.24	-0.09	1.00									
lnINF	0.20	-0.01	0.00	0.11	0.13	-0.32	1.00								
INT	-0.07	0.09	0.12	0.04	-0.08	0.22	-0.31	1.00							
lnPOP	0.78	0.61	0.60	0.61	0.70	0.16	0.25	0.00	1.00						
ROL	0.02	0.43	0.41	0.50	0.00	-0.46	-0.10	0.01	-0.34	1.00					
RMD	0.18	0.52	0.44	0.64	-0.01	0.22	0.11	0.14	0.15	-0.32	1.00				
s1	-0.04	-0.27	-0.21	-0.26	-0.03	-0.04	-0.05	0.00	-0.10	0.05	0.01	1.00			
s2	0.01	0.31	0.30	0.36	-0.09	0.38	0.13	0.12	0.42	-0.44	0.17	-0.05	1.00		
s3	-0.01	-0.13	-0.14	-0.10	-0.03	-0.19	-0.09	-0.08	-0.19	0.08	-0.16	-0.02	-0.70	1.00	
s4	-0.01	-0.28	-0.25	-0.40	0.17	-0.30	-0.07	-0.06	-0.35	0.52	-0.05	-0.01	-0.56	-0.19	1.00

